Government of West Bengal
Department of Environment

Prani Sampad Bhawan, 5th Floor, LB-2, Sect-III, Saltlake, Kolkata-106.

No. 124 /ENV /15099/2/2025 Date: 29/01/ 2026

To
The Secretary
Ministry of Environment, Forest & Climate Change
Government of India

Sub: Compliance report in the matter of M.ANo.14/2024 in connection to O.ANo.178/2022, Principal Bench [*Re: News item published in the Hindu dated 27.02.2022 titled "Tourism has brought economic prosperity to the Himalayan region, but the environmental cost has been catastrophic*"]

Ref: Order dated 30.01.2025 passed by the Hon'ble NGT, Principal Bench, New Delhi

Sir

Apropos the above mentioned- subject matter, please find enclosed herewith the Compliance Report of the State of West Bengal for your kind perusal and necessary action.

Yours Sincerely

Enclo: As stated above

Roshni Sen

(Roshni Sen)
Additional Chief Secretary
to the Government of West Bengal

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COMPLIANCE REPORT FOR THE STATE OF WEST BENGAL

IN PURSUANCE OF THE ORDER DATED 30.01.2025 PASSED BY THE HONBLE TRIBUNAL, NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH in MA 14/2024 in OA178/2022

1. Department of Urban Development and Municipal Affairs

a. *Lack of a comprehensive hazardous waste management plan, with uncontrolled urban growth, high-rise constructions, overlooking govt, regulation and waste dumping diminishing the area's scenic beauty.*

- All the 4 Hill Municipalities have prepared their waste management plan and initiated several activities for Solid, Plastic and Hazardous Waste Management.
- As a first step introduced extensive capacity building and awareness programme for different level of stakeholders including the citizen.
- Engaged NGOs and CBOs and also the community people especially the self help group members as motivator to ensure waste collection takes place in segregated manner i.e. wet, dry and domestic hazardous waste.
- Of the total waste, domestic hazardous waste are in and around 3% to 5% which are being collected by waste collectors in a black pouch.
- With regards to Sanitary / Biomedical waste collected from households have been tagged with District/Sub-Divisional Hospitals from where the authorized Biomedical Waste Management Agencies are collecting for processing. The Battery cells, defunct electronic goods etc. are being disposed through recyclers.
- So far 63 notices have been issued by Darjeeling Municipality to violators for high rise construction beyond permissible limit under Section 218 & 220 of West Bengal Building Rules 1993.

b. *Municipal Solid Waste generation in the Darjeeling hills is rising. Although 100% of the waste is collected, gaps remain in waste segregation and management.*
   i. *No facility for central composting or bio methanation of moist waste*
   ii. *Need for additional waste deposition, segregation centres*

- All these 4 Hill Towns have finalized their DPR for Solid Waste Management and accordingly prepared their Plan of Action to implement the activities as per Solid Waste Management Rules, 2016.
- They have taken several initiatives for developing systematic management of municipal daily fresh waste.

- They have started with complete enumeration of households, markets, hotels, restaurants, religious places, schools, hospitals, tourist places, water bodies, parks and other important places and calculated the generation of daily waste.
- Accordingly prepared the micro plan for deployment of manpower, vehicles and waste bins for segregated collection of waste from each source and identified the place for secondary storage/ collection in each ward.
- On the basis of micro plan provided Nirmal Bandhu for each 75 households for collecting daily segregated waste from source and Nirmal Sathi from the Self Help Group members for each 450 households to motivate the community to ensure segregation of waste at source and also to monitor the activities of Nirmal Bandhus.
- According to respective micro plan arranged household and community bins with green and blue colour and also arranged primary and secondary vehicles for transportation of segregated waste from the point of secondary transfer station.
- They have enforced banning of plastic carry bag below 120 micron and single use plastic (SUP) in their area and initiated a programme with tourism operators, cab drivers, hoteliers etc. urging them to encourage tourists to restrict carrying such plastic items.
- All these 4 Hill Towns have emphasized Home Composting/Community Composting of wet waste. Apart from that poultries and piggeries consume a good amount of daily fresh organic wet waste.
- All the 4 Hill Towns are planning for identification of decentralized locations where mainly dry waste will be sorted as per characteristics and thereafter baled and to be transported to the authorized recyclers in and around Siliguri.
- With the introduction of regular extensive Capacity Building and Awareness Generation Programmes, the hoteliers and restaurants have started handing over their waste in segregated manner.
- Initiatives were taken earlier to reclaim land through the scientific process of legacy waste removal but no agencies turned up especially because of the stiff gradient at the site.
- As such we are contemplating of salvaging non biodegradable waste from the old legacy waste with the help of Himalayan Mountaineering Institute considering the fact that stiff slopes prevent us from carry out conventional bioremediation and biomining method to reclaim land ULB wise some specific actions are placed below.

Darjeeling Municipality:

- Darjeeling Municipality has notified their Bye-Law for Solid Waste Management and shared it in the public domain. Their daily waste generation is 57 TPD, out of that 23 TPD wet waste and 12 TPD dry waste are being collected in segregated manner.

- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.
- As per enumeration total household is 29038 with a population of 145192, hotels & restaurants are 915, eateries are 479, markets are 15, shops are 921 and institution & others are 278 present in the city.
- The ULB has placed 3000 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.
- With regards to the fresh waste processing site at Amar Jyoti Gram, Ward No. 17 of Darjeeling Municipality so far, we have spent around Rs.2.28 crore for approach road, retaining wall, RCC Box Culvert, High Hill slope protection wall and land development.
- DPR for setting up of civil & electrical infrastructure as well as machineries to be installed are under process.
- The target to start processing of both wet and dry waste is October, 2026. With regards to non-biodegradable waste sorting, drying and bailing will be done at the processing site and thereafter will be transported to recyclers duly authorized by WBPCB or at the existing MRF Unit at Siliguri MC.

Kurseong Municipality:

- Kurseong Municipality is on the verge of notifying their Bye-Law for Solid Waste Management. Their daily waste generation is 20 TPD, out of that 8 TPD wet waste and 5 TPD dry waste are being collected in segregated manner.
- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.
- As per enumeration total household is 23361 with a population of 68929, hotels & restaurants are 65, eateries are 176, markets are 5, shops are 2620 and institution & others are 92 present in the city.
- The ULB has placed 296 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.
- The present disposal site is at Suntalay Paksha of Ward No.19 where the road is very narrow for vehicular movement and the site itself at a terrain of high slope with no definite shape. So, our initial approach was to make vehicles accessible to all weather and therefore Municipality has constructed approach road and completed land development works for setting up of fresh waste processing plant with a cost of Rs.96 lakhs.
- Soil test for preparation of DPR for civil infrastructure works for setting up of fresh waste processing plant has been completed.
- The construction of the platform for fresh waste processing plant has been completed. Other Civil Infrastructure works like shed etc. for the plant to be completed by June, 2026.

- Fresh Waste processing (biodegradable waste) will be commenced on and from October, 2026. With regards to non-biodegradable waste sorting, drying and bailing will be done at the processing site and thereafter will be transported to recyclers duly authorized by WBPCB/MRF Unit that may be set up at Siliguri or the existing Unit at Siliguri MC.

Mirik Notified Area Authority:

- Mirik NAA has notified their Bye-Law for Solid Waste Management and shared it in the public domain. Their daily waste generation is 4 TPD, out of that 2 TPD wet waste and 1 TPD dry waste are being collected in segregated manner.
- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.
- As per enumeration total household is 3106 with a population of 12211, hotels & restaurants are 43, eateries are 30, markets are 3, shops are 541 and institution & others are 54 present in the city.
- The ULB has placed 155 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.
- Mirik Municipality has applied for NOC for land from Thurbo Tea Estate to set up Central processing unit for fresh waste processing, but it is still awaiting for approval. On availability of land, DPR will be prepared and the plant will be set up within one year.

Kalimpong Municipality:

- Kalimpong Municipality is on the verge of notifying their Bye-Law for Solid Waste Management. Their daily waste generation is 21 TPD, out of that 9 TPD wet waste and 6 TPD dry waste are being collected in segregated manner.
- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.
- As per enumeration total household is 11146 with a population of 68931, hotels & restaurants are 55, eateries are 152, markets are 1, shops are 1385 and institution & others are 36 present in the city.
- The ULB has placed 526 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.
- A fresh site has been selected which is at a very high slope and for development of such fresh site measures has already been taken and for that work for RCC box culvert, passage for storm water, bituminous macadam with mastic asphalt on approach road have been completed and the amount of expenditure is around Rs. 2 crore.
- Soil test for preparation of DPR for civil infrastructure works for setting up of fresh waste processing plant has been completed.

- Civil Infrastructure for the plant to be completed by September, 2026. Fresh Waste processing (biodegradable waste) will be commenced on and from October, 2026.

- With regards to non-biodegradable waste sorting, drying and bailing will be done at the processing site and thereafter will be transported to recyclers duly authorized by WBPCB or at the existing MRF Unit at Siliguri MC.

c. *Impact on Water Quality*

i. *Mirik Lake affected due to untreated sewage disposal from hotels & residential areas.*
ii. *High anthropogenic pressure on Mirik lake and its catchment due to high tourist influx.*

- To combat Water Pollution and to improve water quality of Mirik lake Three (3) nos. STPs have been constructed. STP1: 600 KLD capacity, STP 2: 300 KLD capacity and STP3: 300 KLD capacity will cover 1057 nos House connection surround the lake.

- At present Work in progress for all 3nos STPs and 65% of House Connection completed and targated to commissioning the project by April '2026. AA&FS Amount Rs.8.60 crore and Tendered Amount Rs.7.32 crore for this work.

  After completion of these projects the sewage from the hotels, restaurants, households etc. will be treated under these three STPs and the treated water will be discharged into a suitable place.

- **Rejuvenation of Sumendu (Mirik) Lake will also improve water quality of Mirik lake.** The necessity for rejuvenation of Mirik Lake emerged from the following critical observations:

1. **Environmental Degradation Due to Sewage Inflow:** Untreated sewage generated from nearby hotels and residential areas is being discharged into the lake, leading to significant deterioration of water quality.

2. **High Anthropogenic Pressure:** The lake and its catchment area are under considerable stress owing to heavy tourist influx, causing increased pollution, siltation, and ecological imbalance.

Recognizing these concerns, the AMRUT Directorate, UD&MA Department, Government of West Bengal undertook the initiative to restore and rejuvenate the water body. A comprehensive project proposal was prepared and subsequently approved under the 3rd tranche of AMRUT 2.0, with a sanctioned project cost of ₹10.00 Crore.

Key Components of the Project

- **Dredging and Desiltation :** Removal of accumulated silt and sludge from various sections of the lake using a Cutter Suction Dredger to restore its storage capacity and improve water quality.

- **Vegetation and Weed Removal :** Clearing of invasive species such as water hyacinth, weeds, shrubs, and bushes from the northern and southern zones of the lake to revive the lake ecosystem.

- **Shoreline Strengthening and Beautification:** Construction of boulder protection walls and installation of paver blocks along the south-western and north-eastern embankments to prevent erosion and enhance the structural stability of the lake boundary.

The tendering process has been completed, and the proposal is presently awaiting approval from the competent authority (SLPIC/SLTC). The project is scheduled to commence on ground by the end of December, 2025 and is targeted for completion by December, 2026.

Water Body Parameter	Existing value	Target value
Volume (cubic meter)	196896.47	337301.75
Biological Oxygen Demand (BOD) mg/l	25	10
Chemical Oxygen Demand (COD) mg/l	75	50
Dissolved Oxygen (DO) mg/l	3	4
Total Dissolved Solids (TDS) mg/l	2500	1500
Turbidity (NTU)	16	9

d. *Impact on Forest, Biodiversity & Eco-sensitive areas : Mismanaged waste influence on feeding habits of Red Panda & Kaleej Pheasant*

- In addition to above, an all out effort is being made to sensitize the citizens and especially the tourists not to litter the environment so that the floras and faunas get affected.
- For this, they have enforced banning of plastic carry bag below 120 micron and single use plastic (SUP) in their area and initiated a programme with tourism operators, cab drivers, hoteliers etc. urging them to encourage tourists to restrict carrying such plastic items.
- Further at the places of high footfall they have arranged iron cages to treat these as dustbins for dry wastes and also placed community bins in certain intervals.

e) *Elaborate on the initiatives for effective solid waste management in Himalayas and how it helped in nullifying climate change adversities in the state of West Bengal.*

In continuation to the reply in Point-3 above some other initiatives have been taken along with plantation initiatives involving self-help groups for nullifying climate change adversities.

Darjeeling Municipality:

- Darjeeling Municipality has identified 183 Garbage Vulnerable Points out of which 118 have already been cleared. 56 most vulnerable points they have transformed to small parks, sitting arrangement for pedestrians, kids zone, installed statues and shop corners.
- They have achieved Open Defecation Free (ODF) Status as per Government of India certification.
- They have constructed 63 new Community Toilets and 8 new Public Toilets and maintaining the same involving the community and self-help groups. 13 others are under construction. They have already applied for ODF+ certification.

Kurseong Municipality:

- Kurseong Municipality has identified 131 Garbage Vulnerable Points out of which 117 has already been cleared. 41 most vulnerable points they have transformed to sitting arrangement for pedestrians and shop corners.
- They have achieved Open Defecation Free (ODF) Status as per Government of India certification.
- They have constructed 1 new Community Toilet and 7 new Public Toilets and maintaining the same involving the community and self-help groups. They have already applied for ODF+ certification.

Mirik NAA:

- Mirik NAA has identified 42 Garbage Vulnerable Points and cleaned the same. 17 most vulnerable points they have transformed to amusement parks, and shop corners. They have made sitting arrangements at their Helipad ground out of eco-bricks utilizing plastic bottles.
- They have achieved Open Defecation Free Plus (ODF+) Status as per Government of India certification.
- They have constructed 22 new Community Toilets and 5 new Public Toilets and maintaining the same involving the community and self-help groups. 19 others are under construction.

Kalimpong Municipality:

- Kalimpong Municipality has identified 239 Garbage Vulnerable Points out of which 224 have already been cleared. 67 most vulnerable points they have transformed to small parks, sitting arrangement for pedestrians, kids zone, and shop corners.
- They have achieved Open Defecation Free Plus (ODF+) Status as per Government of India certification.
- They have constructed 65 new Community Toilets and 4 new Public Toilets and maintaining the same involving the community and self-help groups. 22 others are under construction.

2. DEPARTMENT OF TRANSPORT

Impact on Air quality

(i) *To control number of tourists and ill managed traffic through exploring threshold value*

STU under Transport Department maintains a considerable number of CNG buses and EVs. For CSTC and CTC, both EV and CNG buses generally operate within Kolkata and adjoining areas.

For SBSTC buses, both EV and CNG buses operate in South Bengal region including Kolkata.

These measures are expected to mitigate air pollution in a significant manner.

(ii) *Use of carbon neutral bus and cabs to be promoted*

WBTC has initiated the process for procurement of 200 new CNG AC Buses under SASCI Project and delivery of the same is expected within this financial year.

It is expected that the total fleet strength of CNG buses under all STUs of the Transport Department is expected to be around 1300 nos. and EV buses nearing 90 nos. by June 2026. This is surely going to have a long term impact on the mitigation of air pollution.

(iii) *Non Bharat VI standard vehicles not to ply*

Transport Department has been encouraging the registration and plying of BS VI norms vehicles through its RTO/ARTO offices across the State. This intervention is expected to reduce vehicular air pollution across the State

(iv) *Studies should be conducted to distinguish the different sources (tourist vehicles) of air pollution in the area.*

Necessary coordination with Tourism Department is being taken up in order to mitigate any type of air pollution arising out of Tourist vehicles specifically. Motor Vehicle Enforcement

drives will be taken up accordingly against such identified air polluting vehicles in popular tourist spots.

3. DEPARTMENT OF FORESTS

(1) Impact of Tourism:

Nature based tourism to be promoted to control environmental losses

Forest Department has taken a number of measures to promote nature based tourism. This includes opening up of new trekking paths inside Singalila and Neora valley. National Parks, camp sites, observation spots, development of basic facilities for nature lovers.

A Rhododendron and Bird festival is being organized for the last few years which attracts nature lovers from all over the country and even abroad.

(2) Impact on Forest, Biodiversity & Eco-sensitive areas

a) *Deforestation in Darjeeling, with drastically changing forest cover due to construction of roads and resort accommodation, expansion of settlements, increase in cultivated land*

Forest cover assessment of Darjeeling district done by the Forest Survey of India does not show significant change in previous assessment cycles.

Year of Assessment	Forest cover
2019	2367.80 sq.km, 75.19%
2021	2348.88sq. km, 74.62%
2023	2336.14 sq. km,74.22%

b) *Rhododendron on verge of extinction*

Rhododendron thrives very well along its ranges in Darjeeling and Kalimpong districts. In last two decades no contraction of range of this species or large scale mortality has been noticed (other than occassional processionary moth attack).

In at least three places Rhododendron park has been established and more are on the offing. There is also a renewed interest in planting Rhododendron in the city landscape.

Overall all the species of Rhododendron are doing well in the Himalayan districts of West Bengal.

c) *Sustainability of ecosystem of National Park and Red Panda Habitat*

Most forests in the Himalayan hills fall within National parks and Wildlife Sanctuaries where even NTFP (Non-Timber Forest Product) collection is strictly prohibited and enforced.

The eco system of this area is pristine as human disturbance is strictly regulated in these zones. Other than nature based tourism no entry is permitted inside these National parks and Sanctuaries which constitutes bulk of the Red panda habitats. Fire Control and invasive species control are two main measures taken up to check the transformation of eco system.Being located in the moist eastern Himalayan region water supply in the National Parks is abundant. In selected places these are supplemented by man-made water storage structures for animal use.

d) *Mismanaged waste influence on feeding habits of Red Panda and Kaleej Pheasant*

Red Panda and Kaleej Pheasant habitats in Darjeeling and Kalimpong districts have very few to none enclave villages inside them. Thus, the chance of generation of anthropogenic waste from such sources is rare. The tourists passing along selected stretches do generate waste and sometimes they litter the path. Awareness generation measures are routinely taken to counter this problem. Tourists are also cautioned against at littering at the entry point of sanctuaries and national parks. Litter bins have been placed at regular intervals along the trekking/tourism routes which are regularly emptied outside the protected areas. So far, the excretory deposited by Red Pandas and Khaleej Pheasant has not shown any plastic residue.

(3) *Need for carrying capacity assessments and preparation of Zonal and Tourism Master Plans in Eco-sensitive Zones (ESZs)*

(a) States/UTs have been advised to undertake such studies for at least one ESZ in their region

This exercise will be taken up shortly for the Mahananda Wild Life Sanctuary.

(b) The Management Plans of the Protected Areas of North Bengal which exists in the Himalayan region of the State contain specific limits of carrying capacity

The carrying capacity of the tourists has been specified in the management plants of all protected areas of North Bengal.

National Park/Wildlife Sanctuary	Maximum No. of visitors allowed per day	Maximum No. of vehicles allowed per day
Singallia National Park	360	60
Neora Valley National Park	272	45
Sinchal Wildlife Sanctuary	204	34
MahanandaWildlife Sanctuary	397	67

(4) Efforts put in places to increase forest cover in the Himalayan Region of West Bengal

The Forest Department Government of West Bengal distributes free saplings to encourage tree planting during Van Mahotsav period and involves massive movements of people, students, NGOs and others to improve the green covers in Hills. Apart from this the State of West Bengal also strictly enforces the West Bengal Trees Protection and Conservation Areas) Act, 2006 where permission from the Competent Authority is a statutory mandate for the purpose of felling of trees in Non Forest Areas.

In FY 2024-25 approximately 14,465 seedlings were planted by the Forest Department along with Civil Society members, NGOs, students and others. Additionally, around 62,474 seedlings were distributed among the public for distribution. Such large scale plantation drives are conducted every year to enhance the green cover in hilly regions.

4. DEPARTMENT OF TOURISM

Information pertaining to Tourism Department is given below:

1. Accommodation Availability and Homestay Model framework

The availability and spatial distribution of accommodation infrastructure indicate a decentralised, balanced and relatively low-impact tourism model, as per the survey report, Darjeeling district has around 277 hotels and 414 homestays registered under the Tourism Department, while Kalimpong district has 1,135 homestays registered under the Tourism Department.

The homestay model promotes community participation, local livelihood generation and environmentally responsible tourism, while supporting wider geographical dispersal of visitors in line with sustainable and responsible tourism principles, thereby enabling dispersion of tourist footfall and reducing pressure on core urban centres.

2. Capacity Building and Service Provider Regulation

The Tourism Department has undertaken systematic capacity building initiatives through training and certification of tourist guides under the West Bengal Tourist Guide Certification Scheme, resulting in 2,050 trained guides, including over 400 women guides, of whom more than 1,100 are currently actively engaged across the State. In addition, approximately 245 Tourism Service Providers have been registered under the Recognition of Tourism Service Providers Scheme, 2021, contributing to regulated tourist movement and enhanced visitor awareness of local ecology, culture and heritage.

3. Regulation in Forest and Protected Areas

Tourism Department proposes that tourism activities within forest areas and protected landscapes are undertaken in strict compliance with Forest Department regulations, which are designed to safeguard ecological integrity while allowing controlled visitor access. Key regulatory provisions include the following:

- **Protected Area Governance and Regulatory Framework:** The Forest Department implements a precautionary regulatory framework to conserve forests and biodiversity in the Himalayan region. A significant portion of forest land of the Darjeeling-Kalimpong hills are notified as National Parks and Wildlife Sanctuaries, where strict protection measures are enforced.
- **Regulation of Human Activities:** Human activities are tightly controlled, with restricted entry, prohibition on non-timber forest produce collection, and permission only for regulated, nature-based tourism as per approved management plans
- **Carrying Capacity and Visitor Management:** Tourism is regulated through site-specific carrying capacity norms, with daily visitor and vehicle limits enforced in Singalila, Neora Valley, Senchal, and Mahananda.
- **Controlled Movement and Waste Management:** Tourist movement is limited to designated routes, supported by entry controls, awareness measures, and regulated waste management to protect sensitive wildlife habitats.
- **Ecosystem Protection and Legal Enforcement:** Ecosystem protection measures include fire control, habitat conservation, and wildlife support, reinforced by forest monitoring, afforestation drives under Van Mahotsav, and enforcement of the West Bengal Trees (Protection and Conservation Areas) Act, 2006.

Together, these mechanisms ensure that ecological integrity, biodiversity conservation, and limited sustainable tourism coexist within the Himalayan forest landscape.

4. Monitoring Indicators and Thresholds

The assessment framework may include measurable indicators such as permissible visitor limits at critical sites, waste generation vis-à-vis treatment capacity, accommodation occupancy levels, tourist-to-resident ratios, seasonal infrastructure load and traffic volumes. These may be maintained by the local bodies including Urban Local Bodies.

5. Ecological Sensitivity, Land Use and Infrastructure Limits

Tourism planning shall account for ecological sensitivity, infrastructure constraints and seasonal tourist inflows, particularly in hill towns and protected landscapes. Land Use Development Control

Plans (LUDCPs) may be prepared for fragile and eco-sensitive areas in coordination with the Urban Development and Municipal Affairs Department to ensure compliance with land-use regulations and environmental safeguards.

6. Municipal Coordination, Pollution Control and Transport Management

Close coordination with Urban Local Bodies is essential to manage roads, traffic circulation, water supply, sewerage, solid waste management and public transport. Municipal authorities, in coordination with the Pollution Control Board and Transport Department, may strengthen pollution control measures, regulate vehicular emissions, promote public transport and shared mobility, restrict non-essential vehicular movement in congested areas, and strictly enforce bans on open waste burning.

7. Pressure Dispersal, Enforcement and Awareness

The Tourism Department may continue promoting offbeat destinations such as Lamhatta and Tinchuley to disperse tourist pressure while supporting community livelihoods. Tourism activities in eco-sensitive zones shall be governed through close inter-departmental coordination with the Forest, Environment and Transport Departments. Responsible tourism awareness may be strengthened through targeted campaigns, signage and dissemination of do's and don'ts for tourists and service providers to foster environmentally responsible travel.

5. DEPARTMENT OF PANCHAYAT AND RURAL DEVELOPMENT

Initiatives for effective solid waste management in Himalayas and how it helped in nullifying climate change adversities in the state of West Bengal

To ensure cleaner and garbage free environment a hosts of activities have been done by the P&RD Department under SBM-G Phase-2 Programme. Details of the activities are as below.

1. **Individual Household latrines (IHHL):** To make the areas free from Open Defecation (ODF) special campaign are undertaken time to time. Intensive awareness campaigns through IEC/BCC activities are undertaken so that households who don't have IHHL facilities construct IHHL at their household and generate good habits for regular toilet use. Filed verifications by the third party organization are done to ensure no one is left without IHHL facility. Camps are undertaken

to provide IHHL facility to the households who need IHHL facility. 14,110 families have been provided with IHHLs facility.

2. **Community Sanitary Complex (CSC):** For the ensuring ODF in the areas of public congregation especially in markets, bazaars, bus stand, community places etc CSCs are constructed. 107 CSCs have been constructed in the areas of public congregation.

3. **Solid Waste Management (SWM):** To manage solid waste generated in the rural areas SWM facility are created. In per-urban areas the management Unit is set up in a central area like Gram Panchayat where solid waste are collected from the households transported in the Central Management Unit in a tri-cycle. The bio-degradable waste is turned into compost. Non-biodegradable wastes especially plastic waste are sorted and transported to the block level plastic waste management units. 109 SWM units are constructed under SBM-G programme. SWM facility is available in every village. In certain areas where generation of bio-degradable waste is less, households are motivated to manage the waste at household levels.

   Households are motivated through IEC/BCC activities for household segregation of waste and proper management of waste at household and public places.

4. **Plastic Waste Management Unit (PWMU):** At block level PWMU are set up for management of plastic waste. Plastic waste are collected from villages are transported to this units. There are specific machines like cleaners, bailers and shredders for management of plastic waste. Eco brick technology using plastic bottles have been adopted in management of Plastic Waste. Three PWM units at block level have been constructed.

   Households are motivated through IEC/BCC activities for refusing use of plastic and motivated to use plastic alternatives.

5. **Grey Water Management (GWM):** To prevent outbreak of vector borne disease (VBD) management of grey water at households and community level is necessary. GWM assets are crated at community, institutional levels to prevent accumulation of used water and prevent outbreak of VBD. 278 GWM assets like leach pit, settler with ABR and filter chamber have been constructed under this initiative.

   People are motivated through IEC/BCC activities for management of used water at household levels.

6. **Fecal Sludge Management (FSM):** Appropriate twin pit toilet technology reduces the menace of fecal sludge at substantial level in rural areas. Apart from that fecal sludge is managed through FSTP (Fecal Sludge Treatment Plant).

7. **Gobardhan :** To mange cattle waste Gobardhan units are constructed. Two Gobardhan units have been constructed.

8. **Capacity Building:** For transfer of technology for implementation of works capacity building activities are undertaken at regular level. Capacity Building of different stakeholders is undertaken with the help of expert agencies/institutions like IIT Kharagpur, SPMNIWAS, Joka, PriMove, UNICEF etc. More than 150 training have been done and 3040 no participant has been trained. With PRI members supervisor of SWM units, staffs of PRI bodies to operate SWM unit/PWM unit.

9. **IEC/BCC:** To motivate people to adopt good hygiene behaviors different IEC activities including campaigns are undertaken at regular intervals. Special events like Swachh Marathons, Community football match, human chain, rally with student etc are under taken. Community Triggering activities at community and institutional levels are undertaken to ensure good hygiene behaviours in the people.

10. **How does SBM-G activities contributes to minimize the bad impact of climate change :** Swachh Bharat Mission-Grameen (SBM-G) immensely contributes to the reduction of climate change through integrated solid and liquid waste management (SLWM), renewable energy generation from waste, and promoting a circular economy. Key SBM activities that contribute to climate change reduction are as below.

Solid Waste Manatement (SWM): SBM-G promotes scientific SWM, which involves source segregation, collection, processing, and disposal to reduce the amount of waste going to landfills, which are a major source of methane emissions. The activities include construction of Resource Recovery Centers (RRCs), composting pits, material recovery facilities (MRFS), waste-to-energy plants, and plastic waste processing units.

Use of Plastic Waste under Plastic Waste Management (PWM) activities: Non-recyclable plastic waste is often shredded and used in road construction, which provides an economic incentive for plastic collection and management, and reduces dependency on conventional road construction materials.

Adoption of clean transport system for SWM and PWM: Rural areas are transitioning to eco-friendly vehicles for waste collection. Districts have deployed electric autos and e-rickshaws for transportation of collected waste.

Climate Impact of SWM and PWM Initiatives: This initiative eliminates significant annual diesel consumption, drastically cutting down on greenhouse gas emissions and improving local air quality.

Liquid Waste Management (LWM): SBM-G Phase II addresses grey water (wastewater from washing, bathing, etc.) and black water management.

This involves constructing soak pits, leach pits, waste stabilization ponds (WSPs), and setting up fecal sludge treatment plants (FSTPs) to safely manage and treat used water before potential reuse (e.g., for irrigation or construction), thus preventing water body pollution and related health hazards.

GOBAR-dhan: The GOBAR-dhan (Galvanizing Organic Bio-Agro Resources Dhana) scheme is one of the important components SBM-G Phase II Programme. It focuses on converting cattle dung, agricultural waste, and other organic waste into valuable resources like biogas/compressed biogas (CBG) and organic manure.

Climate Impact of the GOBAR-dhan Scheme: Biogas is a clean, renewable fuel that replaces traditional cooking fuels like firewood and kerosene, reducing deforestation, improving indoor air quality (benefiting women's health), and cutting greenhouse gas emissions, particularly methane.

Behavioral Change and Awareness: Large-scale public awareness campaigns that promote sustainable practices like waste segregation at source (using separate green and blue bins), reducing single-use plastic, and conserving energy. This "Jan Andolan" (people's movement) institutionalizes swachh (clean) behavior at the community level, which is vital for long-term sustainability and climate resilience. Through these activities, SBM-G is directly integrating environmental considerations into public health initiatives, helping to mitigate climate change and build more sustainable communities in the state.

6. DEPARTMENT OF PUBLIC HEALTH ENGINEERING

For mitigating drinking water shortage in the Himalayan districts of Darjeeling and Kalimpong thirty four (34) schemes in Darjelling Disrtict and forty one (41)schemes in Kalimpong District has been proposed for augmentation of source of drinking water by the PHED, Government of West Bengal .

7. DEPARTMENT OF SCIENCE AND TECHNOLOGY AND BIOTECHNOLOGY

This Department has provided the names and location of 434 spring data to the Irrigation and Waterways Department for conducting the 1st census of the springs in the State of West Bengal

under the aegis of the Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR) Ministry of Jal Shakti.

The Spring Date available with the Department of Science and Technology and Biotechnology and the Interim Report (generated for NMSHE project) have been attached.

8. DISTRICT MAGISTRATE, KALIMPONG

Impact of Tourism

(a) *Urgent need of carrying capacity assessment for Darjeeling town and key tourist destination in the West Bengal Hills.*

(b) Promotion of nature based tourism

- In **Kalimpong District**, homestays are being developed as an integral part of sustainable, nature-oriented tourism, with emphasis on community participation and environmental protection. As on date, 1,170 homestays have been registered in the district, contributing to income generation for local households and promoting responsible tourism practices in rural and forest-adjacent areas.
- The district administration is encouraging the growth of eco-friendly tourism models through homestays, village-based tourism, trekking, bird-watching, and cultural experiences. These initiatives aim to provide visitors with authentic local experiences while ensuring the protection of natural landscapes, biodiversity, and traditional lifestyles.
- Efforts are being made to strengthen the capacity of homestay owners, local guides, and tourism service providers through training and awareness programmes, focusing on hygiene, hospitality standards, waste management, and environmentally sustainable operations. Such initiatives are intended to improve service quality while maintaining ecological balance.
- Cultural heritage and local traditions are being integrated into tourism promotion through local festivals, zero-waste harvest celebrations, and community-led cultural programmes, thereby enhancing visitor engagement and encouraging wider community involvement.
- Preference is being given to local tourist guides, and the documentation and dissemination of indigenous knowledge relating to flora, fauna, traditional practices, and local history are being promoted to add value to nature-based tourism experiences.
- To address environmental concerns, plastic waste collection points have been installed at strategic roadside locations near major tourist destinations under the Swachh Bharat Mission (SBM). A total of 42 such collection points have been established to support proper waste disposal and maintain cleanliness in tourism zones.
- For promotion of Nature-Based Tourism Projects, the Tourism Department, in coordination with local stakeholders, is actively promoting nature-based tourism projects. Several initiatives are already operational, while others are at various stages of development. Recently some tourism

projects have been forwarded from the district to Department, which are expected to significantly contribute to the promotion of nature based tourism.

(2) *Rising MSW generation; gaps in segregation & processing,*

a) No central composting facility.

b) Need for additional segregation centres.

- Strengthened segregation at source through sustained awareness campaigns, community participation, and strict enforcement mechanisms.
- Renovation of a centralized composting/biomethanation unit is under processing.
- Segregation centre is operative under Kalimpong Municipality
- IEC campaigns strengthened to promote 100% segregation at source.
- Augmenting processing capacity by establishing adequate composting, recycling, and waste-to-energy facilities based on scientific waste assessment.
- Improving door-to-door collection systems and integration of informal waste pickers into formal waste management frameworks.
- Promoting reduction of waste at source, especially single-use plastics, through regulatory and economic measures.
- Regular monitoring, data-driven planning, and capacity building of urban local bodies to bridge the gap between MSW generation and processing.
- Single used plastic bag below 120 micron has been banned and it has been enforced by Kalimpong Municipality and local bodies by conducting raids.
- Public awareness is also done for plantation of tress to minimize carbon contents of the environment.
- To alleviate pressure on tourism as a source of employment, the horticulture department is distributing poly houses to promote horticulture activities as an alternative source of engagement.

(3) *Need for carrying capacity assessments and preparation of Zonal and Tourism Master Plans in Eco- sensitive Zones (ESZs)*

a. The matter was deliberated in the meeting of the District Tourism Development Committee, Kalimpong, with all concerned stakeholders, namely hoteliers, homestay owners, and representatives of the taxi union. The views and suggestions of the stakeholders were solicited regarding the promotion of nature-based tourism with a view to preventing the deterioration of the fragile environment.

b. Five (5) tourism projects have been forwarded by the district to the Department which are expected to make a significant contribution towards the promotion of nature-based tourism.

(4) *Expansion of institutional capacity of local governments for climate change planning.*

- Capacity-building workshops conducted for ULB and Panchayat officials.
- GSI has conducted 5 days awareness & training campaign with local Officials of local Governments & PRIS
- NGOs are also performing awareness and training programme on Environment in co-ordination with Government Officials.
- DM & CD Department is also performing awareness and training programme on Earthquake, mitigation of Landslide, Lightning etc.

.....

Government of West Bengal
Department of Urban Development & Municipal Affairs
Town & Country Planning Branch
"NAGARAYAN"
DF-8, Sector – I, Bidhannagar, Kolkata – 700 064
jsasqm.udma@gmail.com

No-18-UDMA-24011(99)/11/2025-ESTT-TCP SEC-Dept. of UDMA Dated-07.01.2026

From: The Special Commissioner
to the Govt. of West Bengal

To : The Additional Chief Secretary
Environment Department
Govt. of West Bengal

Sub: Submission of Compliance Report to NGT Order dated 30.01.2025 in the matter of M.A. 14/2024 in OA No. 178/2022.

Ref No- Your office memo-2368/ENV-15016/4/2024 dated 05.12.2025

Madam,

With reference to the above, I am directed to send the updated Action Taken Report (ATR) on the implementation of the recommendations contained in the report titled "Environmental Assessment of Tourism in the Indian Himalayan Region (EATIHR) in **Compliance with the NGT Order dated 30.01.2025 in connection with the matter of M.A.14/2024 in OA No. 178/2022.**

Enclo- As stated

Yours faithfully,

Mbanerjee 7/1/2026
Special Commissioner
to the Govt. of West Bengal

No-18/1-UDMA-24011(99)/4/2025-ESTT-TCP SEC-Dept. of UDMA Dated-07.01.2026

Copy forwarded for kind information to:-

1. Sr. P.S. to Principal Secretary, UD & MA Department

Mbanerjee 7/1/2026
Special Commissioner
to the Govt. of West Bengal

Action Taken Report for Municipal Solid waste processing of 4 Hill Towns of West Bengal

Point No.	Point of Action As per the NGT order dated 31.01.2025 in the matter MA No.4/2014
2.	**Lack of a comprehensive hazardous waste management plan, with uncontrolled urban growth, high-rise constructions, overlooking govt, regulation and waste dumping diminishing the area's scenic beauty.**
	• **All the 4 Hill Municipalities have prepared their waste management plan and initiated several activities for Solid, Plastic and Hazardous Waste Management.** • As a first step introduced extensive capacity building and awareness programme for different level of stakeholders including the citizen. • Engaged NGOs and CBOs and also the community people especially the self help group members as motivator to ensure waste collection takes place in segregated manner i.e. wet, dry and domestic hazardous waste. • Of the total waste, domestic hazardous waste are in and around 3% to 5% which are being collected by waste collectors in a black pouch. • With regards to Sanitary / Biomedical waste collected from households have been tagged with District/Sub-Divisional Hospitals from where the authorized Biomedical Waste Management Agencies are collecting for processing. The Battery cells, defunct electronic goods etc. are being disposed through recyclers. • So far 63 notices have been issued by Darjeeling Municipality to violators for high rise construction beyond permissible limit under Section 218 & 220 of West Bengal Building Rules 1993.
3.	**Municipal Solid Waste generation in the Darjeeling hills is rising. Although 100% of the waste is collected, gaps remain in waste segregation and management.** **a. No facility for central composting or bio methanation of moist waste** **b. Need for additional waste deposition, segregation centers**
	• **All these 4 Hill Towns have finalized their DPR for Solid Waste Management and accordingly prepared their Plan of Action to implement the activities as per Solid Waste Management Rules, 2016.** • They have taken several initiatives for developing systematic management of municipal daily fresh waste. • They have started with complete enumeration of households, markets, hotels, restaurants, religious places, schools, hospitals, tourist places, water bodies, parks and other important places and calculated the generation of daily waste. • Accordingly prepared **the micro plan** for deployment of manpower, vehicles and waste bins for segregated collection of waste from each source and identified the place for secondary storage/ collection in each ward. • On the basis of **micro plan** provided Nirmal Bandhu for each 75 households for collecting daily segregated waste from source and Nirmal Sathi from the Self Help Group members for each 450 households to motivate the community to ensure segregation of waste at source and also to monitor the activities of Nirmal Bandhus. • According to respective micro plan arranged household and community bins with green and blue colour and also arranged primary and secondary vehicles for transportation of segregated waste from the point of secondary transfer station.

- They have enforced banning of plastic carry bag below 120 micron and single use plastic (SUP) in their area and initiated a programme with tourism operators, cab drivers, hoteliers etc. urging them to encourage tourists to restrict carrying such plastic items.

- **All these 4 Hill Towns have emphasized Home Composting/Community Composting of wet waste.** Apart from that poultries and piggeries consume a good amount of daily fresh organic wet waste.

- **All the 4 Hill Towns are planning for identification of decentralized locations where mainly dry waste will be sorted as per characteristics and thereafter baled and to be transported to the authorized recyclers in and around Siliguri**.

- With the introduction of regular extensive Capacity Building and Awareness Generation Programmes, the hoteliers and restaurants have started handing over their waste in segregated manner.

- Initiatives were taken earlier to reclaim land through the scientific process of legacy waste removal but no agencies turned up especially because of the stiff gradient at the site.

- As such we are contemplating of salvaging non biodegradable waste from the old legacy waste with the help of Himalayan Mountaineering Institute considering the fact that stiff slopes prevent us from carry out conventional bioremediation and biomining method to reclaim land ULB wise some specific actions are placed below.

Darjeeling Municipality:

- **Darjeeling Municipality has notified their Bye-Law for Solid Waste Management and shared it in the public domain.** Their daily waste generation is 57 TPD, out of that 23 TPD wet waste and 12 TPD dry waste are being collected in segregated manner.

- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.

- As per enumeration total household is 29038 with a population of 145192, hotels & restaurants are 915, eateries are 479, markets are 15, shops are 921 and institution & others are 278 present in the city.

- The ULB has placed 3000 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.

- **With regards to the fresh waste processing site at Amar Jyoti Gram, Ward No. 17 of Darjeeling Municipality** so far, we have spent around Rs.2.28 crore for approach road, retaining wall, RCC Box Culvert, High Hill slope protection wall and land development.

- DPR for setting up of civil & electrical infrastructure as well as machineries to be installed are under process.

- The target to start processing of both wet and dry waste is October, 2026. With regards to non-biodegradable waste sorting, drying and bailing will be done at the processing site and thereafter will be transported to recyclers duly authorized by WBPCB or at the existing MRF Unit at Siliguri MC.

Kurseong Municipality:

- **Kurseong Municipality is on the verge of notifying their Bye-Law for Solid Waste Management.** Their daily waste generation is 20 TPD, out of that 8 TPD wet waste and 5 TPD dry waste are being collected in segregated manner.

- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.

- As per enumeration total household is 23361 with a population of 68929, hotels & restaurants

are 65, eateries are 176, markets are 5, shops are 2620 and institution & others are 92 present in the city.

- The ULB has placed 296 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.
- **The present disposal site is at Suntalay Paksha of Ward No.19** where the road is very narrow for vehicular movement and the site itself at a terrain of high slope with no definite shape. So, our initial approach was to make vehicles accessible to all weather and therefore Municipality has constructed approach road and completed land development works for setting up of fresh waste processing plant with a cost of Rs.96 lakhs.
- **Soil test for preparation of DPR for civil infrastructure works for setting up of fresh waste processing plant has been completed**.
- The construction of the platform for fresh waste processing plant has been completed. Other Civil Infrastructure works like shed etc. for the plant to be completed by June, 2026.
- Fresh Waste processing (biodegradable waste) will be commenced on and from October, 2026. With regards to non-biodegradable waste sorting, drying and bailing will be done at the processing site and thereafter will be transported to recyclers duly authorized by WBPCB/MRF Unit that may be set up at Siliguri or the existing Unit at Siliguri MC.

Mirik Notified Area Authority:

- **Mirik NAA has notified their Bye-Law for Solid Waste Management and shared it in the public domain.** Their daily waste generation is 4 TPD, out of that 2 TPD wet waste and 1 TPD dry waste are being collected in segregated manner.
- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.
- As per enumeration total household is 3106 with a population of 12211, hotels & restaurants are 43, eateries are 30, markets are 3, shops are 541 and institution & others are 54 present in the city.
- The ULB has placed 155 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.
- **Mirik Municipality has applied for NOC for land from Thurbo Tea Estate to set up Central processing unit** for fresh waste processing, but it is still awaiting for approval. On availability of land, DPR will be prepared and the plant will be set up within one year.

Kalimpong Municipality:

- **Kalimpong Municipality is on the verge of notifying their Bye-Law for Solid Waste Management.** Their daily waste generation is 21 TPD, out of that 9 TPD wet waste and 6 TPD dry waste are being collected in segregated manner.
- To ensure 100% door to door collection and segregation at source from all sorts of waste generators special drive has been taken in sensitization of tourists, hoteliers, cab operators, other stakeholders.
- As per enumeration total household is 11146 with a population of 68931, hotels & restaurants are 55, eateries are 152, markets are 1, shops are 1385 and institution & others are 36 present in the city.
- The ULB has placed 526 Community Bins of 100 ltrs. Capacity, both green and blue at major tourist footfall areas and markets.
- **A fresh site has been selected which is at a very high slope and for development of such fresh site measures has already been taken** and for that work for RCC box culvert, passage for storm water, bituminous macadam with mastic asphalt on approach road have been completed

	and the amount of expenditure is around Rs. 2 crore. • **Soil test for preparation of DPR for civil infrastructure works for setting up of fresh waste processing plant has been completed.** • Civil Infrastructure for the plant to be completed by September, 2026. Fresh Waste processing (biodegradable waste) will be commenced on and from October, 2026. • With regards to non-biodegradable waste sorting, drying and bailing will be done at the processing site and thereafter will be transported to recyclers duly authorized by WBPCB or at the existing MRF Unit at Siliguri MC.
4.	**Impact on Water Quality** a. **Mirik Lake affected due to untreated sewage disposal from hotels & residential areas.** b. **High anthropogenic pressure on Mirik lake and its catchment due to high tourist influx.**
	• To combat Water Pollution and to improve water quality of Mirik lake Three (3) nos. STPs have been constructed. STP1: 600 KLD capacity, STP 2: 300 KLD capacity and STP3: 300 KLD capacity will cover 1057 nos House connection surround the lake. • At present Work in progress for all 3nos STPs and 65% of House Connection completed and targated to commissioning the project by April '2026. AA&FS Amount Rs.8.60 crore and Tendered Amount Rs.7.32 crore for this work. After completion of these projects the sewage from the hotels, restaurants, households etc. will be treated under these three STPs and the treated water will be discharged into a suitable place. • **Rejuvenation of Sumendu (Mirik) Lake will also improve water quality of Mirik lake.** The necessity for rejuvenation of Mirik Lake emerged from the following critical observations: 1. **Environmental Degradation Due to Sewage Inflow:** Untreated sewage generated from nearby hotels and residential areas is being discharged into the lake, leading to significant deterioration of water quality. 2. **High Anthropogenic Pressure:** The lake and its catchment area are under considerable stress owing to heavy tourist influx, causing increased pollution, siltation, and ecological imbalance. Recognizing these concerns, the AMRUT Directorate, UD&MA Department, Government of West Bengal undertook the initiative to restore and rejuvenate the water body. A comprehensive project proposal was prepared and subsequently approved under the 3rd tranche of AMRUT 2.0, with a sanctioned project cost of ₹10.00 Crore. **Key Components of the Project** • **Dredging and Desiltation :** Removal of accumulated silt and sludge from various sections of the lake using a Cutter Suction Dredger to restore its storage capacity and improve water quality. • **Vegetation and Weed Removal :** Clearing of invasive species such as water hyacinth, weeds, shrubs, and bushes from the northern and southern zones of the lake to revive the lake ecosystem. • **Shoreline Strengthening and Beautification:** Construction of boulder protection walls and installation of paver blocks along the south-western and north-eastern embankments to prevent erosion and enhance the structural stability of the lake boundary. The tendering process has been completed, and the proposal is presently awaiting approval from the competent authority (SLPIC/SLTC). The project is scheduled to commence on ground by the end of December 2025 and is targeted for completion by December 2026.

Expected Outcomes

Water Body Parameter	Existing Value	Target Value
Volume (Cubic Meter)	196896.47	337301.75
Biological Oxygen Demand (BOD((mgL)	25	10
Chemical Oxygen Demand (COD) (mg/L)	75	50
Dissolved Oxygen (DO) (mg/L)	3	4
Total Dissolved Solids (TDS) (mg/L)	2500	1500
Turbidity (NTU)	16	9

5. **Impact on Forest, Biodiversity & Eco-sensitive areas :**

(d) Mismanaged waste influence on feeding habits of Red Panda & Kaleej Pheasant

- In continuation to the reply in Point-3 above an all out effort is being made to sensitize the citizens and especially the tourists not to litter the environment so that the floras and faunas get affected.
- For this, they have enforced banning of plastic carry bag below 120 micron and single use plastic (SUP) in their area and initiated a programme with tourism operators, cab drivers, hoteliers etc. urging them to encourage tourists to restrict carrying such plastic items.
- Further at the places of high footfall they have arranged iron cages to treat these as dustbins for dry wastes and also placed community bins in certain intervals.

10. **Elaborate on the initiatives for effective solid waste management in Himalayas and how it helped in nullifying climate change adversities in the state of West Bengal.**

In continuation to the reply in Point-3 above some other initiatives have been taken along with plantation initiatives involving self-help groups for nullifying climate change adversities.

Darjeeling Municipality:

- Darjeeling Municipality has identified 183 Garbage Vulnerable Points out of which 118 have already been cleared. 56 most vulnerable points they have transformed to small parks, sitting arrangement for pedestrians, kids zone, installed statues and shop corners.
- **They have achieved Open Defecation Free (ODF) Status as per Government of India certification**.
- They have constructed 63 new Community Toilets and 8 new Public Toilets and maintaining the same involving the community and self-help groups. 13 others are under construction. They have already applied for ODF+ certification.

Kurseong Municipality:

- Kurseong Municipality has identified 131 Garbage Vulnerable Points out of which 117 has already been cleared. 41 most vulnerable points they have transformed to sitting arrangement for pedestrians and shop corners.
- **They have achieved Open Defecation Free (ODF) Status as per Government of India**

certification.

- They have constructed 1 new Community Toilet and 7 new Public Toilets and maintaining the same involving the community and self-help groups. They have already applied for ODF+ certification.

Mirik NAA:

- Mirik NAA has identified 42 Garbage Vulnerable Points and cleaned the same. 17 most vulnerable points they have transformed to amusement parks, and shop corners. They have made sitting arrangements at their Helipad ground out of eco-bricks utilizing plastic bottles.
- **They have achieved Open Defecation Free Plus (ODF+) Status as per Government of India certification.**
- They have constructed 22 new Community Toilets and 5 new Public Toilets and maintaining the same involving the community and self-help groups. 19 others are under construction.

Kalimpong Municipality:

- Kalimpong Municipality has identified 239 Garbage Vulnerable Points out of which 224 have already been cleared. 67 most vulnerable points they have transformed to small parks, sitting arrangement for pedestrians, kids zone, and shop corners.
- **They have achieved Open Defecation Free Plus (ODF+) Status as per Government of India certification.**
- They have constructed 65 new Community Toilets and 4 new Public Toilets and maintaining the same involving the community and self-help groups. 22 others are under construction.

Compliance Report as per reporting format by Transport Department

(Highlighted in yellow)

Point of Action As per the NGT order dated 31.01.2025 in the matter MA No.	Responsible Agency	Remarks/ Action taken
1. **Impact of Tourism** a. Urgent need of carrying capacity assessment for Darjeeling town and key tourist destinations in the West Bengal hills. b. Nature based tourism to be promoted to control environmental losses	1. District 2. Tourism Department 3. Forest Department	
2. Lack of a comprehensive hazardous waste management plan, with uncontrolled urban growth, high- rise constructions, overlooking govt. regulation and waste dumping diminishing the area's scenic beauty.	1 Urban Development & Municipal Affairs 2 West Bengal Pollution Control Board	
3. Municipal Solid Waste generation in the Darjeeling hills is rising. Although 100% of the waste is collected, gaps remain in waste segregation and management	1. District Magistrate 2. Urban Development & Municipal Affairs Department	
a. No facility for central composting or biomethanation of moist waste		
b. Need for additional waste deposition, segregation centres		
4. Impact on Water Quality	1. Urban Development & 2. District Magistrate, Darjeeling and 3. Department of Science, Technology & Biotechnology (DSTBT).	
a. Mirik Lake affected due to untreated sewage disposal from hotels & residential		
b. High anthropogenic pressure on Mirik lake and its catchment due to high tourist influx.		
5. Impact on Forest, Biodiversity & Eco-sensitive areas	1. Forest Department 2. Urban Development & Municipal Affairs Department	
a) Deforestation in Darjeeling, with drastically changing forest cover due to construction of roads and resort accommodation, expansion of settlements, increase in cultivated land		

Point of Action As per the NGT order dated 31.01.2025 in the matter MA No.	Responsible Agency	Remarks/ Action taken
b) Rhododendron on verge of extinction		
c) Sustainability of ecosystem of National Park and Red Panda Habitat		
d) Mismanaged waste influence on feeding habits of Red Panda & Kaleej Pheasant		
6. Impact on Air Quality	1. Tourism Department	
a)To control number of tourists and ill managed traffic through exploring threshold value b) Use of carbon neutral bus and cabs to be promoted c) Non Bharat VI standard vehicles not to ply	2. Transport Department	b) (1)STUs under Transport Department maintains a considerable number of CNG Buses and EV Total Non-AC CNG Buses run by all STUs — 284 nos. [CSTC — 32 , CTC — 30 , SBSTC — 192 , NBSTC — 30] Total AC Electric Buses (EVs) run by all STU s — 122 nos. [WBTC – 120 {Owned – 80 , Opex model -40 } , SBSTC — 2] For CSTC & CTC , both EV & CNG Buses generally operate within Kolkata & and adjoining areas ; SBSTC Buses , both CNG & EV , operate in South Bengal region including Kolkata. These measures are expected to mitigate air pollution in a significant manner .
		b) (2)WBTC has initiated the process for procurement 200 new CNG AC Buses under SASCI Project and delivery of the same is expected within this FY ; WBTC initiated the procurement of additional 25 Nos. CNG AC Buses [CSTC — 21 & CTC – 4 Nos.] after sanction but proposal had to be resubmitted to FD in view of cost escalation. SBSTC initiated procurement of 5 Nos. 40 Seater CNG AC Deluxe Bus after sanction which is in the procurement process.

Point of Action As per the NGT order dated 31.01.2025 in the matter MA No.	Responsible Agency	Remarks/ Action taken
		NBSTC initiated procurement of 14 Nos. CNG AC Buses and 53 Nos. CNG Non AC Buses after sanction which is in pipeline Fresh 500 CNG Buses in PPP model is proposed by WBTC but is under FD consideration Under XV Finance Commission , National Clean Air Programme (NCAP) Fund , WBTC & SBSTC has initiated procurement of 20 Nos. & 5 Nos. EV Buses respectively with necessary accessories & charging , which is expected to materialize shortly. Part of the fund has been released by WBPCB . Under NCAP 2025-26 , a plan has been sent to KMC proposing procurement of 200 CNG Buses for WBTC & another 40 Nos. CNG Buses for SBSTC , at a budgetary estimate of nearly Rs 147 Crores .This is under active consideration of the concerned authority and a commitment for early release of Rs 50 Crores has been received from the KMC authority. If above proposals fructify , then the fleet strength of CNG Buses under Transport Department STUs will increase by 1062 Nos. It is expected that the total fleet strength of CNG Buses under all STUs of the Transport Department is expected to be around 1300 Nos. & EV Buses nearing 90 Nos. by June 2026 . This is surely going to have a long term impact on the mitigation of air pollution .
d) Studies should be conducted to distinguish the different sources (tourist vehicles) of air pollution in the area.		c)Transport Deptt. has been encouraging the Registration and plying of BS VI norms vehicles through its RTO /ARTO Offices across the State . As on 31.12.2025), 54,98,058 BSVI Private vehicles covering various classes have been registered across the State . Another 2,56,573 Commercial

Point of Action As per the NGT order dated 31.01.2025 in the matter MA No.	Responsible Agency	Remarks/ Action taken
		BS VI norms vehicles have been registered, which includes 4703 nos. Luxury Cabs and 26,781 nos. Motor cabs among others . This intervention is expected to reduce vehicular air pollution across the State .
		d)Necessary coordination with Tourism Department is being taken up in order to mitigate any type of air pollution arising out of Tourist vehicles specifically. Motor Vehicle Enforcement drives will be taken up accordingly against such identified air polluting vehicles in popular tourist spots .
7. Need for Carrying Capacity assessments and preparation of Zonal and Tourism Master Plans in Eco-Sensitive Zones (ESZs).	1. Forest Department 2. Department of Science, Technology & Biotechnology (DST&BT). 3. Tourism Department 4. DM of the respective district	
a) States/UTs have been advised to undertake such studies for at least one ESZ in their region.		
b) The CPCB, through CSIR-NEERI, conducted a carrying capacity assessment for Sanjay Gandhi National Park, Mumbai.		
c) The Management Plans of the Protected Areas of North Bengal which exists in the Himalayan region of the state contain specific limits of carrying capacity		
8. Expansion in the institutional capacity of local government for climate change planning is urgently needed. This will require adaptation practices to evolve in view of NDC and SDGs.	1. Environment Department 2. DMs of respective District	
9. Efforts put in place to increase forest cover in the Himalayan Region of West Bengal	Forest Department	

Point of Action As per the NGT order dated 31.01.2025 in the matter MA No.	Responsible Agency	Remarks/ Action taken
10. Elaborate on the initiatives for effective solid waste management in Himalayas and how it helped in nullifying climate change adversities in the state of West Bengal.	1. Department of Urban and Municipal Affairs	
	2. Panchayat & Rural Development Department	

Spl. LO 12/12/2025

GOVERNMENT OF WEST BENGAL
DEPARTMENT OF FORESTS
ARANYA BHAWAN, BLOCK-LA-10A, SECTOR-III
SALT LAKE CITY, KOLKATA-700106

No. 1685-FOR Date: 11.12.2025

From: Joint Secretary to the Govt. of West Bengal

To : The Special Secretary
Environment Department, Government of West Bengal
Pranisampad Bhavan, 5th Floor, LB-2, Sector-III, Salt Lake, Kolkata-106

Sub: Compliance report to the NGT Order dated 30.01.2025 in MA14/2024 regarding implementation of recommendation provided in EATIHR.

Ref. No. 2368/ENV-15016/4/2024 dated 05.12.2025

Madam,

In inviting a reference to the subject mentioned above, I am directed to forward the report in prescribed format in compliance with the Order dated 30.01.2025 passed by the Hon'ble NGT relating to MA No. 14 of 2025 in OA No. 178/2022 in the matter of News Item, Published in The Hindu, dated 27.02.2022 in connection with the findings of the "Environmental Assessment of Tourism in the Indian Himalayan Region (EATIHR)" for your kind information and necessary action.

Joint Secretary to the Government of West Bengal

No. 1685-FOR /1(3) Date: 11.12.2025

Copy forwarded for information and necessary action to:-

1. The CCF, PGL&I , Directorate of Forests, WB
2. Chief Environment Officer, Environment Department , Govt. of West Bengal
3. Law Officer, Environment Department, Govt. of West Bengal.

Joint Secretary to the Government of West Bengal

<table>
<tr><th>Point of Action As per the NGT order dt 31.01.2025 in the matter MA No.14/2024</th><th>Responsible Agency</th><th>Remarks/Action taken</th></tr>
<tr><td>1.Impact of Tourism
a. Urgent need of carrying capacity assessment for Darjeeling town and key tourist destinations in the West Bengal hills

b. Nature based tourism to be promoted to control environmental losses</td><td>1.District Magistrate , Darjeeling
2.Tourism Department
3 Forest Deapartment</td><td>1 a) Does not pertain to Forest Department.

b) Forest Department has taken a number of measures to promote nature based tourism. This includes opening up of new trekking paths inside Singalila and Neora Valley National Parks, camp sites , observation spots, development of basic facilities for nature lovers.
A Rhododendron and Bird festival is being organized for the last few years which attracts nature lovers from all over the country and even abroad.</td></tr>
<tr><td>5.Impact on Forest,Biodiversity & Eco sensitive areas
a)Deforestation in Darjeeling, with drastically changing forest cover due to construction of roads and resort accommodation, expansion of settlements, increase in cultivated land

b) Rhododendron on verge of extinction
c) Sustainability of ecosystem of National Park and red Panda Habitat
d) Mismanaged waste influence on feeding habits of Red Panda & Khaleej Pheasant</td><td>1.Forest Department
2.UD & MA Department</td><td>a)Forest cover assessment of Darjeeling district done by Forest Survey of India does not show significant change in previous assessment cycles. The relevant data is furnished below :
<table>
<tr><th>Year of assessment</th><th>Forest cover</th></tr>
<tr><td>2019</td><td>2367.80 sq.km,75.19%</td></tr>
<tr><td>2021</td><td>2348.88sq.km,74.62%</td></tr>
<tr><td>2023</td><td>2336.14 sq.km,74.22%</td></tr>
</table>
b)Rhododendron thrives very well along its ranges in Darjeeling and Kalimpong districts. In last two decades no contraction of range of this species or large scale mortality has been noticed (other than occasional processionary moth attack).
In at least three places Rhododendron park has been established and more are on the offing. There is also a renewed interest in planting Rhododendron in the city landscape.

Overall, all the species of Rhododendron are doing well in the Himalayan districts of west Bengal.
c)The national parks and Sanctuaries located in Darjeeling and Kalimpong district are Mahananda Wild life</td></tr>
</table>

		Sanctuary(161.17 sq.km),Senchal Wildlife Sanctuary (38.60sq.km),Singalila National Park(78.60 sq.km) and Neora Valley National Park(159.89 sq.km).Approximately 36.4% of the recorded forest area in Darjeeling and Kalimpong Districts has been declared as Wildlife Sanctuaries and National Parks where strict protection of wildlife is enforced. Most forests in the Himalayan hills fall within National Parks and Wildlife Sanctuaries, where even NTFP(Non-Timber Forest Product) collection is strictly prohibited and enforced. The eco system of this area is pristine as human disturbance is strictly regulated in these zones. Other than nature based tourism no entry is permitted inside these National Parks and Sanctuaries which constitutes bulk of the Red Panda habitats. Fire Control and invasive species control are two main measures taken up to check the transformation of eco system. Being located in the moist eastern Himalayan region water supply in the National Parks is abundant. In selected places these are supplemented by man-made water storage structures for animal use. We see no cause of concern for the sustainability of the eco system in the National Parks and Sanctuaries of Darjeeling Himalayas. d)Red Panda and Khaleej Pheasant habitats in Darjeeling and Kalimpong districts have very few to none enclave villages inside them. Thus, the chance of generation of anthropogenic waste from such sources is rare. The tourists passing along selected stretches do generate waste and sometimes they litter the path. Awareness generation measures are routinely taken to counter this problem. Tourists are also cautioned against littering at the entry point of sanctuaries and national parks. Litter bins have been placed at regular intervals along the trekking/ tourism routes which are regularly emptied outside the protected areas. So far, the excretory deposited by Red Panda and Khaleéj Pheasant has not shown any plastic residue.
7.Need for Carrying Capacity assessments	1.Forest Department	a) This exercise will be taken up shortly for the Mahananda Wild Life Sanctuary.

<table>
<tr>
<td>and preparation of Zonal and Tourism Master Plans in Eco-Sensitive Zones (ESZs).

a)States/UTs have been advised to undertake such studies for at least one ESZ in their region.
b)The CPCB, through CSIR-NEERI, conducted a carrying capacity assessment for Sanjay Gandhi National Park, Mumbai.
c) The Management Plans of the Protected Areas of North Bengal which exists in the Himalayan region Of the state contain Specific limits of carrying capacity.</td>
<td>2.department of Science, Technology & Biotechnology
3.Tourism Department
4.District Magistrate</td>
<td>b) NA
c) Carrying capacity of the tourists has been specified in the management plans of all protected areas of North Bengal. The figure is furnished below :
<table>
<tr><th>National Park/Wildlife Sanctuary</th><th>Maximum No. of visitors allowed per day</th><th>Maximum No. of Vehicles allowed per day</th></tr>
<tr><td>Singalila National Park</td><td>360</td><td>60</td></tr>
<tr><td>Neora Valley National Park</td><td>272</td><td>45</td></tr>
<tr><td>Senchal Wildlife Sanctuary</td><td>204</td><td>34</td></tr>
<tr><td>Mahananda Wildlife Sanctuary</td><td>397</td><td>67</td></tr>
</table>
</td>
</tr>
<tr>
<td>9.Efforts put in place to increase forest cover in the Himalayan Region of West Bengal</td>
<td>Forest Department</td>
<td>The Forest Department, Government of West Bengal distributes free saplings to encourage tree planting during Van Mahotsav period and involves massive movements of people, students, NGOs 'and others to improve the green covers in Hills. Apart from this the State of West Bengal also strictly enforces the West Bengal Trees(Protection and Conservation Areas) Act, 2006 where permission from the Competent Authority is a statutory mandate for the purpose of felling of trees in Non Forest Areas.

In FY 2024-25 approximately 14,465 seedlings were planted by the Forest Department along with Civil Society members, NGOs', students and others. Additionally, around 62,474 seedlings were distributed among the public for distribution. Such large scale plantation drives are conducted every year to enhance the green cover in hilly regions.</td>
</tr>
</table>

This is with Reference to vide Memo No. EN/715/2E-06/2025 dated 08/04/2025 and Memo No. EN/1566 dated 06.08.2025

Information pertaining to Tourism Department is given below:

1. Accommodation Availability and Homestay Model framework

The availability and spatial distribution of accommodation infrastructure indicate a decentralised, balanced and relatively low-impact tourism model. As per the survey report, Darjeeling district has around 277 hotels and 414 homestays registered under the Tourism Department, while Kalimpong district has 1,135 homestays registered under the Tourism Department.

The homestay model promotes community participation, local livelihood generation and environmentally responsible tourism, while supporting wider geographical dispersal of visitors in line with sustainable and responsible tourism principles, thereby enabling dispersion of tourist footfall and reducing pressure on core urban centres.

2. Capacity Building and Service Provider Regulation

The Tourism Department has undertaken systematic capacity-building initiatives through training and certification of tourist guides under the West Bengal Tourist Guide Certification Scheme, resulting in 2,050 trained guides, including over 400 women guides, of whom more than 1,100 are currently actively engaged across the State. In addition, approximately 245 Tourism Service Providers have been registered under the Recognition of Tourism Service Providers Scheme, 2021, contributing to regulated tourist movement and enhanced visitor awareness of local ecology, culture and heritage.

3. Regulation in Forest and Protected Areas

Tourism Department proposes that tourism activities within forest areas and protected landscapes are undertaken in strict compliance with Forest Department regulations, which are designed to safeguard ecological integrity while allowing controlled visitor access. Key regulatory provisions include the following:

- **Protected Area Governance and Regulatory Framework:** The Forest Department implements a precautionary regulatory framework to conserve forests and biodiversity in the Himalayan region. A significant portion of forest land of the Darjeeling–Kalimpong hills are notified as National Parks and Wildlife Sanctuaries, where strict protection measures are enforced.
- **Regulation of Human Activities:** Human activities are tightly controlled, with restricted entry, prohibition on non-timber forest produce collection, and permission only for regulated, nature-based tourism as per approved management plans.
- **Carrying Capacity and Visitor Management:** Tourism is regulated through site-specific carrying capacity norms, with daily visitor and vehicle limits enforced in Singalila, Neora Valley, Senchal, and Mahananda.
- **Controlled Movement and Waste Management:** Tourist movement is limited to designated routes, supported by entry controls, awareness measures, and regulated waste management to protect sensitive wildlife habitats.
- **Ecosystem Protection and Legal Enforcement:** Ecosystem protection measures include fire control, habitat conservation, and wildlife support, reinforced by forest monitoring, afforestation drives under Van Mahotsav, and enforcement of the West Bengal Trees (Protection and Conservation Areas) Act, 2006.

Together, these mechanisms ensure that ecological integrity, biodiversity conservation, and limited sustainable tourism coexist within the Himalayan forest landscape

4. Monitoring Indicators and Thresholds

The assessment framework may include measurable indicators such as permissible visitor limits at critical sites, waste generation vis-à-vis treatment capacity, accommodation occupancy levels, tourist-to-resident ratios, seasonal infrastructure load and traffic volumes. These may be maintained by the local bodies including Urban Local Bodies.

5. Ecological Sensitivity, Land Use and Infrastructure Limits

Tourism planning shall account for ecological sensitivity, infrastructure constraints and seasonal tourist inflows, particularly in hill towns and protected landscapes. Land Use Development Control Plans (LUDCPs) may be prepared for fragile and eco-sensitive areas in coordination with the Urban Development and Municipal Affairs Department to ensure compliance with land-use regulations and environmental safeguards.

6. Municipal Coordination, Pollution Control and Transport Management

Close coordination with Urban Local Bodies is essential to manage roads, traffic circulation, water supply, sewerage, solid waste management and public transport. Municipal authorities, in coordination with the Pollution Control Board and Transport Department, may strengthen pollution control measures, regulate vehicular emissions, promote public transport and shared mobility, restrict non-essential vehicular movement in congested areas, and strictly enforce bans on open waste burning.

7. Pressure Dispersal, Enforcement and Awareness

The Tourism Department may continue promoting offbeat destinations such as Lamhatta and Tinchuley to disperse tourist pressure while supporting community livelihoods. Tourism activities in eco-sensitive zones shall be governed through close inter-departmental coordination with the Forest, Environment and Transport Departments. Responsible tourism awareness may be strengthened through targeted campaigns, signage and dissemination of do's and don'ts for tourists and service providers to foster environmentally responsible travel.

GOVERNMENT OF WEST BENGAL
PANCHAYATS & RURAL DEVELOPMENT DEPARTMENT
Joint Administrative Building (6th to 10th Floors), HC-7, Sector-III
Bidhannagar, Kolkata-700106

Memo No. 236 -PRD-24023(11)/1/2020-JS(PRD) **Kolkata, dated 09.01.2026**

From: Mission Director, SBM (G) &
Additional Secretary to the Govt. of West Bengal

To: Roshini Sen, IAS
Additional Chief Secretary,
Department of Environment,
Government of West Bengal

Sub: Compliance to the NGT order dated 30.01.2025 in the matter of M.A 14/2024, Implementation of recommendation provided in EATIHR— reg.

Ref: Letters issued by the Additional Chief Secretary, Department of Environment, Government of West Bengal:
i) No.-2368/ENV-15016/4/2024 dated 05/12/2025.

.....

Madam,

In pursuance to the subject and reference cited above, the status report on Compliance to the NGT order dated 30.01.2025 in the matter of M.A 14/2024 is enclosed herewith for your kind perusal and necessary action.

Enclo: As stated

Yours faithfully,

Mission Director, SBM (G) &
Addl. Secretary to the Govt. of West Bengal

Initiatives for effective solid waste management in Himalayas and how it helped in nullifying climate change adversities in the state of West Bengal

To ensure cleaner and garbage free environment a hosts of activities have been done by the P&RD Department under SBM-G Phase-2 Programme. Details of the activities are as below.

1. **Individual Household latrines (IHHL):** To make the areas free from Open Defecation (ODF) special campaign are undertaken time to time. Intensive awareness campaigns through IEC/BCC activities are undertaken so that households who don't have IHHL facilities construct IHHL at their household and generate good habits for regular toilet use.

   Filed verifications by the third party organization are done to ensure no one is left without IHHL facility. Camps are undertaken to provide IHHL facility to the households who need IHHL facility. 14,110 families have been provided with IHHLs facility.
2. **Community Sanitary Complex (CSC):** For the ensuring ODF in the areas of public congregation especially in markets, bazaars, bus stand, community places etc CSCs are constructed. 107 CSCs have been constructed in the areas of public congregation.
3. **Solid Waste Management (SWM):** To manage solid waste generated in the rural areas SWM facility are created. In per-urban areas the management Unit is set up in a central area like Gram Panchayat where solid waste are collected from the households transported in the Central Management Unit in a tri-cycle. The bio-degradable waste is turned into compost. Non-biodegradable wastes especially plastic waste are sorted and transported to the block level plastic waste management units. 109 SWM units are constructed under SBM-G programme. SWM facility is available in every village.

   In certain areas where generation of bio-degradable waste is less, households are motivated to manage the waste at household levels.

   Households are motivated through IEC/BCC activities for household segregation of waste and proper management of waste at household and public places.
4. **Plastic Waste Management Unit(PWMU):** At block level PWMU are set up for management of plastic waste. Plastic waste are collected from villages are transported

to this units. There are specific machines like cleaners, bailers and shredders for management of plastic waste. Eco brick technology using plastic bottles have been adopted in management of Plastic Waste. Three PWM units at block level have been constructed.

Households are motivated through IEC/BCC activities for refusing use of plastic and motivated to use plastic alternatives.

5. **Grey Water Management (GWM):** To prevent outbreak of vector borne disease (VBD) management of grey water at households and community level is necessary. GWM assets are crated at community, institutional levels to prevent accumulation of used water and prevent outbreak of VBD. 278 GWM assets like leach pit, settler with ABR and filter chamber have been constructed under this initiative.

   People are motivated through IEC/BCC activities for management of used water at household levels.

6. **Fecal Sludge Management (FSM):** Appropriatetwin pit toilet technology reduces the menace of fecal sludge at substantial level in rural areas. Apart from that fecal sludge is managed through FSTP (Fecal Sludge Treatment Plant).
7. **Gobardhan :** To mange cattle waste Goabrdhan units are constructed. Two Gobardhan units have been constructed.
8. **Capacity Building:** For transfer of technology for implementation of works capacity building activities are undertaken at regular level. Capacity Building of different stakeholders is undertaken with the help of expert agencies/institutions like IIT Kharagpur, SPMNIWAS, Joka, PriMove, UNICEF etc.More than 150 training have been done and 3040 no participant has been trained. With PRI members supervisor of SWM units, staffs of PRI bodies to operate SWM unit/PWM unit.
9. **IEC/BCC:** To motivate people to adopt good hygiene behaviors different IEC activities including campaigns are undertaken at regular intervals. Special events like Swachh Marathons, Community football match, human chain, rally with student etc are under taken. Community Triggering activities at community and institutional levels are undertaken to ensure good hygiene behaviors in the people.

10. **How does SBM-G activities contributes to minimize the bad impact of climate change** :

Swachh Bharat Mission-Grameen (SBM-G) immensely contributes to the reduction of climate change through integrated solid and liquid waste management (SLWM), renewable energy generation from waste, and promoting a circular economy. Key SBM activities that contribute to climate change reduction are as below.

Solid Waste Management (SWM): SBM-G promotes scientific SWM, which involves source segregation, collection, processing, and disposal to reduce the amount of waste going to landfills, which are a major source of methane emissions.

The activities include construction of Resource Recovery Centers (RRCs), composting pits, material recovery facilities (MRFs), waste-to-energy plants, and plastic waste processing units.

Use of Plastic Waste under Plastic Waste Management (PWM) activities: Non-recyclable plastic waste is often shredded and used in road construction, which provides an economic incentive for plastic collection and management, and reduces dependency on conventional road construction materials.

Adoption of clean transport system for SWM and PWM: Rural areas are transitioning to eco-friendly vehicles for waste collection. Districts have deployed electric autos and e-rickshaws for transportation of collected waste.

Climate Impact of SWM and PWM Initiatives: This initiative eliminates significant annual diesel consumption, drastically cutting down on greenhouse gas emissions and improving local air quality.

Liquid Waste Management (LWM): SBM-G Phase II addresses grey water (wastewater from washing, bathing, etc.) and black water management.

This involves constructing soak pits, leach pits, waste stabilization ponds (WSPs), and setting up fecal sludge treatment plants (FSTPs) to safely manage and treat used water before potential reuse (e.g., for irrigation or construction), thus preventing water body pollution and related health hazards.

GOBAR-dhan: The GOBARdhan (Galvanizing Organic Bio-Agro Resources Dhana) scheme is one of the important components SBM-G Phase II Programme. It focuses on

converting cattle dung, agricultural waste, and other organic waste into valuable resources like biogas/compressed biogas (CBG) and organic manure.

Climate Impact of the GOBAR-dhan Scheme: Biogas is a clean, renewable fuel that replaces traditional cooking fuels like firewood and kerosene, reducing deforestation, improving indoor air quality (benefiting women's health), and cutting greenhouse gas emissions, particularly methane.

Behavioral Change and Awareness: Large-scale public awareness campaigns that promote sustainable practices like waste segregation at source (using separate green and blue bins), reducing single-use plastic, and conserving energy. This "Jan Andolan" (people's movement) institutionalizes swachh (clean) behavior at the community level, which is vital for long-term sustainability and climate resilience. Through these activities, SBM-G is directly integrating environmental considerations into public health initiatives, helping to mitigate climate change and build more sustainable communities in the state.

BEST PRACTICES ON SWM/PWM AT LAVA DEV BLOCK, KALIMPONG

INTRODUCTION:-

Lava Dev. Block is located in the hilly terrain of Kalimpong District of West Bengal and has a population of around 45000. It has great tourism potential but at the same time there are lots of challenges here with regard to implementation of SBM(G) schemes. As the houses here in the hills are distantly located and the villages are far from one another, regular waste collection was a herculean task. Similarly, due to hilly terrain, E-Carts for waste collection were not feasible. Moreover, the quantum of fund flow under 15th CFC is also less due to less population.

Realizing the fact that biodegradable wastes can easily be composted at HH levels, the Block administration came up with an initiative of Plastic Waste Mgt and the SWM Unit constructed earlier out of SBM G Fund was turned into a Plastic Waste Mgt Unit.

COMMUNITY TRIGERRING AND METHODOLOGY:-

Our first challenge was community level triggering and to make people aware about the hindrances of burning of plastic, a practice which is prevalent here. Block Level & GP Level Task Force were formed & SHGs were mobilized for door to door awareness. **A pool of manpower known as "Swachhata Sathis" were raised from amongst SHG members for door to door plastic waste collection.**

CONCEPT OF ECOBRICKS:-

We came up with an initiative of Ecobricks – a simple, non-capital methodology to keep plastic safe and secure so that it can be put to good, green use. A model was worked out to collect plastic waste from the HH level, brought to the centralized PWM Unit and processed into Ecobricks.

In order to make the initiative sustainable, a convergence based and a community managed approach was adopted. **A revenue generating model has been developed wherein each HHs contribute a nominal monthly user fee and this revenue supports daily waste collection, vehicle fuel and honorarium to SHG workers ensuring the continuity of the services without dependance on Govt Grants.**

COST EFFECTIVE PLANNING & MANAGEMENT:-

A dedicated vehicle follows a route mapped collection schedule covering all 7 Gram Panchayats over a rotating fortnightly cycle. This reduces transportation cost and fuel wastage while SHG activity days are aligned with the collection cycle to support sorting and segregation, ensuring operational efficiency.

Proper financial records is being maintained at the Gram Panchayats while the SHG Federations handle daily logistics and manpower deployment. This grassroot level management ensures transparency and minimizes administrative overheads.

REVENUE GENERATION:-

The plastic wastes collected from the HHs are processed into Ecobricks and then sold at Rs. 5/- per pc by the Panchayat Samiti. With these ecobricks, structures like benches, community compost pits and decorative structures at tourist spots are being constructed. **This has not only helped in waste management but has also been generating additional Own Source Revenue for the Panchayat Samiti and incentive for the SHG.**

By combining community ownership, cost-effective technology, revenue generating mechanism & decentralized governance, an affordable and replicable model has been created that ensures long term sustainability without financial burden on beneficiaries or the State.

A GENDER INCLUSIVE APPROACH:-

The entire task from waste collection, segregation to ecobrick making is being managed by the SHG women making this initiative **gender inclusive**. More than 250 women are involved in this activity. The SHG women have also been stitching cloth bags with regular collection of old clothes from the HHs. Paper bags are also being made by the SHGs on a large scale. **With these alternatives to Plastics, use of SUPs has been completely banned under Lava Block w.e.f 6th of May, 2025.**

IT'S IMPACT:-

The initiative led by the Block Administration have received overwhelmingly positive feedback from all corners of the society. The people have readily accepted our initiative and have been gladly contributing the user fee on monthly basis. As Lava Block is a tourism Block, this system of Waste management has helped in overall cleanliness with no plastic litters and PET bottles strewn here and there. Lava Block has been declared a Plastic Managed Block on 5th of June'2025 and this itself will boost tourism with more people flocking in. More tourist inflow means more revenue generation, more employment creation leading to sustainable livelihood.

POTENTIAL FOR REPLICATION:-

As this initiative is community driven and is based on a convergence model – integrating sanitation, livelihood generation & women empowerment and at the same time, it is environmentally sustainable, hence its is an ideal model for replication in other geographies, especially rural & semi-rural region across India.

The ecobrick technology for plastic waste management is an innovative approach that has been successfully taken up under Lava Dev. Block. This model not only reduces landfill waste but also generates revenue and reduces material cost for public works. The Grey Water Filtration Units constructed at HH level, Schools, ICDS & Homestays have been designed using low cost, locally available materials and require minimal maintenance and no electricity. These effectively treat waste water making it useful for irrigation purpose as there is scarcity of water in the hills.

SOCIAL RESPONSIBILITY ENSURED:-

Social Responsibility has been ensured through community ownership and cultural alignment. This initiative through consultation with local PRI members, SHG federations, homestay associations & village level institutions. Community awareness campaigns were conducted in local dialect, thus making the intervention relatable and non-intrusive. In our model, women are the central figure, making this gender inclusiveness. At the same time, our initiative is environmentally sustainable and due priority have been given towards strengthening of grassroot institutions like SHGs, Village Organizations, Cluster Level Federations & Producer Groups.

11/08/2025

BLOCK DEVELOPMENT OFFICER
LAVA DEVELOPMENT BLOCK

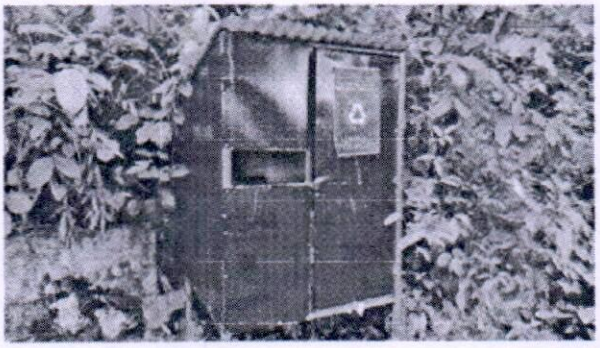
Block Development Officer
Lava Development Block
Kalimpong

Management of Solid and Plastic Waste in Rangli-Ranliot Block, Darjeeling

Introduction.

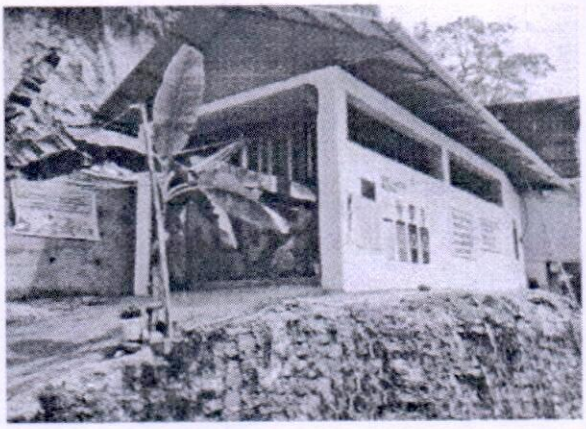
Solid Waste Management (SWM) - is a systematic process of collecting, segregating, transporting, processing, and disposing of solid waste generated from households, commercial establishments, institutions, markets, and other sources. The main objective is to reduce the harmful impact of waste on human health and the environment while promoting recycling, reuse, and recovery of resources wherever possible.

To facilitate this, SWM Units have been installed at various locations across the Rangli Rangliot Development Block.



Solid Waste Management units

Plastic Waste Management (PWM) is a focused sub-component of SWM that deals specifically with plastic waste. Owing to the non-biodegradable nature of plastics and their widespread usage, proper handling is essential. PWM includes the collection and segregation of plastic based on type and nature, followed by appropriate disposal methods such as recycling, incineration, or reuse through innovative approaches like plastic road construction. It also emphasizes reducing plastic use, promoting alternatives, and ensuring scientific disposal to prevent environmental pollution.



Plastic Waste Management Unit segregation of plastic inside PWM.

How Waste is being managed

At Community Level

At the household level, waste is initially segregated into biodegradable and non-biodegradable. Residents are encouraged to compost biodegradable waste within their premises.To support this initiative, each Gram Panchayat (GP) has appointed trained waste collectors from local Self-Help Groups (SHGs). These collectors visit households twice a month to collect non-biodegradable (dry) waste and create awareness on cleaning and drying plastic waste before disposal, to avoid contamination and ease segregation.

At Market Area

In the market areas, biodegradable waste (such as vegetable peels and food waste) is stored separately by shopkeepers and vendors. Waste collectors visit the markets two to three times a week to collect non-biodegradable dry waste, which is then transported to SWM Units for further segregation.

Waste collection from house

Storing at PWM

Segregated for transport

Segregated waste at PWM

Transportation of waste

Plastic booth concept -

The Plastic Waste Management (PWM) Unit at Takdah operates as a micro-level segregation and storage booth. It serves as a central facility that collects plastic waste from various SWM units. Trained personnel segregate plastic based on type (e.g., PET, LDPE, HDPE, multilayered plastic) and store it in larger sacks. The sorted plastic is then dispatched to Sonada for recycling, supporting a circular economy and reducing environmental impact.

Segregated waste at PWM

Planning of Waste Collection

Periodicity / Interval

- Households: Waste collectors visit twice a month.
- Business Establishments & Market Areas: Collection occurs two to three times a week.

Mode of Transportation

Collected waste from households and markets is transported to Solid Waste Management Units using local transportation means or dedicated vehicles. From there, plastic waste is picked up by a central vehicle and taken to the Takdah PWM Unit.



Mode of Transportation

User Fee Collection

To streamline and digitize the process, a dedicated mobile application has been installed on the fee collector's phone. This app allows the collector to:

- Track household-wise fee collection data and records.
- Collect user fees using a QR code scanner.
- Operate in offline mode where internet connectivity is poor.


Mobile app

Offline collection of fees

QR code for online payment

GOVERNMENT OF WEST BENGAL
PANCHAYATS & RURAL DEVELOPMENT DEPARTMENT
Joint Administrative Building (6th to 10th Floors), HC-7, Sector-III
Bidhannagar, Kolkata-700106

No. 3931-PRD- 24099/5/2021-Sanitation **Kolkata, dated 12.08.2025**

From : Mission Director, SBM-G &
Additional Secretary to the Govt. of West Bengal

To : Divya Sinha
Director & Divisional Head UPC-II
Central Population Control Board
Ministry of Environment, Forest & Climate Change
Government of India

Sub: Successful initiatives adopted for effective solid waste management in Darjeeling and Kalimpong districts of West Bengal- reg.
Ref: Your office memo F.No. EQ-99/8/2025-UPC-II-HO-CPCB-HO dated 16.07.2025

Madam,

With regard to the subject and referenced letter dated 16.07.2025 kindly find enclosed two successful initiatives for effective management of Solid Waste undertaken by Lava Development Block, Kalimpong district and Rangli-Ranliot Development Block, Darjeeling district for your perusal.

Enclo: As stated above.

Yours faithfully,

Mission Director, SBM (G) &
Addl. Secretary to the Govt. of West Bengal

SLO
19.12.25

18 DEC 2025
3068/12N/PR
Government of West Bengal

Government of West Bengal
Department of Public Health Engineering
Janaswasthya Karigari Bhawan (Nijalaya)
CN8, Street Number 18, CN Block, Sector V
Bidhannagar, Kolkata-700091

Memo No. 3031 / PHE-15015/1/2024-LAW CELL-Dept. of PHE Dt. 15.12.2025

From: The Special Secretary
PHE Department, Govt. of West Bengal

To: Chief Environment Officer
Environment Department
Govt. of West Bengal.

Subject: **Responses to the queries based on the NIHE report and order of Hon'ble NGT**

Sir,

With reference to the Notes stated above, I am directed to inform that to mitigate the impact causing drinking water shortage, the sources may be adequately augmented in the districts of Darjeeling and Kalimpong as detailed below:

Action Plan of PHED, Government of West Bengal for drinking water source augmentation in Himalayan districts

Sl. no.	Impacted component	Action point	District	No. of schemes proposed	Target date from date of approval
1.	Drinking water	Augmentation of source	Darjeeling	34	3 months
2.	Drinking water	Augmentation of source	Kalimpong	41	3 months

Yours sincerely,

Sd/-
Special Secretary
to the Government of West Bengal

Memo No. 3031 / **PHE-15015/1/2024-LAW CELL-Dept. of PHE** Date :15.12.2025
Copy forwarded for information:-

1. Sr. P.A. to the Principal Secretary, PHE Department
2. Sr. P.A. to the E-IN-C. PHE Department.
3. Special Law Officer &.E.O.D.S. (Law), PHE Department.

Special Secretary
to the Government of West Bengal

Memo No. 3031/ **PHE-15015/1/2024-LAW CELL-Dept. of PHE** Date :15.12.2025
Copy forwarded for information:-

1. SE-II PMU, WBPWSP (DPHE) PHE Dte.

15/12/25
Special Secretary
to the Government of West Bengal

Annexure VII

Government of West Bengal
Department of Science and Technology and Biotechnology
Vigyan Chetana Bhavan, 26/B, DD Block, Sector I,
Salt lake, Kolkata - 700064

No. 338 /STBT-11011(17)/31/ 2025- ST SEC-Dept. of STBT Dated : 23/12/2025

To
The Addl. Chief Secretary to the
Government of West Bengal,
Environment Department
Pranisampad Bhaban, 5th Floor,
LB – 2, Salt Lake, Sector – III,
Bidhannagar, Kolkata – 700106

Sub: Inventory and Revival of Springs in Indian Himalayan Region

Madam,

This is to inform you that the DSTBT, GoWB has already provided the Name and Location of 434 spring data to the Irrigation and Waterways Department as per their request as the Irrigation and Waterways Department has been declared as the nodal department for conducting the 1st census of the springs in the State of West Bengal, under the aegis of the Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR) Ministry of Jal Shakti.

I avail this opportunity to attach the Spring Data available with the DSTBT, GoWB and a copy of an Interim Report (generated for NMSHE project) for your perusal and suitable action.

Enclo: i. Spring Database
ii. Interim Report

Yours faithfully,

26/12/25
Secretary
to the Govt. of West Bengal

Interim Report

Spatial Decision Support System on Spring Water Management
Darjeeling Himalayan Region
A Case Study of the Kalimpong District
West Bengal, India

Government of West Bengal
Department of Science and Technology and Biotechnology
2022

1533

Spatial Decision Support System on Spring Water Management Darjeeling Himalayan Region

A Case Study of the Kalimpong District West Bengal, India

2022

Government of West Bengal
Department of Science and Technology and Biotechnology

In collaboration with

Department of Environment, Government of West Bengal

Under the mission

NMSHE NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM

Under the project

Establishing/Strengthening State Climate Change Centre/ Cell under NMSHE [SCCC-NMSHE] in the State of West Bengal

Sponsored by

Department of Science and Technology
Ministry of Science & Technology
Government of India

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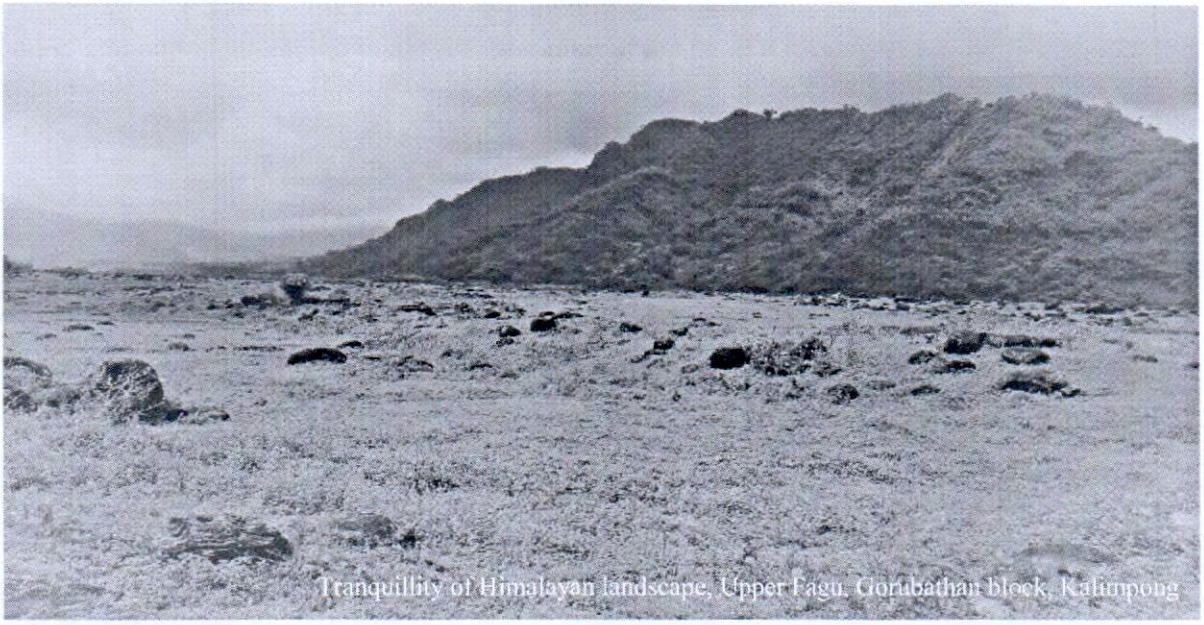
Chapter 1

Himalayan Springs



Tranquility of Himalayan landscape, Upper Fagu, Gorubathan block, Kalimpong

1.1 Himalayan Springs and Its Distribution

The Indian Himalayan Region (IHR) is spread across a length of 2,500 km with a width varying from of 250 to 300 km. Besides the physical bearing of these mighty mountains in the IHR, the Himalayas are of great social, cultural and economic significance for the people of India. It is the home to more than 50 million people who eke out their lives and livelihoods in these mountains. Most of northern India's river systems originate in the Himalayan region, fed either by glacial melt or the numerous springs that do occur in the mountainous landscape. The Himalayas, aptly known as *the water tower of the earth*, are therefore a major source of fresh water for perennial rivers such as the Indus, the Ganga and the Brahmaputra. Basically, the IHR spans in 10 hill states and union territories viz., Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and two partial hill States – Assam and West Bengal (hilly parts) (**Fig. 1**). Alongside, here in the Himalayas, the springs are considered to be the integral entity of life, as for many people, springs is the sole source of water. Likewise, a major proportion of drinking water supply in the mountainous parts of Uttarakhand is spring based, while in Meghalaya all villages in the state use springs for drinking, irrigation and for livestock. As per a rough estimate, there are five million springs across India, out of which nearly 3 million are in the IHR alone and both the rural and urban communities of the Himalayas are depending on springs for their everyday's need. Even the most conservative estimates state that 60% of the residents living in the concerned region depend upon spring water in a regular basis (Shrestha et al. 2018).

Villages and hamlets in the high altitudes are at a great disadvantage as most of the fresh water flowing through streams originating in the Himalaya is not readily accessible to them. People living in the lower reaches of Himalaya and the foothills are more likely to benefit from such surface water flows and the upland inhabitants, therefore, have trouble meeting their water demand. Regardless of the situation, an estimate shows that nearly four fifth's of the Himalayan population is directly involved in agriculture; while 12.5% of total land area is cultivated, only 11% of the cultivable land is under irrigation, almost 64% of which is fed by natural springs (National Institution for Transforming India (NITI) Ayaog, 2018). Though, springs have not received their due attention and at present many are drying up. Spring discharge is reported to be declining due to increased water demand, land use change, and ecological degradation and it is more aggravated with climate change impacts e.g., rising temperatures, rise in rainfall intensity and reduction in its temporal spread, and a marked decline in winter rain. Hence, the problem of vanishing springs is being increasingly felt across the IHR, and the contemporary scenario not only exhibits that the water production has declined of the mountainous springs, but also it describes the dangerous sign that aquifers are depleting.

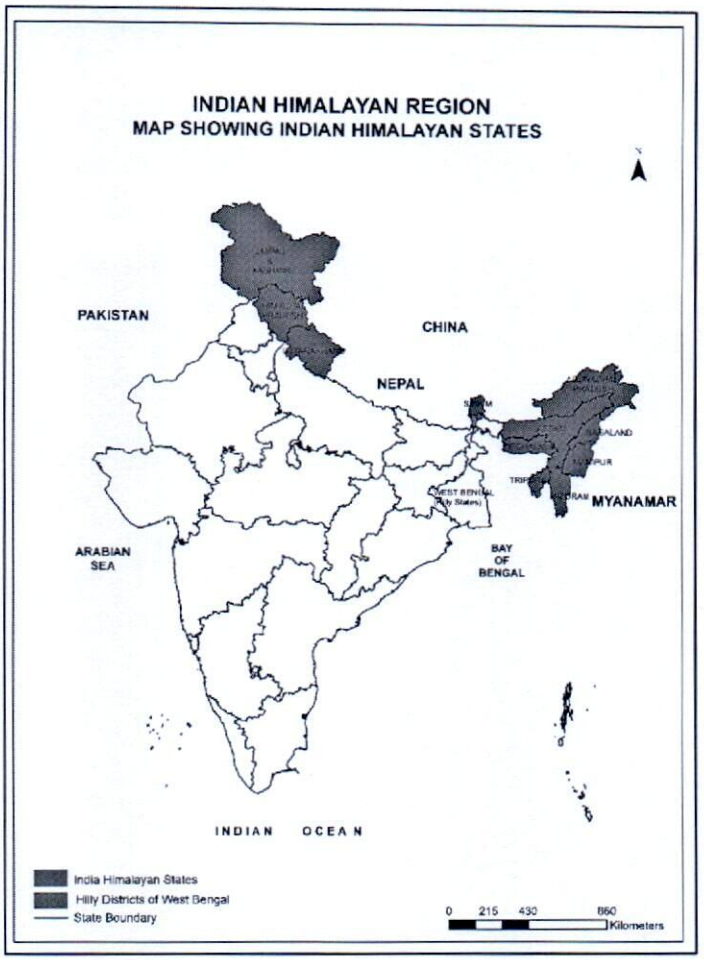


Fig. 1 Location map showing IHR states and Darjeeling Himalayan Region (two hilly districts) of West Bengal

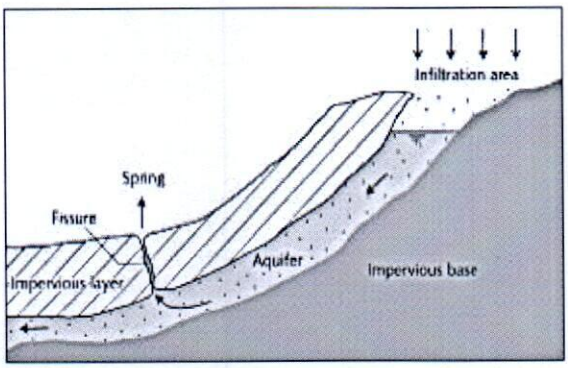


Fig. 2 Conceptual diagram of Spring Water Hydrology. Source: https://sswm.info/

1.2 Spring Water Hydrology

Hydrologically springs are groundwater discharge points that appear where a water bearing layer (aquifer) intersects with the ground surface and water seeps out of rock pores, fissures, fractures, or depressions. Actually, springs are a part of the groundwater system, but the science of hydrogeology that governs the occurrence and movement of water in mountain aquifers till date not

properly explored, thus, the occurrence of springs, is poorly understood. Therefore, it is quite essential to conceptualising some basic concepts of hydrogeology and its association, and that may in turn helps to understand the background of the spring water management study (**Fig. 2**).

1.2.1 The Hydrogeological Cycle

The hydrogeological cycle plays a significant role in spring occurrences. In general, the ground water flow as the cycle begins with the evaporation of water from the extensive surface like ocean. Subsequently, the moist air is lifted, it cools and the water vapour condenses to form clouds. The moisture is then transported in the atmosphere until it returns to the surface as precipitation. Once the water reaches the ground, some other processes take place and among these, one of the processes assists the water percolates into the ground to become groundwater. Groundwater can seep into lakes, streams, rivers, and the ocean, or be released back into the atmosphere through transpiration from vegetation (**Fig. 3**).

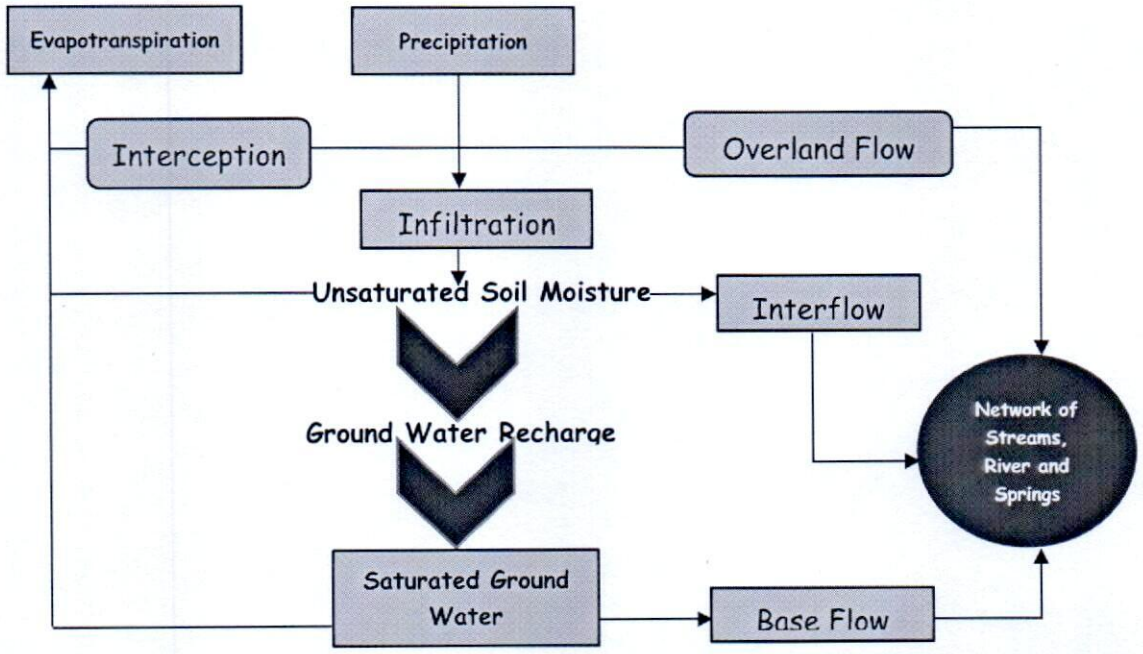


Fig. 3 Schematic diagram of the Hydrological Cycle

1.2.2 Groundwater

The water that fills the fractures, cracks, and pore spaces in soil, sand, rocks, and rock formations is commonly known as *groundwater*. In general, the oceans contain about 97% of the Earth's water, but this is not suitable for drinking, while about 2% is frozen at the poles or in glaciers; whereas, the Groundwater comprises less than 1% of the earth's water but around 98% of the available freshwater and of which, only a little portion of groundwater contributes to the springs discharge.

1.2.3 Groundwater in Rocks-Rock Types and Structure

Groundwater is contained within the openings in rocks, i.e., the pores and cracks. The size and shape (geometry) of the openings (the rock structure) determine the direction of flow and ease with which the groundwater can move. Groundwater moves slowly through the pore spaces that is governed on the basis of porosity and permeability of rocks. Porosity is a measure of the void spaces and is the fraction of the total volume of voids over total volume of rock expressed as a number between 0 and 1 or as a percentage; whereas, permeability describes the ability of the porous rock material to allow water to pass through it from one point to another under a hydraulic gradient. The porosity and permeability characteristics of different rock types determine the total volume of groundwater that they can hold.

The basic rock type in geology describes the long-term transitions across geologic time among the three main rock types e.g.; igneous, sedimentary, and metamorphic-as a result of formation, breakdown, and reformation. Each rock type is altered or morphed physically or chemically when forced out of its equilibrium conditions. Fundamentally, rocks are made up of different minerals each with a definite chemical composition and properties which govern the properties of the rocks and their weathering products. The chemical properties of rocks also play a big role in determining the chemistry of surface and groundwater. There are two types of rock structure; primary and secondary. Mostly, the primary structures develop during rock formation (e.g., columnar joints in basalts, cross bedding in sandstone), while, the secondary structures develop after rock formation in response to tectonic stresses (e.g., fractures, faults, folds). A variety of two - dimensional, or planar, structural features can be observed in the field including bedding lanes, joints, fractures, faults, cleavage, and foliation (repetitive layering) or schistosity. The attitude or trend of bedding planes and other planar features is expressed in terms of strike, dip direction, and dip amount (angle). Many springs, owe their genesis to structural features such as fractures, faults and other such structural planes. These fractures and faults serve as channels through which groundwater flows and finally emerges as from as suitable orifice in form of springs. At the same time, it is not uncommon to find local deposits (sediments) along the slopes and base of higher valleys. These deposits are satisfying all the need to form local aquifers and through springs. Thus, study of such geological elements like rock type, rock texture and structure, and strike and dip facilitate in understanding the aquifer systems that discharge groundwater through springs and thus in understanding the characteristics of the springs themselves.

1.2.4 Aquifers

Groundwater is stored and transmitted with the help of aquifers. Any saturated geological formation or rock formation which stores and transmits groundwater is called an aquifer. An aquifer should be considered as the basic unit for any study of groundwater or in any watershed development or recharge augmentation programme. Different rock types have substantially different porosities and permeability. Open pores gradually close with depth, so the base of the aquifer varies from place to place. In mountain regions such as the Himalayas, high relief and complex geological structures play a vital role in aquifer

formation. The complex interplay of rock types and structure in the Himalaya gives rise to diverse hydrogeological environments that often lie in close proximity to each other. Moreover, the groundwater setting in mountaneous area is a result of the interaction of rock types and structures leading to the development of various permutations and combinations in the porosity and permeability regimes that play the most viable role in configuration of aquifers. Specifically, in hilly terrains loss of aquifer continuity along mountain slopes or along fault and fracture planes, leads to the formation of springs and their discharge also vary considerably depending upon the constituting factors of rock formations. Further, variability in precipitation, altitudinal effects and aspects are all responsible for a variability of spring-water characteristics in such regions.

1.3 Characterisation of Springs

In plain areas, groundwater usually accessed by digging wells into the water-bearing aquifers but, in mountains, groundwater naturally discharges in form of springs, which occur where a water bearing layer (aquifer) intersects with a hill slope and groundwater seeps out. The spring water is part of the groundwater system, and only becomes *surface water* after flowing into a surface water body such as a stream or lake. Springs provide water to the mountain population for a wide range of uses and every spring is unique in terms of its type, catchment, recharge, and discharge. The occurrence of springs and its behavior depend on the aquifer and its properties, thus identifying and understanding aquifers is very important. Since there is great diversity in the physiography, the geology and structural setting of the region, the groundwater system in the Himalaya presents a complex picture. The extent of the aquifers, their geometry, their continuity and discontinuity, their hydrogeological properties, viz. storativity and transmissivity are all quite complex. The high degree of deformation of Himalayan rocks perhaps represents this complex but unique hydrogeological setting that results in a large number of springs in the Himalayan region. The abrupt termination of aquifer boundaries - both in terms of its hydrological and physical boundaries layers against impermeable ones along the mountain slopes and even at rock exposures in valley portions causes the aquifer to discharge groundwater as spring.

Springs can be classified in various ways, for example, on geology (location of discharge, bedrock, geological structure); geography (topography, location and source of discharge); magnitude of discharge; location, size, and flow path of aquifer; source of recharge water; permanence of flow, parameters of water chemistry, ecology that springs support and conservation priorities and human use. In general, springs are in a broader category can be classified on the basis their water availability and may be termed as perennial and seasonal springs. Simultaneously, a classification of springs is available on the basis of their discharge characteristics throughout the year. Although a comprehensive spring typological classification based on the underlying geology is widely used for the purposes of spring water management study in the hilly regions and it focuses on reviving springs that have deteriorated. In such classifications the springs are classified into five types as follows;

- **Depression springs** emerge at topographic lows where the water table intersects the ground surface.
- **Contact springs** mainly located at places where relatively permeable rocks overlie rocks of low permeability.
- **Fracture springs** occur as a result of permeable fracture zones appearing in low permeability rocks. Movement of groundwater is mainly through the fractures which tap both shallow and deep aquifers.
- **Fault springs** are found where groundwater at depth is forced up a fault to the fault opening by hydrostatic pressure.
- **Karst springs** occur where water flows through the cavities and openings in limestone that form as a result of dissolution of rock material and then emerges at the base of the limestone layer.

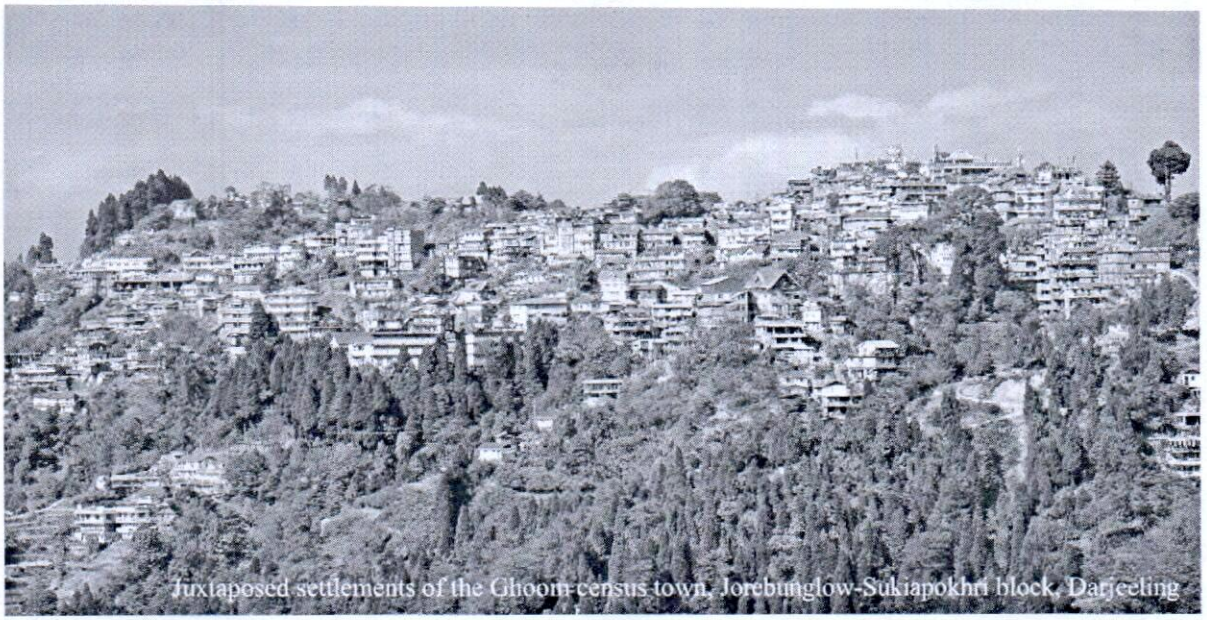
1.4 Role of Himalayan Springs in Climate Change Adaptation Measures

The ongoing changing temperature and rainfall trends and their variability are already impacting both the natural environments and the socio-economic systems. Further, such impacts are projected to only exacerbate under the future climate change making these systems highly vulnerable. According to the Intergovernmental Panel on Climate Change (IPCC), climate change is already occurring and impacting natural ecosystems and human societies (IPCC, 2014). The development push in the mountain ranges and a changing climate pose an ever-increasing threat to the physical stability of mountain systems. Owing to this discernible circumstance, the DHR of West Bengal has been identified as one of the most ecologically sensitive regions of West Bengal in State Action Plan on Climate Change (SAPCC)-West Bengal and considered as a special region due to its unique geo-environment and biodiversity (SAPCC, 2012). Conventionally, the Himalayan ecosystem is quite fragile, and therefore, susceptible to changes caused due to natural and anthropogenic factors. Along with the climate change concerns the seismic activity and ecological degradation associated with LULC change, especially for infrastructure development are putting intense pressures on mountain aquifer systems and a continuing crisis of spring-water depletion. Consequently, this phenomenon affects lives of millions of people in the mountains-both resident and visitors. Results of the sector specific vulnerability are considered to be very important here, as it identifies where the measures need to adapt against climate change impacts relating to water issues. It enables practitioners and decision makers to identify the most vulnerable areas, sectors and social groups, to develop targeted climate change adaptation options for specific contexts. Besides, the assessment of vulnerability generates comparable outcomes that may emphasized on water shortage scenario across the entire IHR, and it demands management techniques that will helps to built resilience to climate change.

In the past, most water conservation programmes in the IHR were based on the concept of watershed. Watersheds are easy to demarcate and hold great appeal for policy makers and implementers alike. However, the watershed concept only accounts for surface water movement over slopes, while movement of spring water which is groundwater. Thus, the concept of watershed cannot account for water which travels outside watershed boundaries, through rock beds that slope towards an adjoining watershed and hereafter, to overcome this limitation in the mountainous region the *Springshed Management* might be the best practice. The term springshed management is a comprehensive term encompassing all aspects related to sourcing, distribution, maintenance, and management of spring water systems. Practically the concept of springshed management is management of the area of recharge of springs, down to the area of discharge, is now getting increasingly well-ingrained in the form of pilots of varying scales across the Himalayan states, and more recently in Bhutan and Nepal. In recent years, there has been an upsurge of studies and initiatives to address spring management in India, given the seriousness of the emerging crises around springs. These have been mostly community-centric initiatives that have looked at distribution rather than regeneration, although they have helped in mitigating the rural water crises to some extent. The first systematic springshed management initiative was undertaken through the Dhara Vikas Programme by the Rural Management and Development Department, Government of Sikkim, and was subsequently undertaken across states like Himachal Pradesh, Nagaland and Uttarakhand. Basically, the concept of springshed management fundamentally entails that recharge areas be correctly identified through the use of simple field-based hydrogeology and community knowledge and appropriate recharge measures are then undertaken to recharge springs. For spring revival, the appropriate unit is the springshed-the unit of land where rain falls (recharge area), and then emerges at discharge point, the spring. In the given folded and faulted nature of Himalayan geology, springsheds often cover more than one watershed; in other words, the recharge area of a spring in one watershed, may as well lie in an adjoining watershed and spring revival programmes have to be cognizant of this. This calls for a paradigm shift from watershed to springshed as an appropriate unit of intervention in the IHR.

Chapter 2

Scenario of the Available Springs in the DHR Context



Juxtaposed settlements of the Ghoom census town, Jorebunglow-Sukiapokhri block, Darjeeling

2.1 Contemporary Status of the Springs

Mountain springs are the origin of water especially for the rural households in the DHR. In addition, for many people, springs are the sole source of water as exemplified, a major proportion the villages in the DHR use spring water for drinking, irrigation and livestock. Despite the key role that springs play, they have not received proper attention and many are drying up. Spring discharge is reported to be declining due to increased water demand accompanied by LULC change and ecological degradation. With climate change adversities e.g., rising temperatures, increase in rainfall intensity, shorter temporal span, and a marked decline in winter rain etc. the problem of dying springs is being prevalently felt across the Darjeeling Himalayan extent of West Bengal. Besides, the water quality of springs is also deteriorating due to dynamic human interventions and improper sanitation. Thus, in such unavoidable circumstances it an utmost need to adopt a measure which can combat with this inevitable phenomenon and for this water management using springshed will be the best practice.

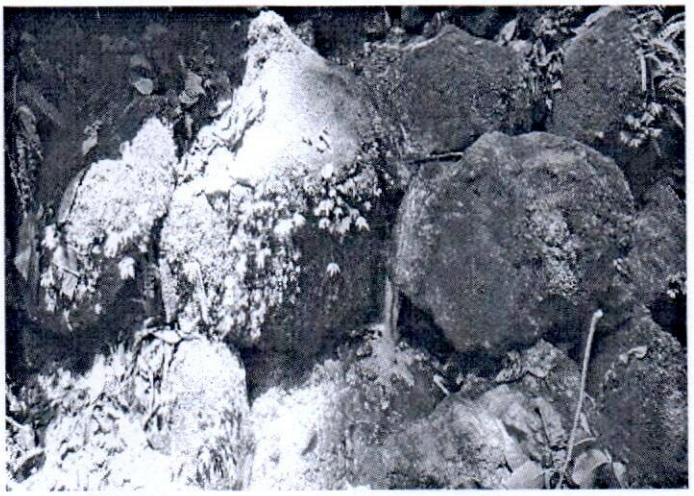


Photo plate 1 Water coming out from a perennial spring in Sittong village, Kurseong block, Darjeeling district

Table 1 Administrative setup of the hilly DHR and block level distribution of springs. Source: http://www.spring-management.info/

Name of the District	Name of the Community Development (C.D) Block	No. of Gram Panchayat (GP)	No. of Villages/Census Towns/ Municipality	No. of Springs
Darjeeling	Darjeeling Pulbazar	24	48	134
	Rangli Rangliot	12	30	51
	Jorebunglow Sukiapokhri	16	46	79
	Kurseong	15	71	100
	Mirik	7	22	17
Kalimpong	Kalimpong I	18	52	126
	Kalimpong II	13	39	71
	Gorubathan	11	38	38

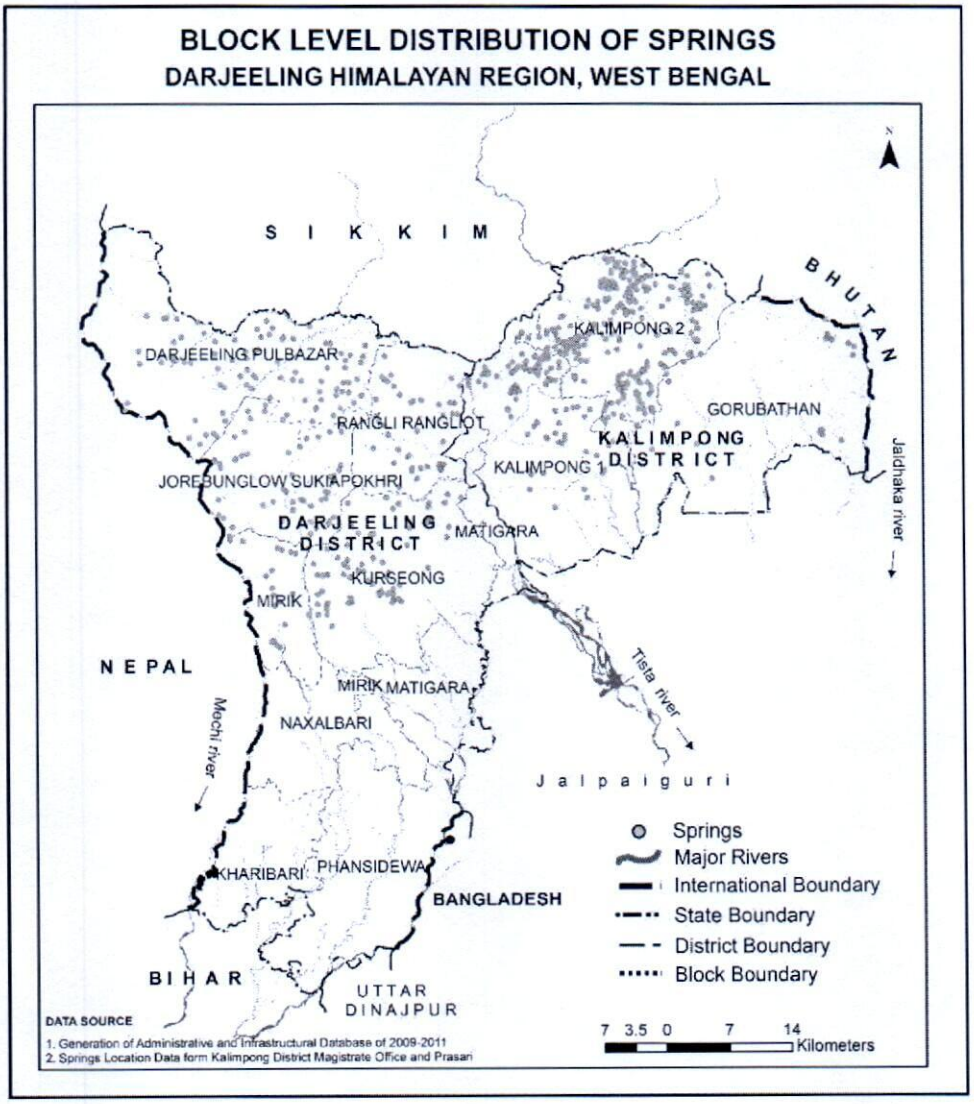


Fig. 4 Block level distribution of springs, DHR, West Bengal

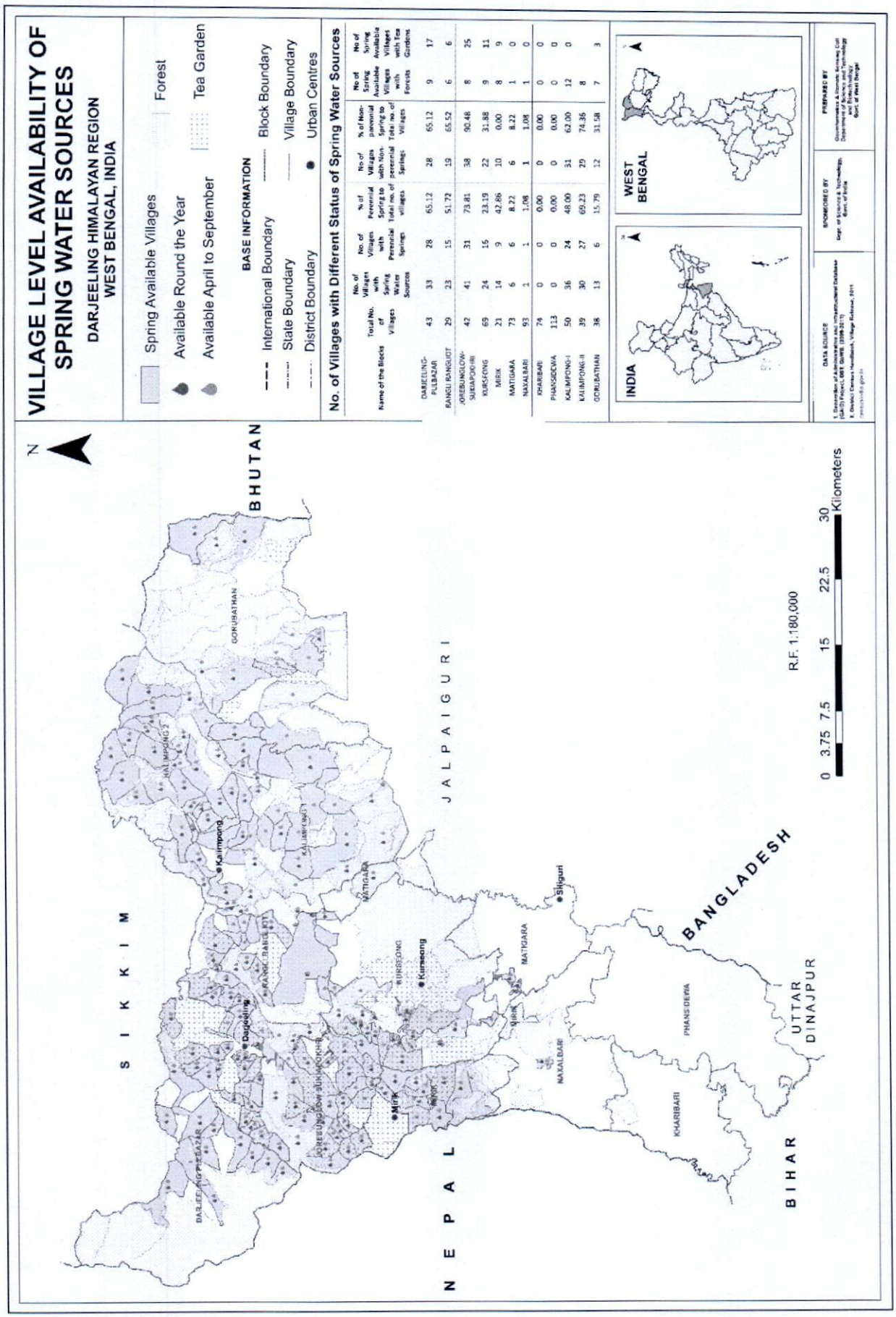


Fig. 5 Village level availability of spring water sources, DHR, West Bengal

2.2 Regional Setup of the Darjeeling Himalaya

Climate change is an inescapable reality and has to be tackled on a war-footing and here, the springshed approach, which combines landscape, watershed and aquifer management may be considered as one of the novel climate change adaptation strategies for the DHR. With this in mind, the physical settings of the concerned Himalayan part offer an insight to know its diversity. The physiography, geology and structural setting of the mountains exhibit great variation. Moreover, in the hills the heterogeneousness regional characteristics on lithological diversity, geomorphological variety, drainage density, forest type differences, elevation changes, pedological variability create a multifariousness in the regional settings. The combination of lithology and geomorphology influences the local terrain as well as climatic characteristics and impacts in the micro-level land use planning too. Though, the primary rock strata along with the structural control of lithology on the fluvial characteristics influence consequent landform formation, but in most cases the topography and its underlying geology are often incongruent. In view of the above, the so-called approaches of watershed management which mainly focus on engineering structures to reduce runoff considering surface hydrology (ridge to valley) and not accounting for subsurface hydrogeological conditions that governs spring behavior might not be adequate. Hence, with higher visible impact that improves water availability (spring discharge), warranting a fresh approach by integrating the science of groundwater with other disciplines, people's participation and decentralized water governance the water management approach can be acquaint with the springshed management technique.

2.2.1 Climate

Darjeeling has a subtropical highland climate with wet summers caused by monsoon rains. The mean annual maximum temperature is 14.9°C (58.8°F) while the mean minimum temperature is 8.9°C (48.0 °F) with monthly mean temperatures ranging from 6°C to 18°C (43°F to 64°F). The lowest temperature recorded was -5 °C (23°F) on 11 February 1905. The average annual precipitation is 309.2 cm (121.7 inch) and the DHR receives an average of 126 days of rain in a year. The highest rainfall occurs in July. Though, observations from

Table 2 Normal monthly average rainfall and percentage departure of rainfall from the normal in Darjeeling district for the recent. Source: https://mausam.imd.gov.in/

Months	Normal monthly average rainfall (mm)	% Departure of rainfall
January	6.5	-87
February	3.0	-91
March	46.3	-20
April	34.0	-74
May	191.4	-27
June	727.9	36
July	1168.3	54
August	310.9	-52
September	535.0	6
October	306.2	157
November	0.0	-100
December	0.0	-100

the SAPCC-WB 2017 and 2020 suggests that in the Darjeeling Himalayan belt the maximum and minimum temperatures are projected to rise at different rates, which means the climate shall become warmer and diurnal differences shall reduce. The evapotranspiration rate shall also increase in warmer weather. Hereafter, the hills of the West Bengal is expected to receive less water from precipitation, alongside the rain is likely to reduce in the summer and monsoon months.

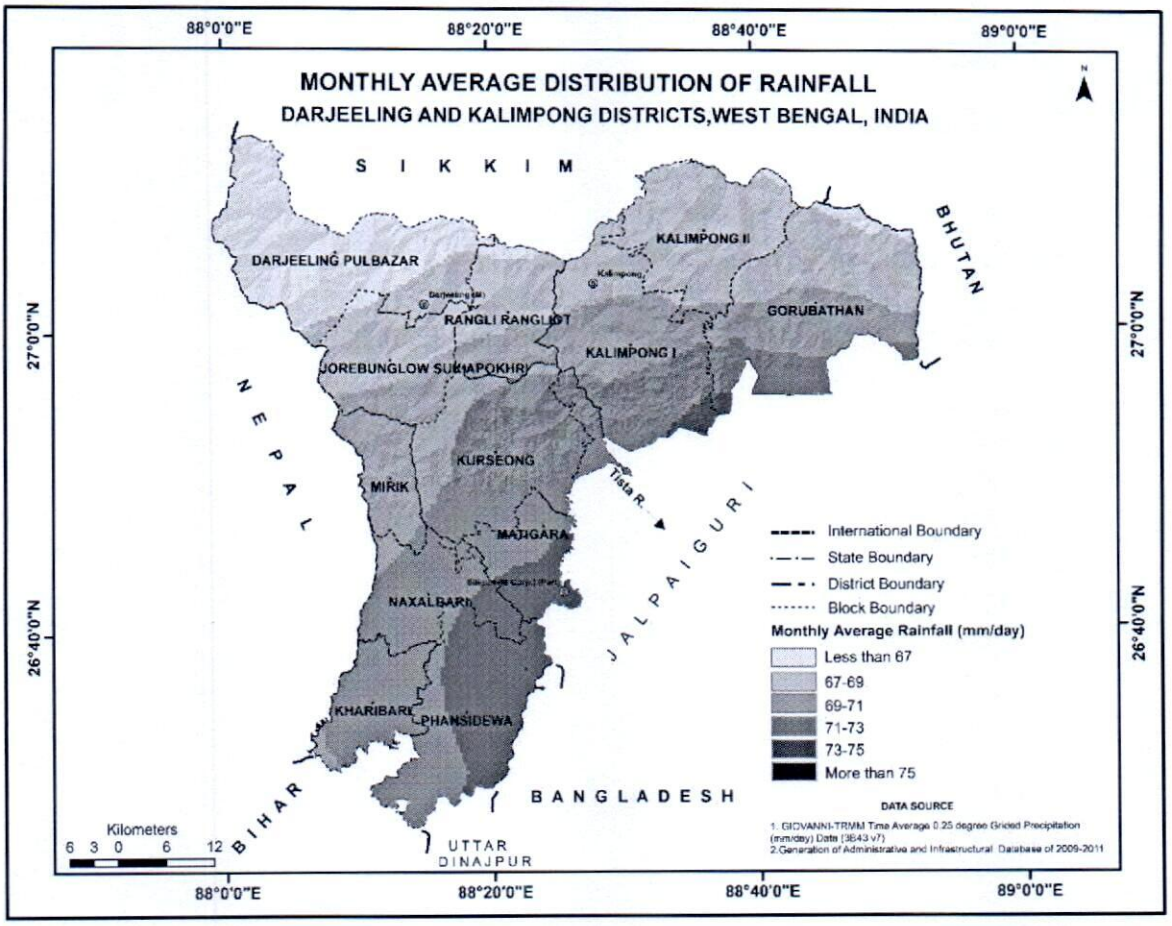


Fig. 6 Monthly average rainfall (mm/day) distribution of rainfall, DHR, West Bengal

Basically, the spring flow both in rainy and non-rainy season is found affected mostly by the quantity of annual rainfall. But, the recession of seasonal springs is much more rapid than the perennial ones and as the springs are a significant component of the ecosystem, drying of spring can result in an environmental crisis such as soil moisture loss, loss of indigenous flora and fauna and human migration. In the DHR, spring discharge was found to follow a linear response to cumulative rainfall during June to September (monsoon months) and January to February (winter rainfall months) and nonlinear response from September to January and February to May (dry months altogether). Moreover, the immediate and sensitive response of spring flow to rainfall indicates that in the concerned region recharge of aquifers is primarily dependent on rainfall and its characteristics.

2.2.2 Geology and Geomorphology

The DHR can be subdivided laterally from south to north as; (a) the sub-Himalaya or the Siwalik belt composed of upper Tertiary Siwalik sediments (b) the lower or lesser Himalayas composed of Gondwanas, lower Tertiaries and Achaean rocks along with some intrusive and (c) the higher Himalayas, composed of intrusive Tertiary Granites and other igneous and metamorphic rocks. The lower Himalayan cratonic rocks and the higher Himalayan geosyncline sediments are roughly separated by the Main Central Thrust (MCT). The upper Tertiary Siwalik rocks are again separated from the Lower and Pre-Tertiary rocks to the north by another fault called the Main Boundary Fault/Thrust (MBF/T). Besides MBT and MCT, many other faults and thrusts have sculpted the structure of the Himalayas and caused the reversal of stratigraphy in the present area. The Central Crystalline Gneissic Complex is covering about 28% area followed by the Daling group which is the most vulnerable litho-unit covers almost 16% area in this region (**Table 3**) (**Fig. 7A**). The hydrological significance of such a wide variety of rocks that are present in the DHR can be understand through the interplay of primary and secondary openings which determine the accumulation as well as movement of groundwater. Weathering, jointing, fracturing, faulting and folding are all present in this region and together contributing to the local as well as regional variabilities in porosity and permeability. The geometry of openings and their interrelationship with the topography decide the storage and transmission of groundwater. Among them, vertical, horizontal and inclined discontinuities are common depending upon the dip and strike of openings that are dominantly a consequence of bedding planes, foliation and fractures and the complex geometry of these openings give rise to a variety of groundwater conditions that in turn result in spring-water systems.

Table 3 Lithological formation details and respective area coverage within the DHR, West Bengal

Geological formations	Area in sq. km.	Area in percentage (%)
River and its channel deposit (rcD)	104.809	3.33
Malda/Jalpaiguri/Ganga-Koshi formation (mjgkF)	374.294	11.89
Shaugaon formation (sF)	223.712	7.11
Chalsa/Matiali/Thaljhora/Samsing formation (cmtsF)	286.222	9.09
Siwaliks (SwlikG)	290.178	9.22
Gondowana super group (GondSG)	114.628	3.64
Daling group (Gorubathan formation) (DGgF)	501.303	15.93
Daling group (Reyang formation) (DGrF)	360.843	11.46
Central crystalline gneissic complex (ccgC)	891.641	28.33

Photo plate 2 Mountainous and foothill landscape as viewed in a single scene from Rohini tea garden, Kurseong block, Darjeeling district

The Darjeeling Himalaya is a source for numerous rivers which are attribute towards developing a great variety of topographical as well as geomorphologic units. The extreme northern part is generally composed of only one type of geomorphology i.e., the structural hill, formed with the central Himalayan metamorphosed rock strata, while a high degree of average slope and Himalayan ridges constitute the major geomorphological sub-units and are identified with dense vegetation cover. The north-eastern along with north-western parts, are moderately dissected by fluvial activity due to its composition with hard crystalline rock strata with a predominance of the granitoid and granitic niece. Other parts are highly dissected where the relative relief ranges between 3000 to 1500 metres and being composed of disintegrated-erodible sedimentary components like phyllite, Schist etc. in turn act as the primary material of Daling group's Gorubathan and Reyang formation and sandstone, shale, conglomerate of the Gondwana and Siwalik formation respectively. Underneath the hills, the foothills are composed of older piedmont alluvium of Chalsa-Matiali formation with the dominance of gravel. Besides in the extreme lower part, catchments of the bigger rivers are identified with abandoned channels, oxbow lakes, meanders and the underlying geology in this region is made up with Shaugaon formation with sand and silt (**Fig. 7B**). The geomorphic setting of the region is perhaps a complex one, but still, it gives rise to a large number of springs. The abrupt termination of aquifer boundaries-both in terms of its hydrological (water tables) and physical boundaries (termination of permeable layers against impermeable ones) along the mountain slopes and even at rock exposures in valley portions causes the aquifer to discharge groundwater in the form of springs. Many springs, therefore, owe their genesis to structural features such as fractures, faults and other such structural planes. These fractures and faults serve as channels through which groundwater flows and finally emerges from a suitable orifice in form of springs. At the same time, it is not uncommon to find local deposits along slopes and at the base of higher valleys. These deposits are porous and permeable enough to form local but strategic aquifers that discharge groundwater too.

2.2.3 Drainage and Terrain Attributes

The IHR having extensive coverage of cryosphere and its immense orographic rainfall is acting as a hub for largest perennial rivers of the Asian sub-continent. In purview of this idea Darjeeling Himalaya is no exception to it, the DHR having Teesta as the major snow-fed river in the Brahmaputra system and Mahananda as the major rain-fed river in the Ganges system. The hills of the DHR have been divided into two parts by the Teesta of which 3 major sub-catchments i.e., Teesta, Jaldhaka and Mahananda can be further divided into 7 major watersheds and more than 500 micro-watersheds following the hierarchy. The drainage density (DD) of the DHR shows a diverse characteristic as the values range from 0 to 47.3 sq.km (**Fig. 8A**). The DD maps shows maximum density in the north-western part which is composed of Central Crystalline rock group with the dominance of Gneissic Granite and Granitoid Gneiss whereas the foothill region or the Terai part shows the lowest density for the dominance of alluvium triggering to higher infiltration rate. About 95% area of the DHR having a DD of medium to high category and rest 5% lies in the very high-density zone. As in other Himalayan mountains, rain-fed streams originating from forested mountain slopes act as the main source of water for the mountain springs in the DHR. Thus, spring depletion in the mountains must be viewed not only through the lens of depleting stocks of groundwater, similarly it can be observed by giving importance for rejuvenation of all the primary order streams/jhoras- micro watershed management practices in the hills because springs have provided water to the mountain communities for centuries.

Photo plate 3 The Tessta river flowing through Riyong forest, Kalimpong I block, Kalimpong district

Cognition of the terrain specifically in the mountainous region assists in the perception development of catchment areas, drainage characteristics, groundwater flow, and water quality. Likewise, the weather pattern is significantly governed by terrain characteristics; geographically contiguous areas may differ in precipitation due to different orographic characterization. The array of relief statistics of the DHR identifies consecutive relief classes; i.e., area <300m (30.97% area to the total area of the DHR) is known as Terai-the foothill region. Actual Himalaya starts uprising towards north from 300m. The area between 300m-900 m (24.47% area) is highly dissected while relief range from 900m-1500m (21.26% area) represents mainly steep down cutting river valleys, spurs, escarpments where active headward erosion by streams take place. 1500m to 2100m range of relief follows main ridges of the region forming steep slope escarpment with moderate dissection and it covers

14.15% area, range covering 2100m - 2700m contains only 6.14% area where narrow areal distribution is mainly associated with the top of the main ridges of the region, located in the central part of Darjeeling district. Relief >2700m with coverage of only 3.01% to total area represents the highest altitude marking ridge tops with low to moderate dissection (**Fig. 8B**).

2.2.4 Soil and Natural Vegetation

The up-slope (25°- 45° slope) in the DHR are highly vulnerable to the processes of mass wasting and soil erosion. It is well-known fact that the degradation of forests and their conversion into degraded land contributed to reducing ground water recharge and resultant decreased water generating capacity of soil in several parts of Himalaya. Fundamentally, the soils of the DHR have been developed depending upon the underlying geological structure and fluvial action. The basic soil types in the DHR are yellow soils, red brown soils and brown forest soils. All the soils are predominantly acidic in nature with a tendency to increase slightly in depth indicating the lack of bases from surface and accumulation in lower horizons. **Table 4** shows the soil textural information along with their unique characteristics which are an essential consideration for analysing pedological diversity of the region (**Fig. 9A**).

Table 4 Pedological details (textural classes, characteristics, and description) of the DHR, West Bengal

Soil Textural Classes	Characteristics and Description
Lithic Udorthents	Shallow, excessively drained, gravelly loamy soils occurring on very steep side slopes with gravelly loamy surface and severely eroded.
Typic Udorthents	Moderately shallow, excessively drained, coarse loamy soils occurring on steep side slopes, gravelly loamy surface with severe erosion and strong rockiness.
Umbric Dystrocherpts	Deep, well drained, fine loamy soils occurring on steep side slopes with gravelly loamy surface with moderate erosion and moderate rockiness.
Typic Haplumbrepts	Moderately shallow, well drained, gravelly loamy soils occurring on steep side slopes, gravelly loamy surface with moderate erosion and moderate rockiness.
Fluverntic Dystrochrepts	Moderately shallow, somewhat excessively drained, coarse loamy soils on gently sloping side slopes, gravely loamy surface with moderate erosion and slight rockiness.
Umbric Dystrocherpts	Very deep, imperfectly drained, coarse loamy soils occurring on very gently sloping upper piedmont plains with loamy surface and moderate erosion.
Fluventic Eutrocherpts	Very deep, imperfectly drained, fine loamy soils occurring on very gently sloping lower piedmont plain with loamy surface and moderate erosion.
Typic Fluvaquents	Very deep, poorly drained, coarse loamy soils occurring on level to nearly level lower piedmont plain with loamy surface.
Fluventic Eutrocherpts	Very deep, imperfectly drained, coarse loamy soils occurring on nearly level lower piedmont plain with loamy surface.
Typic Ustochrepts	Very deep, imperfectly drained, fine loamy soils occurring on level to nearly level recent alluvial plain with loamy surface.

Table 5 Forest status details with area statistics

Forest status	Area in sq. km.	Area in percentage (%)
Reserved Forest	1063.473	63.805
Protected Forest	46.966	2.187
Forest (outside notified area)	170.129	10.227
Tree Clad	386.279	23.781

Elevation in addition with the climate, soil, topography are the main factors that determine the type of forests. Forests are classified according to their nature and composition, the type of climate where they thrive. The varying relief, end product of elevation differences largely controls the soil development process impacted the natural vegetation distribution. The forest cover in the DHR is about 1666.847 sq.km. and it includes 2 national parks i.e., Singalila and Neora valley national parks as well as 2 wildlife sanctuaries i.e., Senchal and Mahananda wildlife sanctuaries along with a total of 95 reserve forests, 2 protected forests (**Table 5**). The major portions of the forests are found at the elevations of 1000m and above. The five major forest types according to the elevational variation found in the region are; (a) Tropical Moist Deciduous Forest (300 m-1000 m), (b) Tropical Evergreen Lower Montane Forest (1000 m-2000 m), (c) Tropical Evergreen Upper Montane Forest (2000m-3000m), (d) Temperate Forest (3000 m-3500 m) and (e) Sub Temperate Forest (above 3500 m), out these most of the area covered by Tropical Evergreen Lower Montane Forest (**Fig. 9B**). Protection and proper management of this natural resource is essential to maintain water quality and quantity especially for the period when its availability is less. Traditionally, forested catchments supply a high proportion of the water for domestic, agricultural and ecological needs in both upstream and downstream areas. Nowadays, a key challenge faced by land, forest and water managers is to maximize the wide range of multi-sectoral forest benefits without detriment to water resources and ecosystem function. It is basically based on the principles of maintaining high water quality that forests make their most significant contribution to the hydrological characteristics of watershed, ecosystems and this can be achieved through minimization of soil erosion, reduction of sediment in water bodies (lakes, streams, rivers) and trapping or filtering of other water pollutants. On sloping land natural forest cover provides the most effective barrier to splash-induced soil erosion, largely because of the contribution of the lower canopy leaves and the ground litter in reducing the force of splashing. Therefore, forest removal and replacement with other land use systems leads in most cases to higher and accelerated erosion and crunch in water availability significantly in the hills.

2.2 Landuse/landcover

The land use practices play the most important role in determining the uninterrupted flows of spring water in the mountaneous tracts. The LULC map of the DHR exhibits that differential LULC categories, especially the anthropogenic practice e.g., agricultural activities, tea and medicinal plant plantations, built-up areas along with natural land cover features like forests, rivers, jhoras etc. are all integrate together in a harmony. But the main problem in respect of the present land use in the Darjeeling hill

areas is related to high density of population and as consequences of it, Khasmahals or government estates are severely affected by extensive deforestation, tremendous agricultural pressure and over-grazing. These changes certainly leads to the result as the precipitated water goes down the deforested slopes causing soil erosion and sliding. Alterations in land use in the hills simultaneously modify the hydrological response and may produce negative impact in the form of increasing water resource problems-drying-up springs. The present LULC map that has been prepared under the NMSHE project similarly confirms likely vestiges of LULC dynamics and in probable circumstances, a micro-scale LULC planning is essential to control and design the land use, land reclamation and the built-up environment, including water, and the infrastructure crisscrossing into and out of the DHR (**Fig. 10**) (**Table 6**).

Table 6 Detail (Level I, II and III) description of LULC classes and area coverage

LULC (Level I)	LULC (Level II)	LULC (Level III)	Area in Ha
Agricultural land	Agricultural Plantation	Agricultural Plantation (other than Tea)	4690.949
Agricultural land	Cropland	Double Crop	12632.557
Agricultural land	Agricultural Practices	Pisciculture/Aquaculture	1.223
Agricultural land	Cropland	Single Crop	34957.043
Agricultural land	Agricultural Plantation	Tea Garden	56416.762
Built Up	Built Up (Urban)	Core Urban	3021.881
Built Up	Built Up (Rural)	Hamlets with Dispersed Households	4.185
Built Up	Mining/Industrial	Mining or Industrial	245.522
Built Up	Built Up (Urban)	Mixed Settlement (Urban)	6024.465
Built Up	Built Up (Rural)	Mixed Settlement (Rural)	20313.863
Forest	Forest	Forest	27129.285
Forest	Forest	Protected Forest	4297.720
Forest	Forest	Reserve Forest	105322.180
Forest	Forest	Tree Clad	25425.488
Wasteland	Wasteland	Barren Rocky	765.413
Wasteland	Wasteland	Grassland/Grazingland	3522.668
Wasteland	Wasteland	Scrubland Dense	101.120
Wasteland	Wasteland	Scrubland Open	1174.853
Wasteland	Wasteland	Waterlogged	407.987
Wasteland	Wasteland	Sandy Area	38.418
Water Bodies	Lake/Ponds	Lakes/Ponds	204.588
Water Bodies	Canal	Canal	127.825
Water Bodies	Tank/Reservoir	Reservoir	1.257
Water Bodies	River/Stream/Drain	River	2895.748
Water Bodies	River Channel Deposits	Sand Bar	5028.282

2.3 Socio-Economic Background

The DHR with its unique strategic location poses a very important position not only in socio-economic canvas but equally or more significantly in the defence strategist planning due to its proximity to four international borders of Nepal, Bhutan, Bangladesh and China as well it is the only territorial extension that likely to serve to the north-eastern states. The total population of this sensitive region increasing continuously maintaining a higher decadal growth rate i.e., 14.47% in-between 2001-2011. This phenomenal growth of population since 1872 is due to two main causes, the development of the tea industry and the influx of settlers to exploit the waste lands of these two Himalayan districts. Apart from the refuges influx from Bangladesh and adjoining states, after partition the consequence is exploding more intensely as the growth centre of the DHR expand in all quarters. In addition, there are massive incursion from adjacent Nepal, Bhutan of which a major portion belongs to the tribal community such as Lepchas, Khampas, Nepalese, Gurungs, Thapas, Gorkhas. The City Development Plan of Siliguri (2015) elucidates that in Darjeeling district, the urbanization rate was 17.24% in 1971 which went higher to 20.01% in 2001. Not a single urban area in the eastern Himalayas does not have such a steady growth in terms of the level of urbanization which marked the Darjeeling district become most urbanized i.e., 47% in the year 2011 in which Siliguri has a crucial contribution (**Fig. 11**).

2.3.1 Demography and Health

Population is one of the prime demographic factors that contributes towards land use changes. Increased population bring various consequences such as higher labour availability, greater employment and logistic demand. Also, in the DHR the population pressure with varying degree of population density has been identified as one of the significant factors for expansion of settlement areas. It is noteworthy to mention that despite increasing population burden and urbanization of places, the agricultural sector remains dominant in the concerned area. Agriculture remains the top contributor to the labour pool with the largest livelihood group. The literacy rate in both the districts of the DHR is nearly 60 percent where the birth and date rate are less than 3 percent per annum. The mountains of this region is the source of resources for the population residing in the hills as well as in the foothills, though the impact of environmental degradation is quite extensive, mostly influenced by human interventions and particularly applied to events like the extraction of timber and other forest produces, mining and agriculture. These activities in the wake of climate change will leave deep impression on the hill ecosystem, disrupting its normal functioning. Specifically, due to the unprecedented growth of populace during the last few decades in the hill areas of the DHR, the nature has started reacting sharply to the accumulated human guilt. Thus, existing relationship between the contemporary LULC dynamics and water resource is increasingly complicated due to natural variability of water availability with general reported effects of unplanned settlement distribution in the hills have been resulting in the per capita water crisis, reduced water quality and water pollution.

Table 7 Demographic information of the DHR, West Bengal. Source

District	Sub-Division	Block	Total Geographical Area (sq.km)	Number of Villages	Total Popu	Popu Density (person/ sq.km)	Sex Ratio (Females /1000 Male)
Darjeeling	Darjeeling Sadar	Darjeeling - Pulbazar	419.60	47	245740	586	998
		Rangli - Rangliot	174.85	30	70125	401	1002
		Jorebunglow-Sukhiapokhari	209.62	46	231644	538	1018
	Kurseong	Kurseong	334.17	70	135535	406	998
	Mirik	Mirik	119.58	21	57887	479	990
	Siliguri	Matigara	166.19	80	1081583	2959	947
		Naxalbari	178.24	99	165523	929	946
		Kharibari	144.31	76	204811	757	971
		Phansidewa	308.85	113	109594	662	962
Kalimpong	Kalimpong	Kalimpong I	371.38	51	124149	334	975
		Kalimpong II	276.30	39	66830	241	934
		Gorubathan	444.55	38	60663	136	953

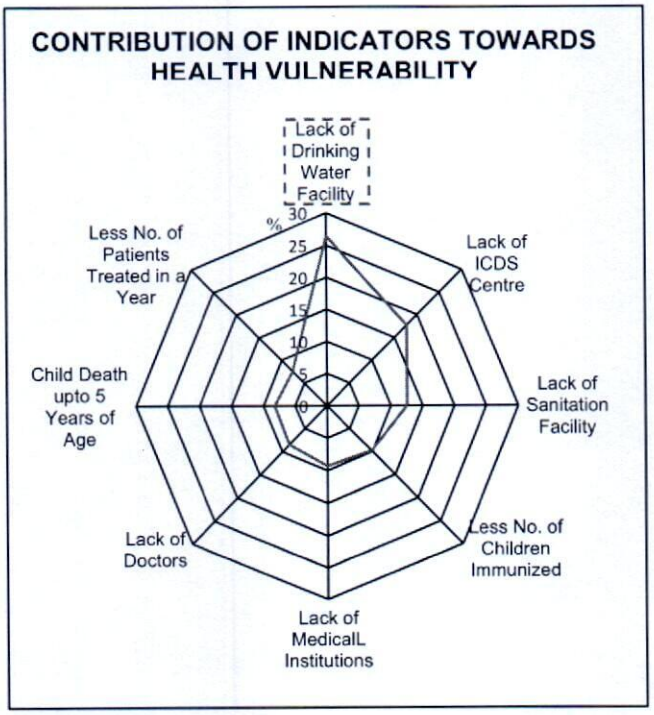


Fig. 12 District level contribution to Health Vulnerability, DHR, West Bengal

A healthy population is the primary condition for the development of a society which has a capacity to cope up with the changing climate conditions. Safe drinking water, an open defection free environment, immunization at birth, balanced diet etc. are the key conditions for staying healthy. With the present trend of population explosion and further the increasing push for development and a changing climate pose threats to the stability of environmental systems and make natural resources such as groundwater constantly susceptible to such changes. While the major concerns may seem purely ecological, the protection and management of natural resources are strongly related to

forestry, water and other sectors. The environmental security of the population is strongly dependent on these essential resources for livelihoods. As a matter of fact, spring depletion has not only affected people but has also had serious impact on wildlife. Depletion has led to water insecurity inside forests and national parks and on their fringes as well. The problem, therefore, transcends the entire spectrum of dependents and dependencies, rural and urban to forests and wildlife. As the earlier Block Level Health Sectoral Vulnerability Assessment (Tier-I) that has been conducted under the NMSHE project conveying the same, outcomes of the study pointing towards lack of drinking water facility in the DHR (**Fig. 12**). Among the eight selected indicators the No. of Drinking Water Sources Available to per 10000 households (HH) contributes more in the Health Vulnerability Index and making the blocks relatively vulnerable than others where the population pressure is high.

2.3.2 Settlement Distribution

In recent years, there has been an upsurge of studies and initiatives to address spring management in India, given the seriousness of the emerging crises around springs. These have been mostly community-centric initiatives that have looked at distribution rather than regeneration, although they have helped in mitigating the rural water crises to a large extent. Thus, the concept of springshed management is now getting increasingly well-ingrained in the form of pilots of varying scales across the DHR. There are over 600 villages in the DHR along with the growing urban centres combinely increase the stress on water resources (**Fig. 13A, 14 & 15**). Many growing urban centres e.g. municipalities and census towns are till date depend on springs and with the expansion of tourism there is an increasing gap between water demand and availability. Additionally, it is believed that nearly half of the perennial springs have already become seasonal and people of the villages are currently facing acute water shortage for drinking and other domestic purposes. It was observed by the natives that closely more than half of low discharge springs that provided water to small habitations in the DHR have reported clear decline during the last couple of decades. Depletion of spring water, unfortunately, has led to the development of many unsustainable and impractical alternatives. People resort to immediate coping mechanisms like transporting water using pack animals, motorcycles and tankers especially during the lean season. The drudgery of women is particularly worth mentioning here; when village springs run dry, women are forced to manually carry water from springs below their village during the lean season.

Photo plate 4 Hard work of women for water collection in the lean period, Darjeeling municipality, Darjeeling district

In effect, the cost of inaction is mainly borne by rural mountain women who are already overburdened with firewood and fodder collection, household chores and as caregivers to the family and livestock. The alternatives to resolve the crises, through public investments, are not always effective. For instance, the proliferation of multi-village larger water supply schemes from springs/streams higher up in the mountain range will progressively become difficult to operate as springs dry up as a consequence of changing climate, LULC dynamics.

2.4 Transport and Communication

Photo plate 5 Transportation of the required water at places through major roads, Mirik municipality, Darjeeling district

During the early times of the British occupation in the DHR, the population grew steadily up, and it actively helped to develop crisscrossed transport networks over the region. Likewise, in respect to the people and resource mobility, the road construction has equally given importance to connecting places over the area. Though the widespread road network eases the communication mechanism, it certainly alters the terrain characteristics, as slope modification at the toe of a slope, which compromises the continuity of water flow and reduces the ability of the slope to drain, in turn reducing its stability and aquifer discharge. The Darjeeling and Kalimpong districts are well connected by National Highway (NH) 10 and 31 whereas the State Highway (SH) 12 encircling the region (**Fig. 13B**). In the DHR, rural roads play a crucial role; with a total length of 4332.081 km, it serves as the only way of transportation of the required water at remote places of the hills. In these unfortunate circumstances, proximity assessment of springs from major metalled roads i.e., NH, SH and district roads and settlements, may offer better visions for proper water management along the major road corridors.

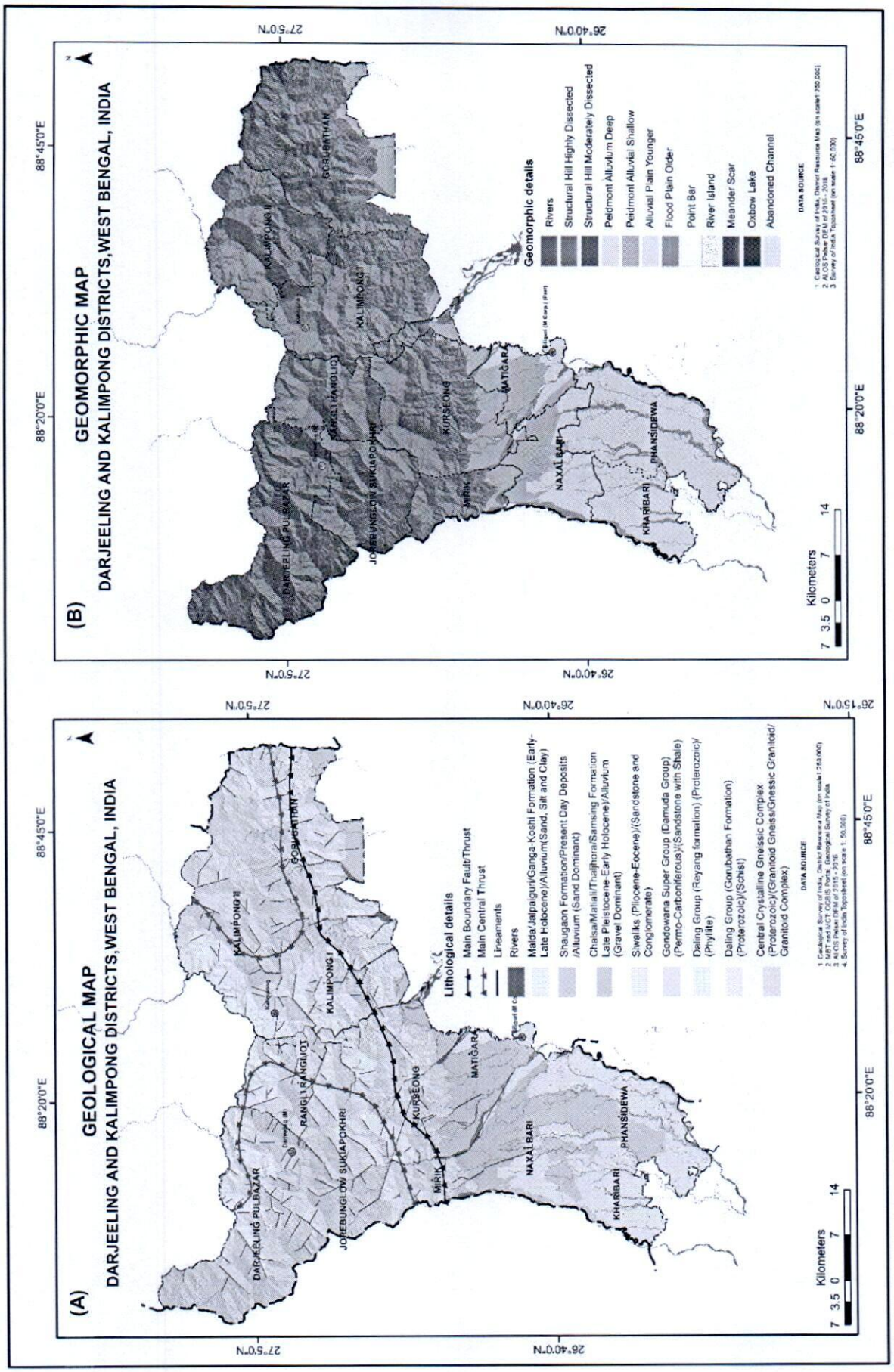


Fig. 7A Geological map showing lithological details with structural information and **7B** Geomorphic map showing geomorphic settings of the DHR, West Bengal

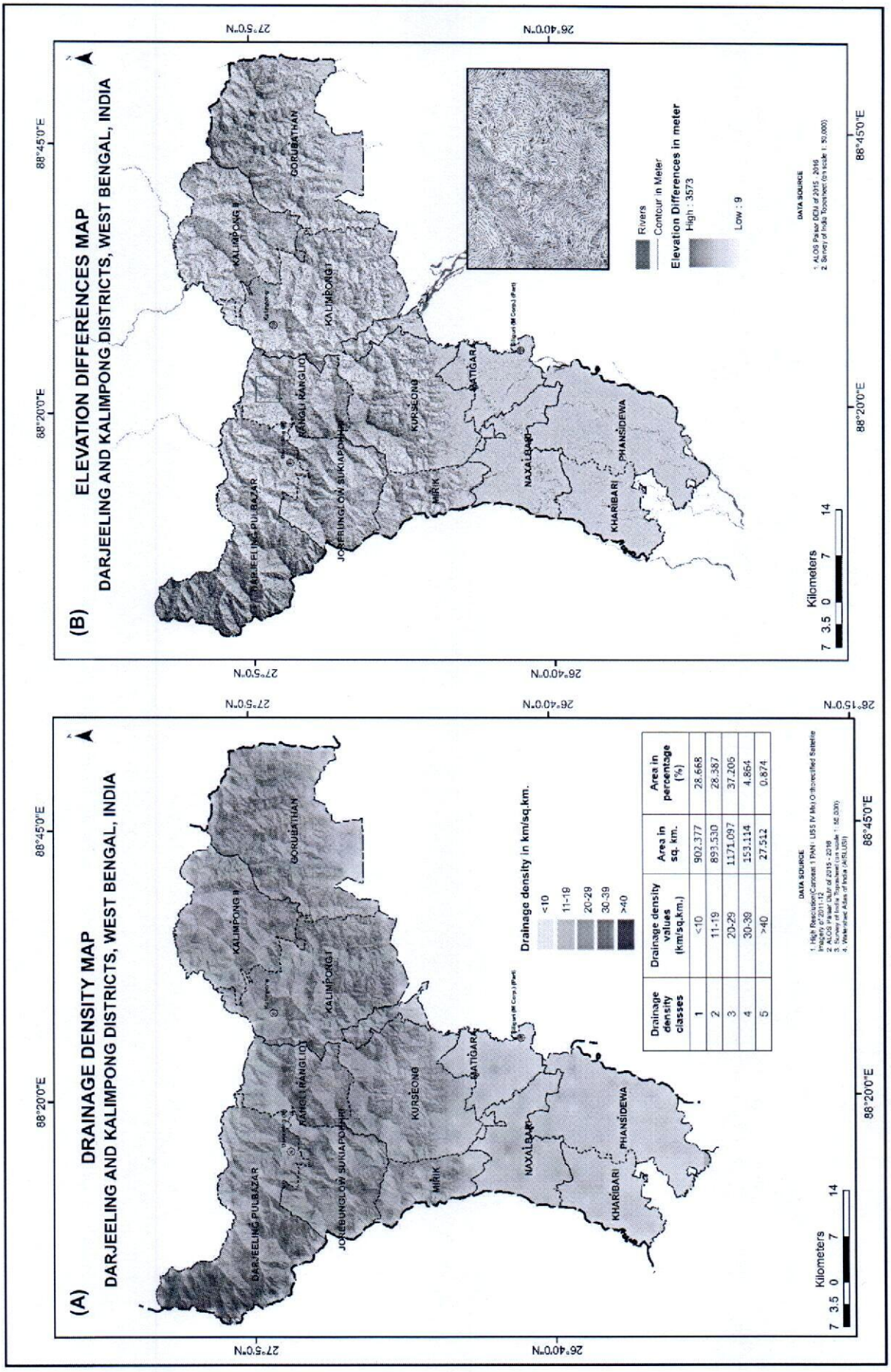


Fig. 8A Drainage density map and **8B** Elevation differences map of the DHR, West Bengal

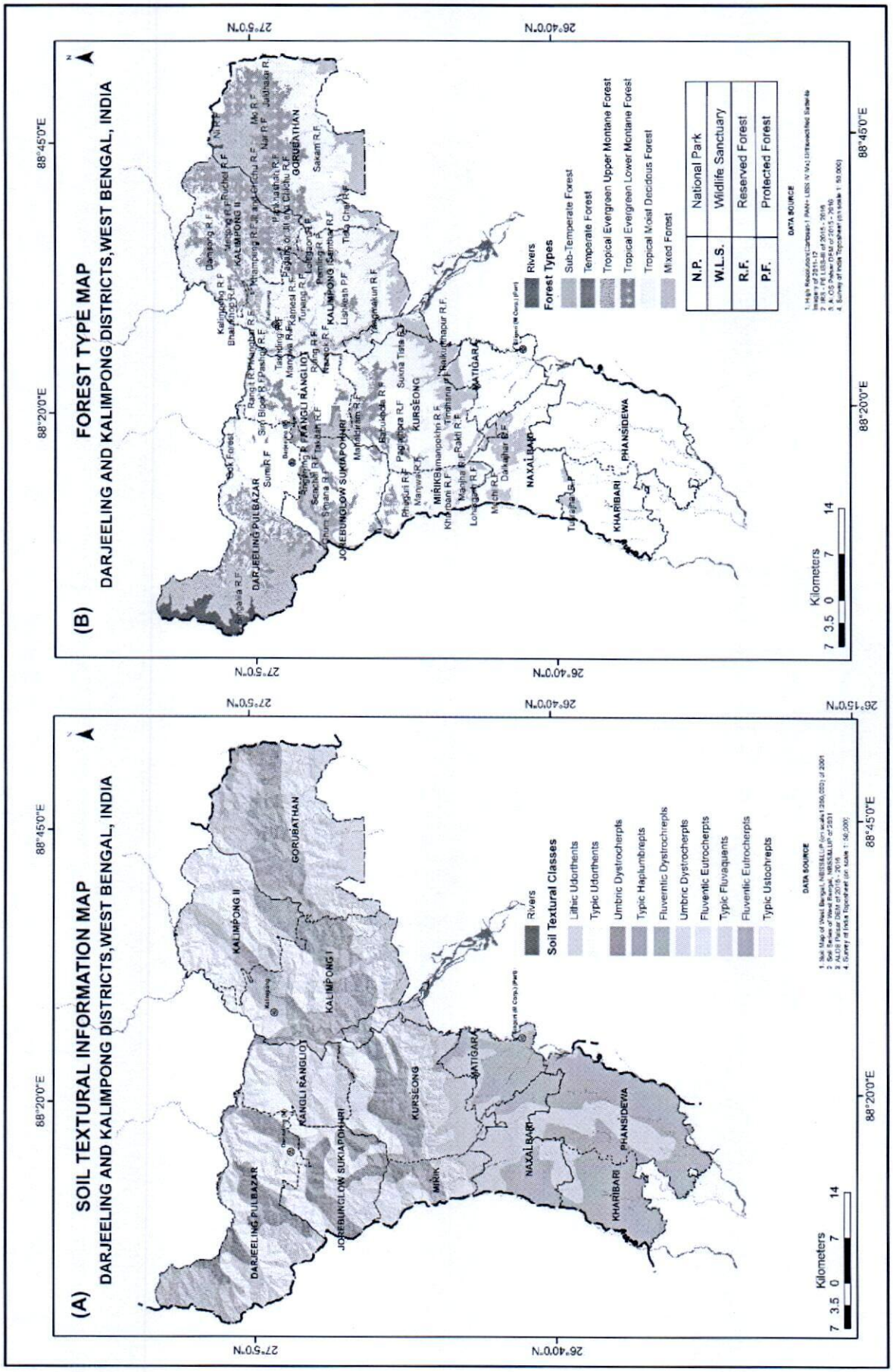


Fig. 9A Soil textural information map and **9B** Forest type map of the DHR, West Bengal

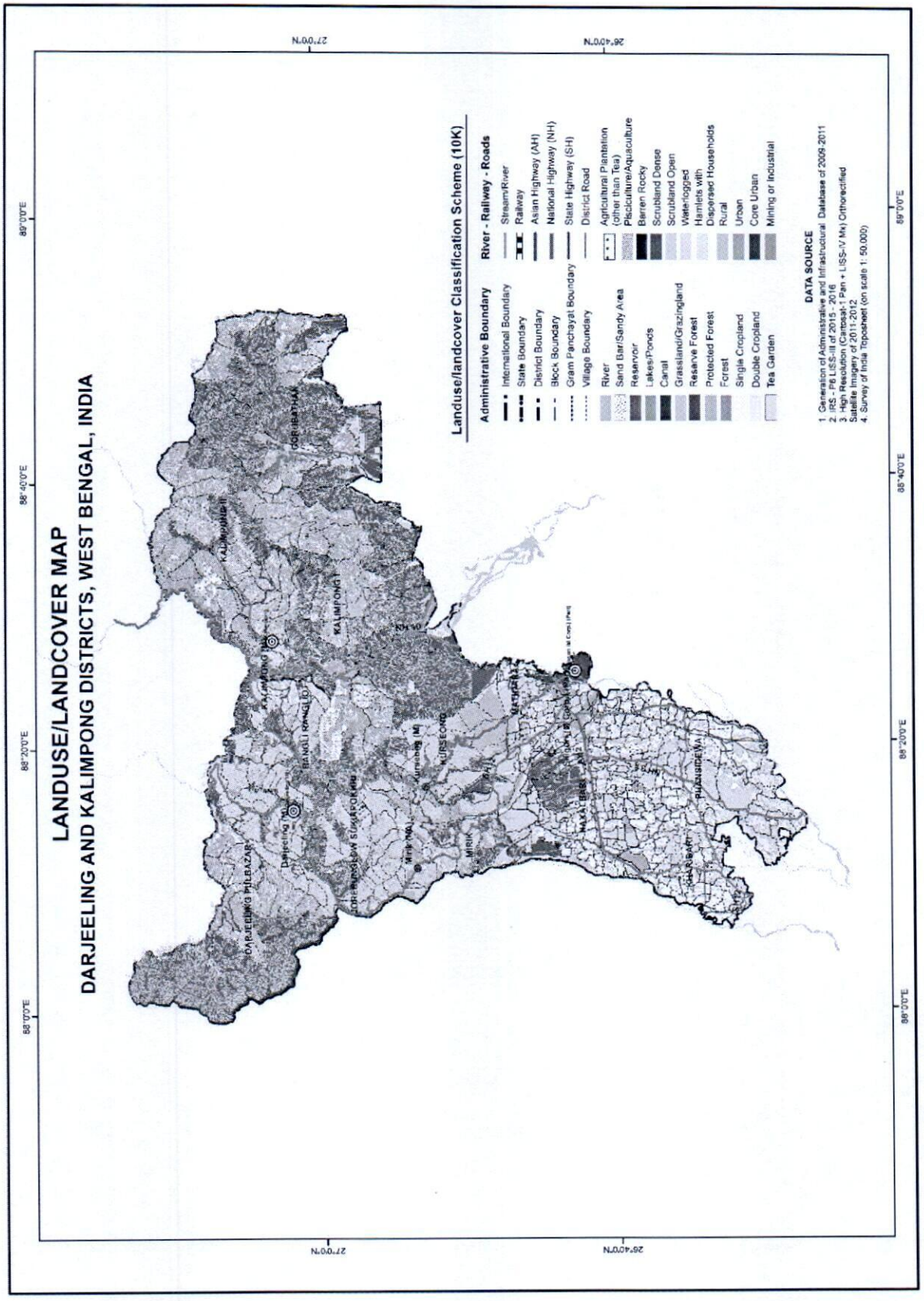


Fig. 10 LULC map of the DHR, West Bengal

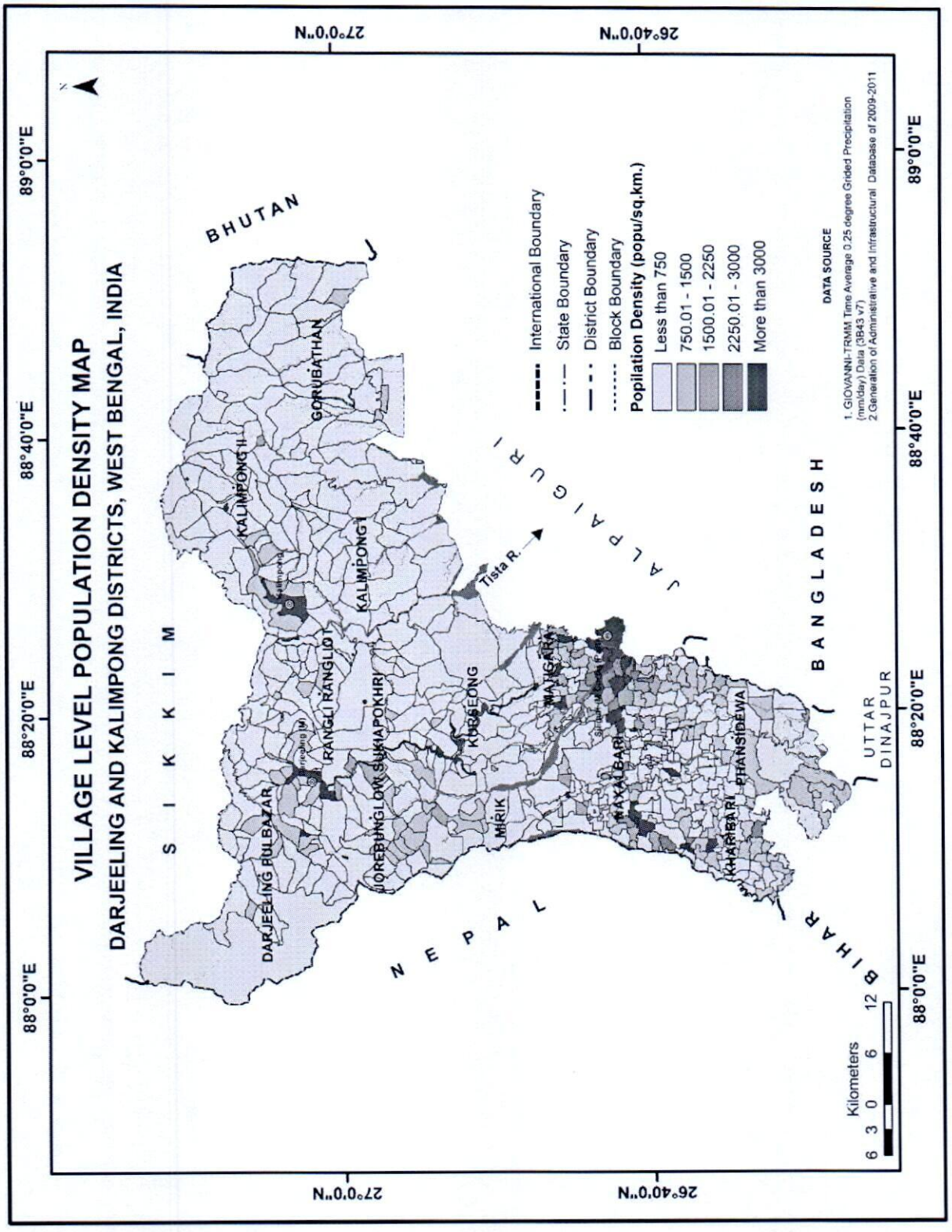


Fig. 11 Village level population density map of the DHR, West Bengal

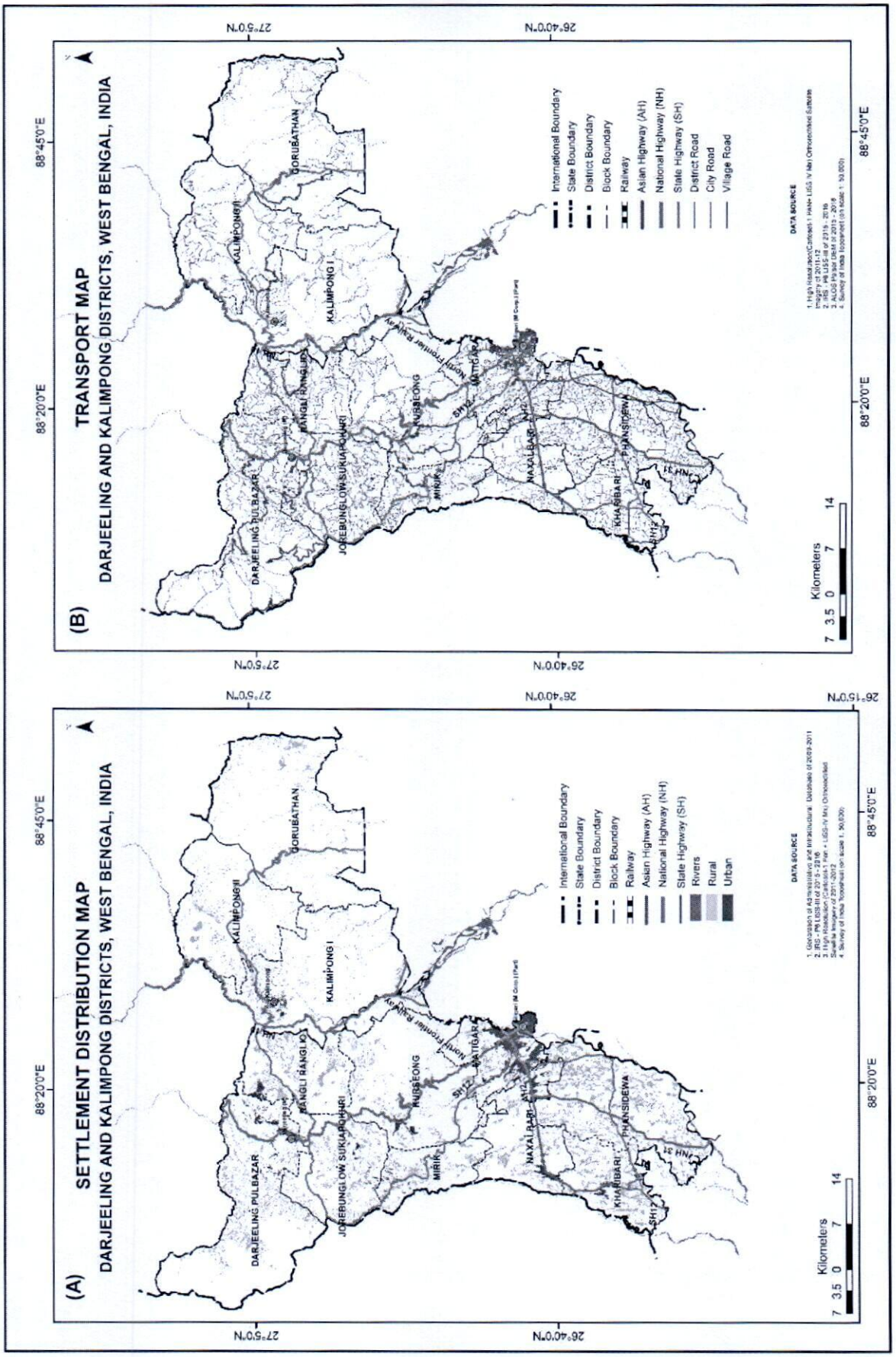


Fig. 13A Settlement distribution map and **13B** Transport map of the DHR, West Bengal

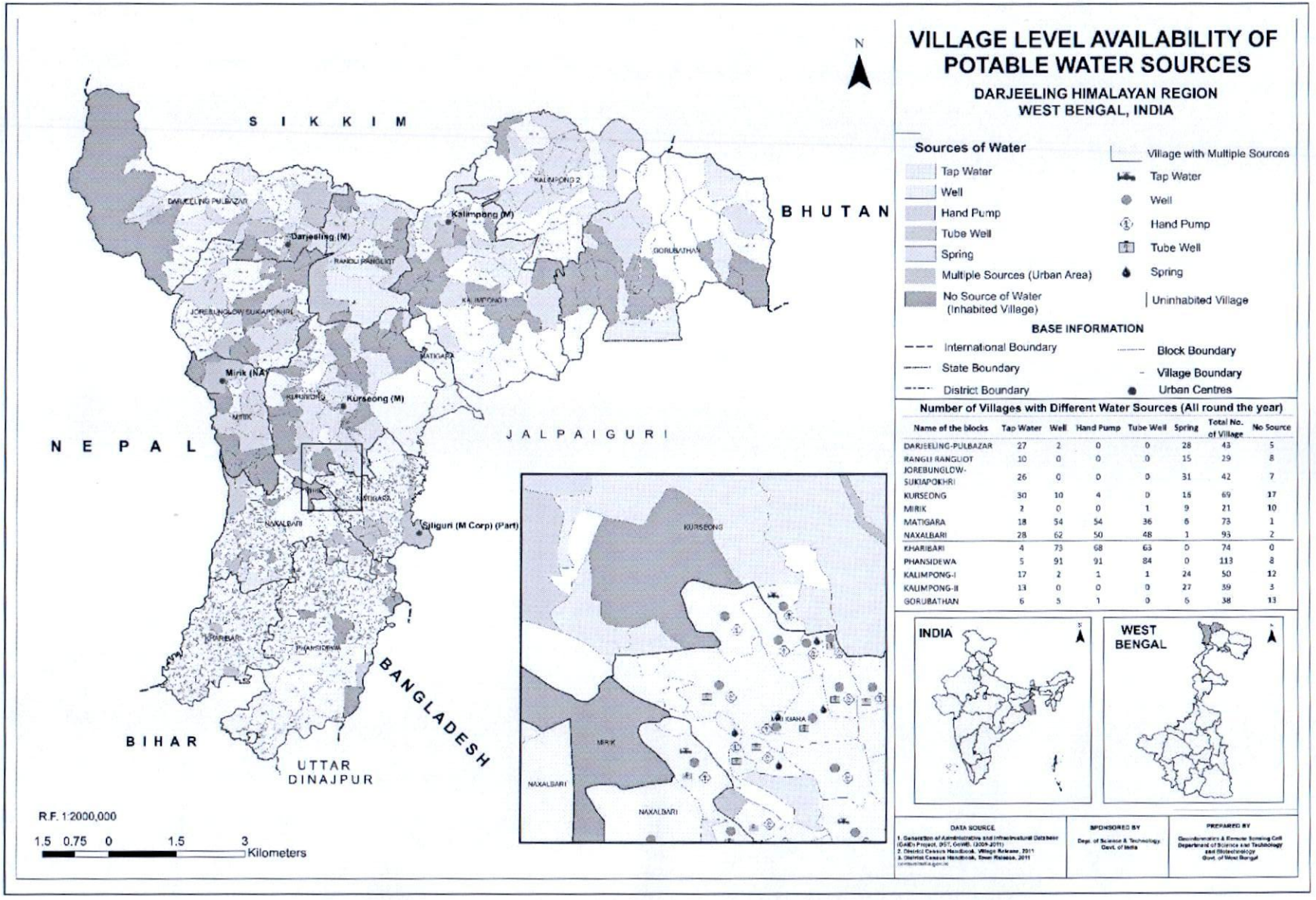


Fig. 14 Village level availability of potable water sources, DHR, West Bengal

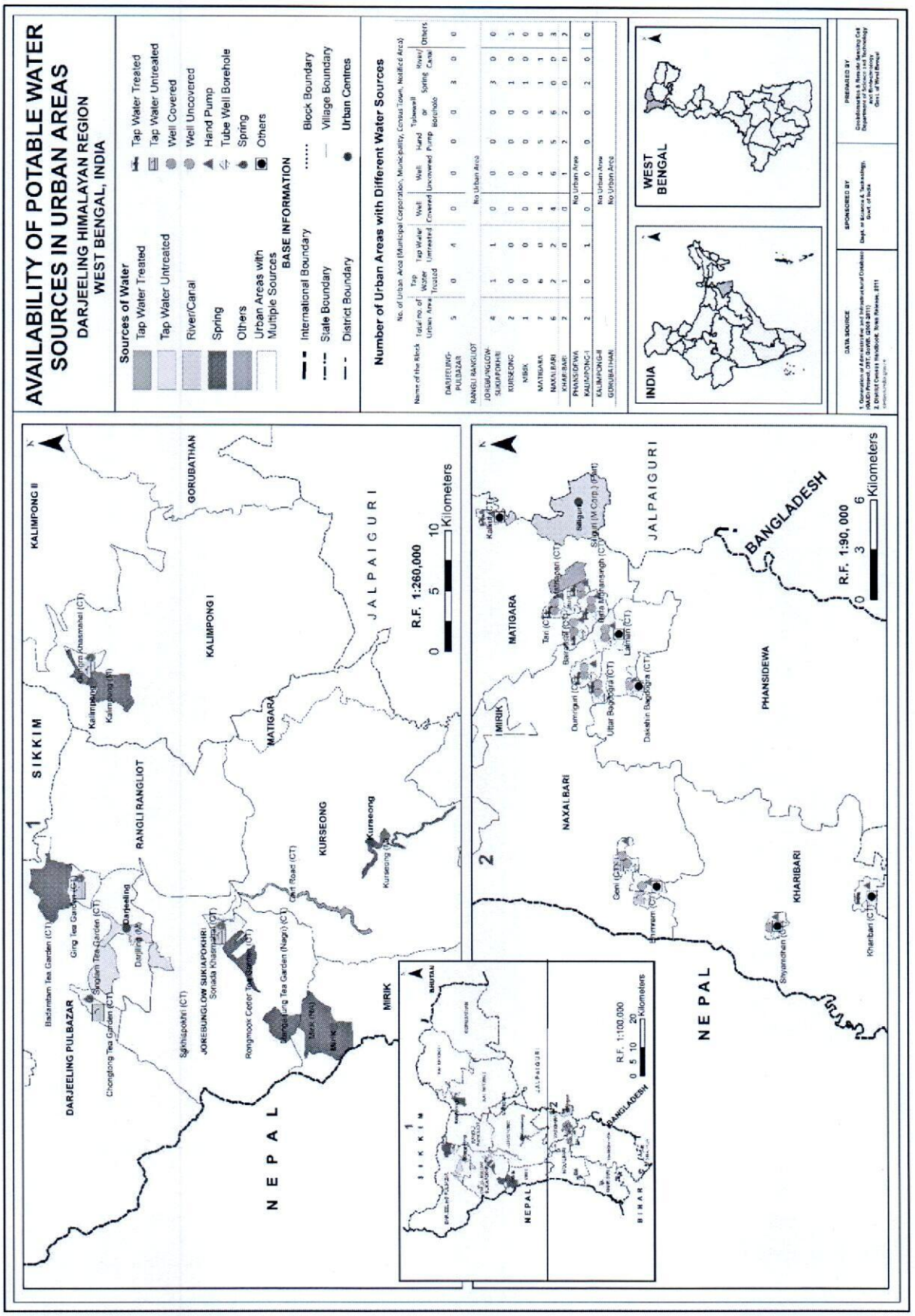
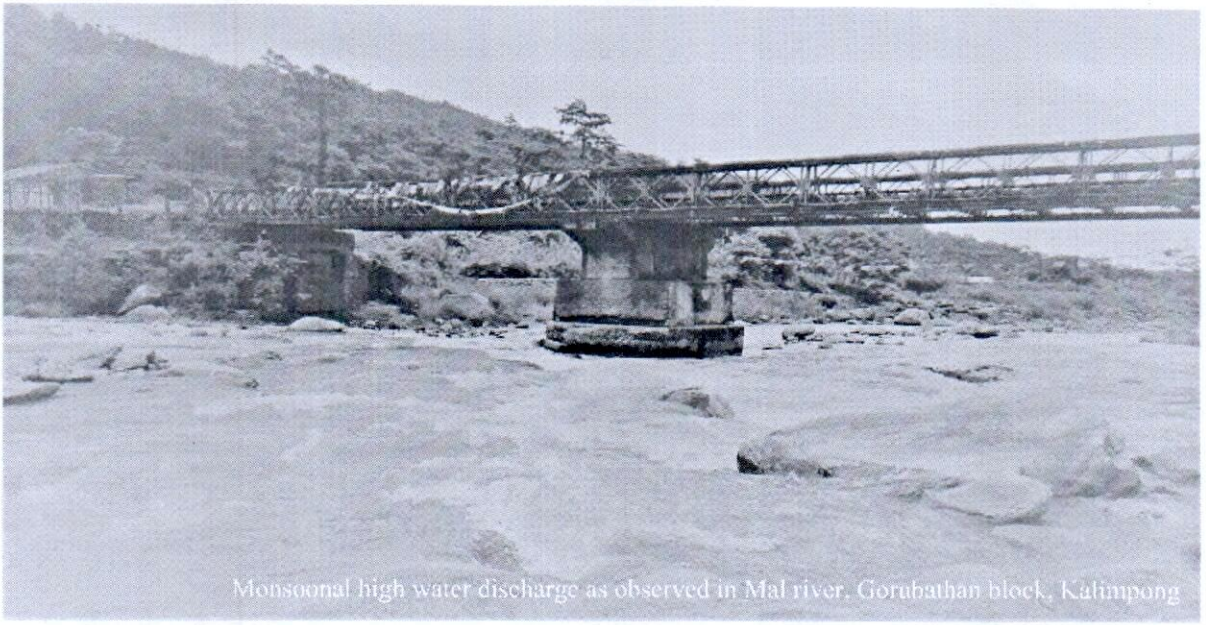


Fig. 15 Availability of potable water sources in urban areas, DHR, West Bengal

Chapter 3

Prospect of Climate Change Adaptation through Spring Water Management



Monsoonal high water discharge as observed in Mal river, Gorubathan block, Kalimpong

3.1 Springs-the Sustainable Water Resources in the Darjeeling Himalayan Hills

In recent years, it is well known that the Himalayan region of the West Bengal region started facing water crisis due to an erratic and skewed pattern of rainfall, increased anthropogenic activities around the spring recharge zone, high population pressure led to rapid urbanization in the area. Moreover, these dynamic changes in the region gradually dismantle the groundwater balance and, henceforth, disrupt the natural springs' discharge to a great extent. Springs are the lifeline for a large part of the Darjeeling Himalayan population for survival and sustenance. Usually, spring water is considered clean due to the natural filtering during infiltration and its movement through shallow and deep aquifers. Still, traditional methods for preserving these springs have not been substantially effective to combat the combined ill-effects of climate change and anthropogenic activities. Hence, measures to augment water supply from springs, on which mountainous habitations depend, can benefit mainly from hydrogeological approaches to planning, implementing, and monitoring programmes such as the springshed development.

3.2 Jharnadhara an Initiative for Spring Management

Panchayat and Rural Development Department (PNRDD) Government of West Bengal (GoWB) initiated a springshed project *Jharnadhara* involving more than 600 springs for the two hill districts (Darjeeling and Kalimpong) of West Bengal through a partnership Programme under MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) involving some CSOs as technical partners. In Jharnadhara, early results show positive impacts and explain the intensive Spring Water

Management emerged as a novel technique to combat water crisis in the hills and ensure livelihood opportunities and food security of the local stakeholders The severe water scarcity crisis is believed to be overcome by the Jharnadhara project, which will be an exemplar for states to fight this battle, armed with the power of civil society and the strength of local communities. In the Jharnadhara programme, PRASARI became a partner with the main responsibilities to capacitate the primary stakeholders, i.e., Gorkhaland Territorial Administration (GTA) resource persons, local spring volunteers, GP and Block resource persons. However, this springshed approach combines landscape, watershed and aquifer management and aims to develop springsheds in four districts, explicitly Darjeeling, Kalimpong, Jalpaiguri and Alipurduar, to revive natural springs in which the majority of the springs are in Darjeeling hills. The project seeks to be a knowledge builder and replicable model of springshed management for practitioners, policymakers, and academia; develop monitoring software tools; facilitate linkages between beneficiary communities, local institutions, and the state; and promote advocacy by leveraging partner networks influence-public investments in springshed management.

3.2.1 Initiatives Taken

In the beginning, the Jharnadhara programme initially started for one month (February-March of 2017) in a pilot phase that ended up with training 56 Dharasevaks (Village Resource Person), GP, Block and District level engineers and preparing 56 Detail Project Reports. In the very first week of the following month, physical work (recharge structures) started in almost every GPs. It can be exemplified as the initiative where science travels a distance from laboratory to village. During the stage, rural Dharasevaks conduct hydro-geological survey and prepare hydro-geological map of a spring to identify recharge zone and, with the help of GP level technical functionaries, design recharge activities. This inspired even the apex level contributors of the development system, which resulted in the state's enthusiasm and aspiration when the GoWB started a chase of completing more than 600 springs. In reality, the implementation part of the springshed programme is challenging; as a whole, it includes science-based aquifer mapping, field surveys and scientific analysis, construction of physical structures, and treatment of upper ridge.

Photo plate 6 Initiative taken (trench excavation for water recharge) under Jharnadhara programme for management of spring water, Sangsey, Kalimpong II block, Kalimpong district

Primarily, under the Jharnadhara project, field training was given to the technical wings who deployed i,e. Skill Technical Persons & Technical Assistants in each block. Afterwards, the trained technical wings who have equally operative potential as any para hydrogeologists went to their respective GP's area and found the critical springs after discussing with the community and chosen a person (Dharasevaks) to supervise Jharnadhara work from their respective community. Now, the MGNREGA Cell, GTA have supported CSO partners i.e., PRASARI and Advanced Center for Water Resources Development and Management (ACWADAM) to train their total 465 Dharasevaks from all the concerned blocks. The vision of Dharasevak training is not only making them technically strong but also motivating them about the springshed project and inspiring them to sensitize their surrounding people in the community. Now, the trained Dharasevaks are identifying the recharge area of each particular spring with the help of technical wings & CSO partners and continuously monitoring the springs. The GP's authority will take the leadership to organize the hamlet meeting to sensitize the community regarding the project. For physical effort to execute the field work, local people will be chosen for maximum efficiency those who have a job card under MGNREGA scheme as they can earn daily wages to sustain their own livelihood. Meanwhile, the PNRDD, GoWB has undertaken an attempt to document field-based data and findings by developing a web-based spring management system, i.e., www.spring-management.info. This system will enable an end user to visualise block-wise all necessary details on springs, their typology, distribution, spring dependency, discharge, water quality, and so on.

3.2.2 Stakeholders, Partner Organisations and Community Participation

The main endeavour of the springshed programme is to facilitate and build community decision-making processes for sustainable usage and utilisation of springs. The GoWB showed great interest in springshed management after a mega-hit of the traditional watershed concept in the western districts to widen and deepen practice in identified districts. Henceforth, the Jharnadhara project was added with great inspiration and financial support from Bharat Rural Livelihood Foundation (BRLF) and Arghyam. In November 2016, during the regional workshop at Jalpaiguri, it was first agreed that the MGNREGA cell at the respective tires of the PNRDD will take up the springshed management work. Among the involved CSOs-PRASARI working closely with Panchayati Raj Institutes in West Bengal was envisaged as the primary agency for technical support to be present in the field and ACWADAM would be mainly having act as the knowledge partner in the programme. Further, ACWADAM and PRSARI reached out to Water Resources Investigation and Development Department to bring spring management on their activity shelf. The World Bank Supported Programme, Accelerated Development of Minor Irrigation Project, has created a special provision to partner with PRASARI for the Jhora Rejuvenation work. This spring management system has undertaken 60 springs (with relatively higher discharge) for sustainable management and judicious water use initiatives. However, conducting scientific tests and taking up appropriate engineering solutions to enhance recharge is not enough. In

addition, there is also a need to address the demand side challenges to ensure that water requirements are met in times of limited resource availability by augmenting the efficiency of water use. To address such issues, under the spring management work at a local scale, involvement of the community, educating various stakeholders, especially the communities depending on spring water as well as those located in the recharge zone about resource protection, preventing contamination of the aquifer that supplies water to springs and land use management and control have been prioritised. Hence, in recent years there has been an upsurge of studies and initiatives to address spring management in the DHR; those are mostly community-centric initiatives that have looked at distribution rather than regeneration, although they have helped in mitigating the rural water crises to some extent.

3.2.3 Vision of the Project

The first initiative was developed under the Jharnadhra to test an approach in a pilot scale and implement the springshed management methodology at regional level in addressing water insecurity in specifically for the hills of the DHR. Moreover, the spring management approach not simply limited to the revival of local springs through extensive mapping of all spring sources through state of the art understanding of localised spring hydrogeology; a comprehensive understanding of socio-economic structure, institutions and multi-layered governance aspects, at the same time it encompasses the opportunity to ensure livelihood opportunities of the people.

Chapter 4

Spring Management using Geoinformation Techniques-A Case Study in the Kalimpong District

Entrainment of spring water, Sittong, Kurseong block, Darjeeling

4.1 New Approaches Adapted

Intensive Spring Water Management emerged as a novel technique to combat water crisis in the hills and ensure livelihood opportunities and food security of the local stakeholders. Specific database pertaining to Spring Water Management and Potential Zones Identification has been undertaken by NMSHE-West Bengal to provide sector-specific solutions. The methodology which is adopted for the case study essentially incorporates the geoinformation techniques. The primary analyses using this geoinformation method study distribution of springs, their relation with the physical environment and further it tries to develop systematic investigation towards prioritisation and management of springs within Kalimpong district. Fundamentally, in spring management, the integrated eight-step methodology is particularly helpful, and it principally includes the account of scientific studies on the spring management subject and further the need for incorporating elements from the natural and social sciences into spring revival implementation activities. This particular methodology was built upon Dhara Vikas Handbook developed by Sikkim's Rural Management and Development Department but was more comprehensive and interdisciplinary in approach. In view of the above, this present work based on the in house expertise and available resources attempts to develop a Spatial Decision Support System methodology on Spring Water Management (SDSS); this Web GIS based SDSS majorly integrates two primary steps of the concerned methodology i.e., comprehensive mapping and data monitoring system and also it should be enhanced further by linking essential Web Map Service and Web Feature Service to it.

4.2 Distribution of Springs under Different Administrative Units upto Village Level

The Kalimpong district is situated at an altitude of 1300 meters in the eastern part of the DHR. The district was formed on 14th February 2017, after splitting from the Darjeeling district as the twenty first district of West Bengal. It consists of the Kalimpong Municipality with 23 wards and three C.D blocks i.e., Kalimpong I, Kalimpong II and Gorubathan, consisting of 42 GPs and 128 villages. The attraction of the mighty Himalayas, pristine beauty of the Dooars, dense virgin flora, enchanting valleys and meadows and of course the perennial shinning but chilling weather together have placed Kalimpong district in the map of the most important tourist destinations in the Eastern Himalayas also and it is the home to the most diverse varieties of orchid, cactus and ornamental plants. The district resides a total of 251642 population (Primary Census Abstract, 2011) among which 80.36% of people live in the rural areas. Such a large amount of rural people directly depends on springs for their everyday needs; the latest estimate of springs from Kalimpong district magistrate office shows 8652 HH households are intensely catered by available 434 spring water.

Photo plate 7 Village level spring water harness mechanism through (**A**) water storage, (**B**) distribution and (**C**) utilization, Upper Burmiak, Kalimpong II block, Kalimpong district

In a more detailed way, the distribution of springs is being segmented in blocks, GP and village level; while considering the block level distribution of springs it has been observed that the occurrence of identified springs is highest in Kalimpong II block i.e., 290 springs which in turn supports 4834 HH, whereas, in case of the Gorubathan block the number of delineated springs is quite poor (24) with a huge 1846 HH dependencies (**Fig. 16**). Availability of scenario of springs for the GP level expresses the same, as in the Gorubathan block the HH pressure on springs is maximum and most interestingly there are 5 inhabited GPs having no springs (**Fig. 17**). For the village level distribution of springs, about 54.69% of villages with spring water sources and 62.67% of springs distributed across villages are of perennial sources. Similarly, village HHs of Gorubathan block are more dependent on spring water, and there are 28 villages in the blocks with no springs. The Village Level Availability of Potable Spring Water Sources map confirms the same; the present analysis with the existing map helps to visualize the water shortage situation in Gorubathan block more transparently. Together with the inevitable water scarcity situation, climate change vagaries have already started impacting water availability and

ubiquitous access. Therefore, it is necessary to manage natural water sources, and in hills, springs are the best option (**Fig. 18**).

4.3 Springs Association with Physical Components

Recognizing the uniqueness of the Himalayas and the challenges for sustainable development, a set of thematic areas need to be explored. While these thematic areas are pretty significant for the Himalayas, they are not exhaustive by any means. Initially, mountain physical specificities require detailed solutions for resilience building that address socio-economic and environmental challenges in the hilly setting. Despite the complexity of spring hydrogeology, geomorphology remains the prime factor on which spring recharge is being promoted in the Himalayan region; a systematic process of identifying the type of springs and characterizing them solely depends on the physical factors of the mountains. Nevertheless, the Himalayan region poses many challenges in the study of springs. First of all, the rugged topography and high relief in many areas make many places inaccessible with a combination of thick vegetation cover. The complex geology of the Himalayas caused by the various repeated structural disturbances is challenging to study and map too; dense forest similarly leaves with limited in-situ exposures for study in detailed regional settings. Natural disasters like landslides add up to the chaos equally. Therefore, it is important to obtain an overview of the regional geologic characteristics, physiographic settings, slope and aspect conditions, drainage, forest distribution and their association with spring occurrence. Furthermore, it is likewise vital to estimate the dynamism nature of LULC and its impact on springs within the study area, as many of the springs presently behold tremendous HH pressure and leading to drying up. Hence, the significant themes that are determinant and relevant to the distribution of springs are summarized below;

4.3.1 Springs in relation with Geological Characteristics

Photo plate 8 High water discharge from spring mostly associated with hard rock terrain forms jhora in monsoon season, Icha Khasmahal, Kalimpong I block, Kalimpong district. Picture Courtesy: Prasari, Kalimpong

While there is generally good agreement between lithological characteristics and spring occurrence but with structural control there are some discrepancies that can also be found. In particular, the lineaments and major thrust of the region work as a medium of water conduit from where flow approaches beneath the surface. Hence, the MBT, MCT and more than a hundred small to minor lineaments of the Kalimpong district can be considered the medium of water percolation below the surface ultimately to feed the aquifers. Whereas the geological formations exhibit an influential characteristic for the occurrence of springs e.g., the Central Crystalline Gneissic Complex (Proterozoic)/(Granitoid Gneiss/Gnessic

Granitoid/Granitoid Complex), basically represents a hard rock terrain which mainly composed of high-grade Darjeeling gneissic basement and schists with subordinate quartzites and isolated lenticular bodies of calcsilicate rocks, fringed below by the MCT. It is spatially distributed over the entire north-eastern Kalimpong districts and covers about 41% area with 275 identified springs. Further, to the western part, low-grade meta-psammopeletic sequence of Precambrian Daling group's Reyang and Groubathan formations cover 30% area to total area. The Gorubathan formation comprises green slate, phyllite, phyllonite, cherty chlorite quartzite, green tuffaceous wake with basic metavolcanic materials, while the Reyang formation consists of variegated slates, phyllite and low graded schists. These bedrocks have been potentially exposed to weathering processes, and due to the presence of highly metamorphosed argillaceous rocks in both the formations, the Daling group is recognized as the highly fragile and most landslide-prone litho-unit of this region. Among these two, the Goaubathan formation resides 133 springs, and the Reyang formation comprises only 11 springs. On the other hand, in formations like Gondowana Super Group (Damuda Gr) (Permo-Carboniferous)/ (sandstone with shale), Siwaliks (Pliocene-Eocene)/ (sandstone & conglomerate) and river and its channel deposits altogether cover 25 percent with a total of 15 springs (**Fig. 19**). Although variability in precipitation, altitudinal effects and slope aspects are all responsible for a spring's existence and water availability, the diversified lithological characteristics range from crystalline to coarse-grained sandstone with deformation history play the most crucial part in the development of ideal spring potential zones.

4.3.2 Physiographic Settings and Springs

The landscape of the DHR is bedrock dominated and highly dissected by tributaries to the Teesta and Mahananda river systems. In the Kalimpong district, the major physiographic units can be explained as hills and Terai as the DHR; the relief can be characterized by successive relief classes i.e., less than 300m, 300m-900m, 900m-1500m, 1500m-2100m, 2100m-2700m and more than 2700m. Among the differential elevation ranges, the elevation class 900m-1500m contains 265 springs which is the maximum and consequently followed by 1500m-2100m class with 155 springs, 300m-900m elevation range with 57 springs. The minimum elevation group i.e., elevation less than 300m and the maximum elevation class 2100m-2700m consist of 4 and 5 springs individually (**Fig. 20**). It has been witnessed from the study of spring association with physiographic settings that elevations strongly determine the amount of springs availability. Most of the springs are identified in the higher elevation classes rather than in the moderate to lower elevation range. Predominantly springs occur in the elevated hillslopes constituted by the moderately permeable bedrock near the entrenched mountains streams, although some of the springs are related with the metamorphosed rock stratum within narrow bedrock valley.

4.3.3 Slope and Aspect Wise Distribution of Springs

The available database on springs and its association with the slope of the Kalimpong district reveal that the maximum availability of springs (165 springs) is observed in between 20°to 30°of slope, which is 38% of total number of springs. Alongside, 147 springs occurred in the slope range 10°to 20°and it

shares 34% of the total number of springs. So significantly, it is evident from the analysis that maximum sprigs occur in between 10° to 30° slope, which is favourable for retaining moisture in the soil layers in the hilly tracts of Kalimpong district (**Fig. 21A**). As a whole, the slope wise distribution of spring demonstrates a negative relation by conforming that as the degree of slope increases, the frequency of spring occurrence decreases. However, the aspect wise the distribution of springs shows that the maximum concentration of springs occur under South, South-West, West and South-East aspects. Almost 62 % of springs to total comes under these aspects; among which the South aspect has the highest incidence of spring i.e., 76 springs, and that may reflect the fact, higher recharge in the windward slope of Kalimpong Himalayas due to monsoonal orographic rainfall (**Fig. 21B**).

4.3.4 Springs association with Landslide

In actual fact, the DHR is a part of Tertiary young, folded mountain with weaker lithology group, and of which the Kalimpong district contains most fragile schist dominated Gorubathan formation, phyllite dominated Reyang formation of Daling group and sandstone bearing Siwalik group of rocks. These rock groups are highly susceptible to landslides and as instances in the Kalimpong district 525 landslide events have been observed which indicate the proneness to landslides within region. A Landslide Susceptibility map has been prepared under the NMSHE project using the Analytical Hierarchy Process at a large scale (1: 10,000) for the hilly DHR, where five distinctive susceptible zones were identified and the corresponding number of springs existing on the respective zones are presented in the **Table 8** (**Fig. 22**).

Table 8 Landslide susceptibility zone categories and corresponding springs occurrence

Landslide Susceptibility Zone Categories	No. of Springs
Very High Landslide Susceptibility Zone	13
High Landslide Susceptibility Zone	61
Moderate Landslide Susceptibility Zone	166
Low Landslide Susceptibility Zone	170
Very Low Landslide Susceptibility Zone	24

Photo plate 9 Major landslide along the SH 12 on Daling group, Santuk, Kalimpong II block, Kalimpong

4.3.5 Influence of Drainage on Springs

Springs display a distinct feature when related to drainage density. The drainage density map presents that almost all the springs are distributed throughout the high drainage density regions. The zone having 4km/sq.km.-6km/sq.km. drainage density accounts for the highest number of springs (342), whereas few number of springs (17) are found in the drainage density zone 2 km/sq.km.-4 km/sq.km. but significantly, the very high drainage density zone also possesses less numbers of springs, which is 75 and it may be due to extraordinary surface runoff over the high hillslopes. The next observable thing is the variation in nature of the spring occurrence with varying drainage density; particularly, the very high drainage density zones generally result in the perenniality of springs. But interestingly, in the western Kalimpong, the highest drainage density zones do not occupy a considerable amount of springs; it may be the result of some litho-structural controls over there or inaccessibility due to forested areas **(Fig. 23)**.

4.3.6 Forest Cover and Spring Occurrences

Maintenance of forest cover is one of the most crucial prerequisite conditions to preserve continue supply of water resource. In maintaining high yield and good quality of water, forests make their most significant contribution. Furthermore, forests can protect water bodies and watercourses by trapping sediments and pollutants from up-slope, land uses and activities. Most importantly, forests help to control the water cycle by regulating precipitation, evaporation, and flows. Layers of the forest canopy, branches and roots can store and release water vapour, which controls rainfall, besides forests can similarly reduce water-related risks such as landslides in the mountains, surface run-off etc. The thick forest cover and its deeply penetrated root system by decreasing the run-off intensity, simultaneously regulate the sedimentation process in streams and assists in groundwater recharge. But in the contemporary scenario, the unprecedented climate change phenomenon, specifically in the Himalayan region altering forest's role in regulating water flows. With the advancement of time, the increased built-up expansion at the cost of deforestation makes the situation worse; consequently, local dwellers face major challenges, and water scarcity is inevitable among these. In the Kalimpong district, the total forest area is about 894.43 sq.km. which is 81.90% in respect to the total geographical area of the district. Nonetheless, the Kalimpong district comprises a wide variety of forest types; as the district is covered by Reserved Forest (R.F.) (541.70 sq.km.),

Photo plate 10 Staggered trenches in forested area for spring water recharge, Mirik block, Darjeeling district. Picture Courtesy: Prasari, Kalimpong

Protected Forest (P.F.) (7.69%), Forest (113.02%) and Social Forest/Tree Clad (232.02%) areas. All of these forest types have their own role in harnessing water sources, i.e., springs in the hills, which majorly influences the volume of water availability. In the R.F. part there are 62 spring, the Forest comprises a total of 144 springs, in the Tree Clad part 137 springs are identified but interestingly the number of springs in the P.F. part is 1. Such distribution of springs in different forest types is not uniform, it is due to data gaps from the existing forest covered area (**Fig. 24**).

4.3.7 Dynamism of Landuse/landcover and Springs

The LULC practices are the determinants for stability in the hill regions. One of the main problems in respect of LULC categories in the DHR is related to the allocation of sustainable natural resources and the high density of population. There is minimal scope for the extension of agricultural land in the study area to cope with the increasing burden of the people. As a result, pressure on forested and other restricted areas is steadily increasing; consequently, the lakes and perennial waterbodies are gradually deteriorating. Assessment of the periodical changes in LULC categories allows us to understand the dynamic nature of a particular area. Derived statistics from LULC classified maps of 2005-06 and 2015-16 similarly exhibit a continuous changing characteristic of the LULC features for the recent decade within the Kalimpong district. In the case of the Kalimpong district, the built-up expansion scenario is prevalent around the Kalimpong municipality, and the associated urban-centric events result from human encroachments, need for living space and allied agricultural-farm activities. Instances should be made here for significant LULC classes e.g., Agricultural plantation, Crop land and Forest from which a considerable amount of have been converted into built-up land (**Table 9**). These land use changes in the springshed area alter the hydrological response and produce negative impacts such as increased runoff and erosion. Wide variations in hydrological response are indeed the outcome of contemporary variations in springshed characteristics. Therefore, it is quite apparent that, unlike hydrological functions, it's the visible status of natural resources that define the goals, issues, and challenges that are addressed by watershed as well as springshed management. The LULC change mechanism and the related hydrological process vary across geographic regions, and their drivers of change often dependent on the ecological, socio-economic and historical-political context. Thus, the change identification in LULC categories over time is essential in monitoring natural resources like springs and making the spring inventory more robust.

Photo plate 11 Homestay under construction in place of Cardamom orchard, Sangsey, Kalimpong II block, Kalimpong district

Table 9 Change matrix table showing dynamism of LULC categories from 2005-06 to 2015-16 for the Kalimpong districts

LULC Class 2005-06 / LULC Class 2015-16	Agricultural Plantation	Barren Rocky	Cropland	Forest	River/ Waterbody	Rural Settlement	Urban Settlement	Scrub Land	Scrub Forest	Fallow Land	Total Area in Ha (2005-06)
Agricultural Plantation	5491.829					4.053		1.808			5497.690
Barren Rocky	40.430	168.566						22.912	3.842		235.750
Cropland	995.738	10.239	15245.818	63995.800		69.205			151.781	82.150	80550.731
Forest	15.187	43.093	55.914			11.600			159.504	5.721	291.019
Waterbodies					2118.100	102.636					2220.736
Rural Settlement		0.467				3832.000					3832.467
Urban Settlement							586.898				586.898
Scrub Land			0.001					14818.727			14818.729
Scrub Forest		66.330	31.492	219.739							317.561
Fallow Land										3.950	3.950
Total Area in Ha (2015-16)	6543.184	288.695	15333.226	64215.539	2118.100	4019.494	586.898	14843.447	315.127	91.821	108355.531

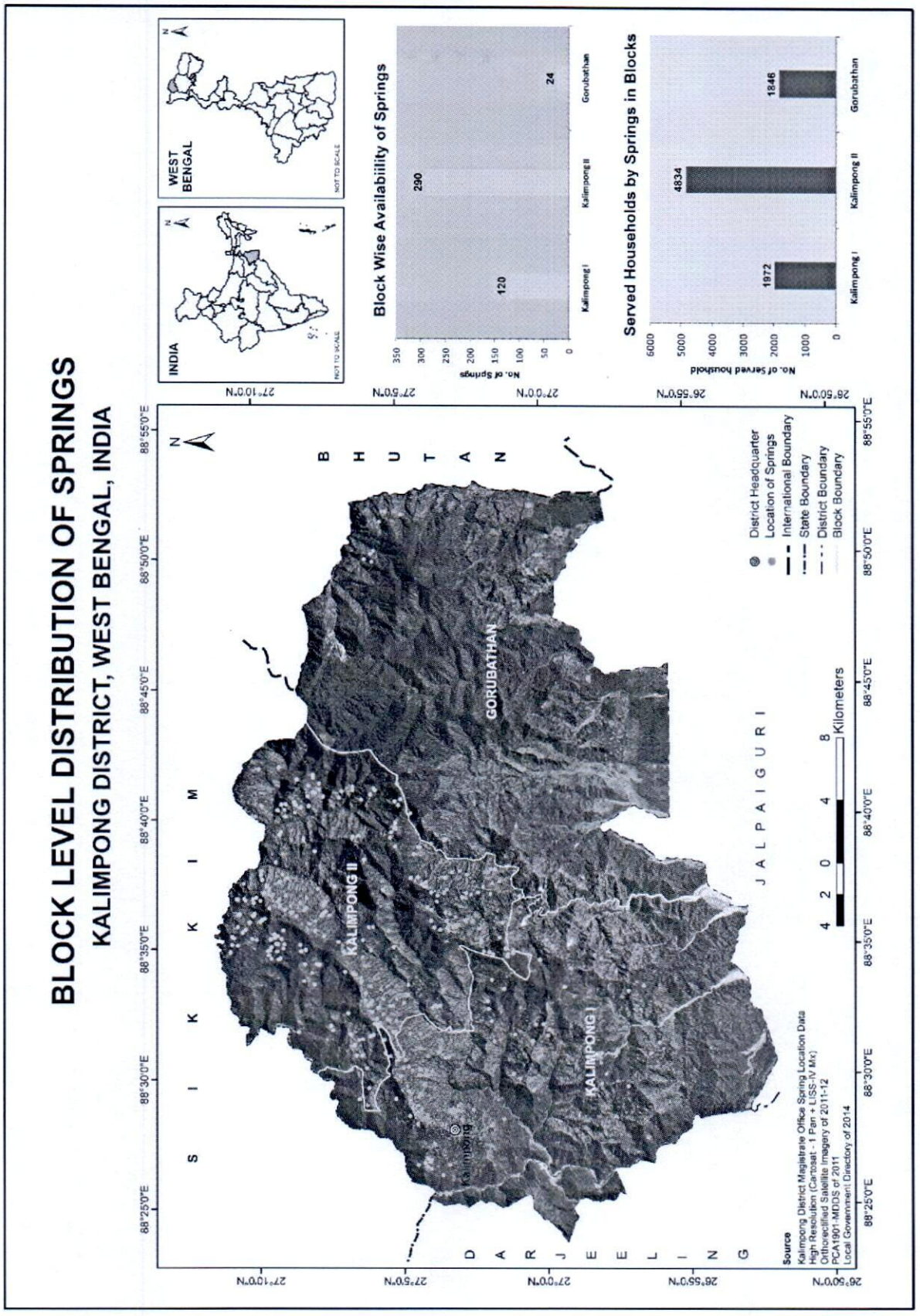


Fig. 16 Block level distribution of springs, Kalimpong district, West Bengal

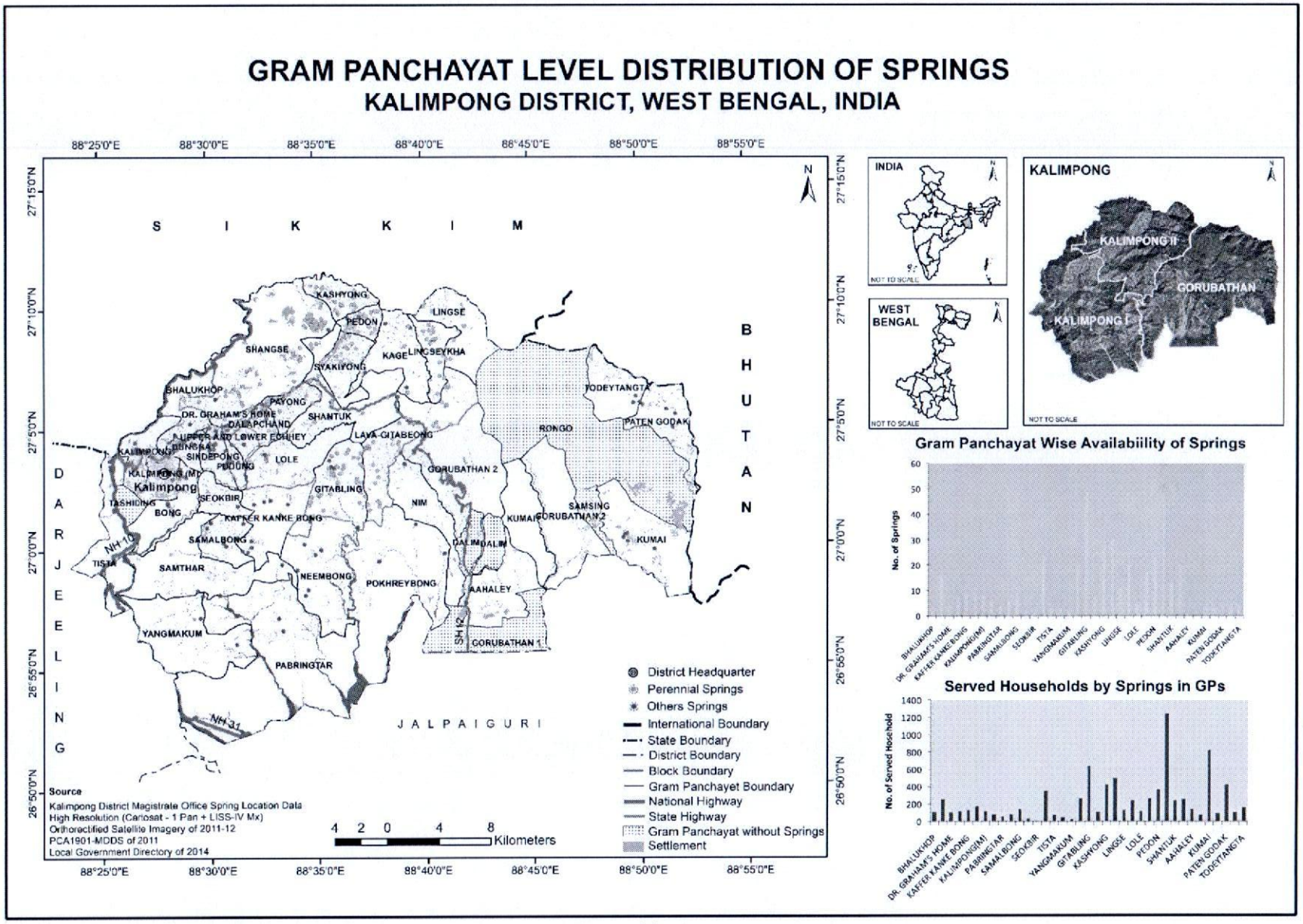


Fig. 17 Gram panchayat level distribution of springs, Kalimpong district, West Bengal

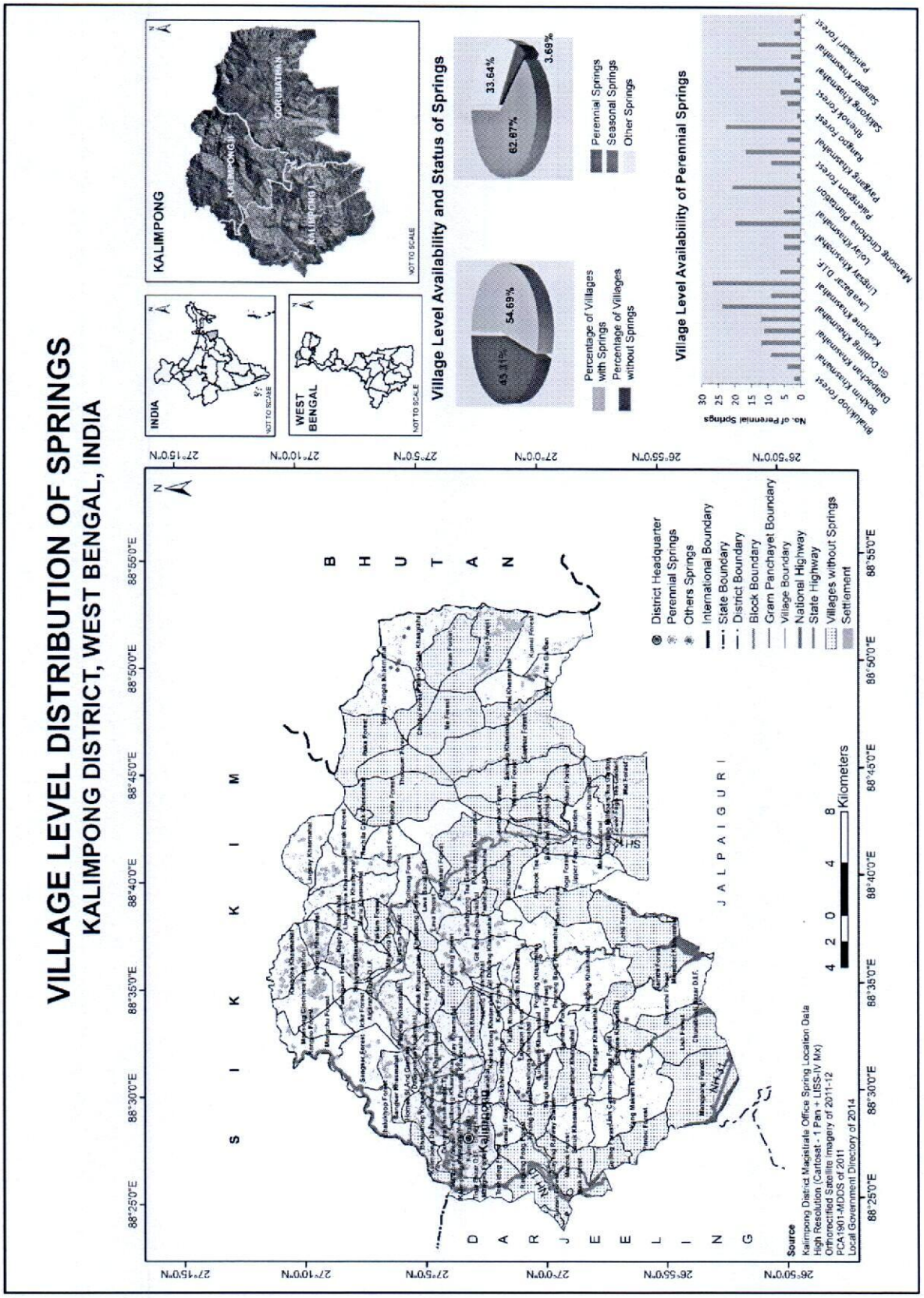


Fig. 18 Village level distribution of springs, Kalimpong district, West Bengal

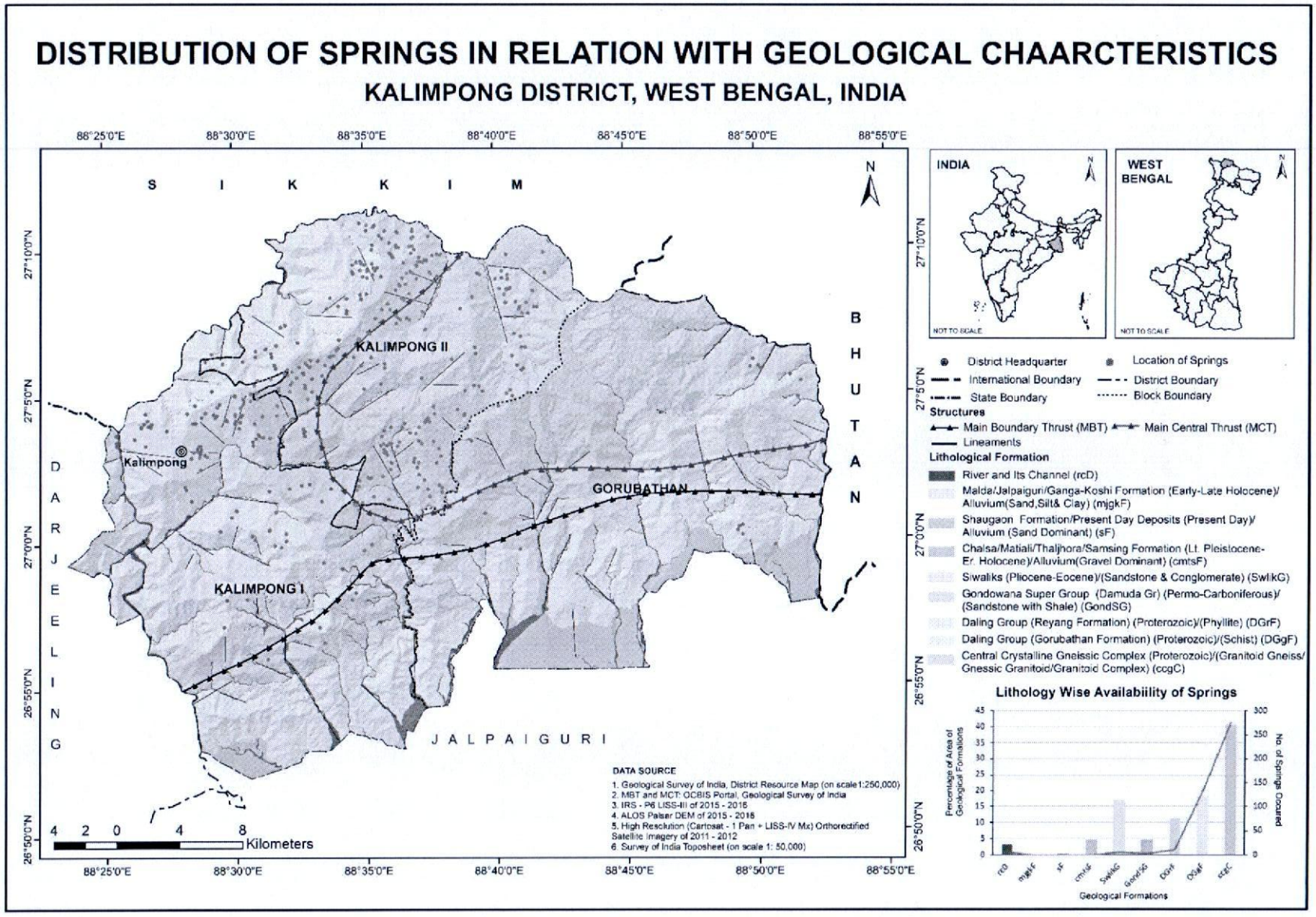


Fig. 19 Distribution of springs in relation with geological characteristics, Kalimpong district, West Bengal

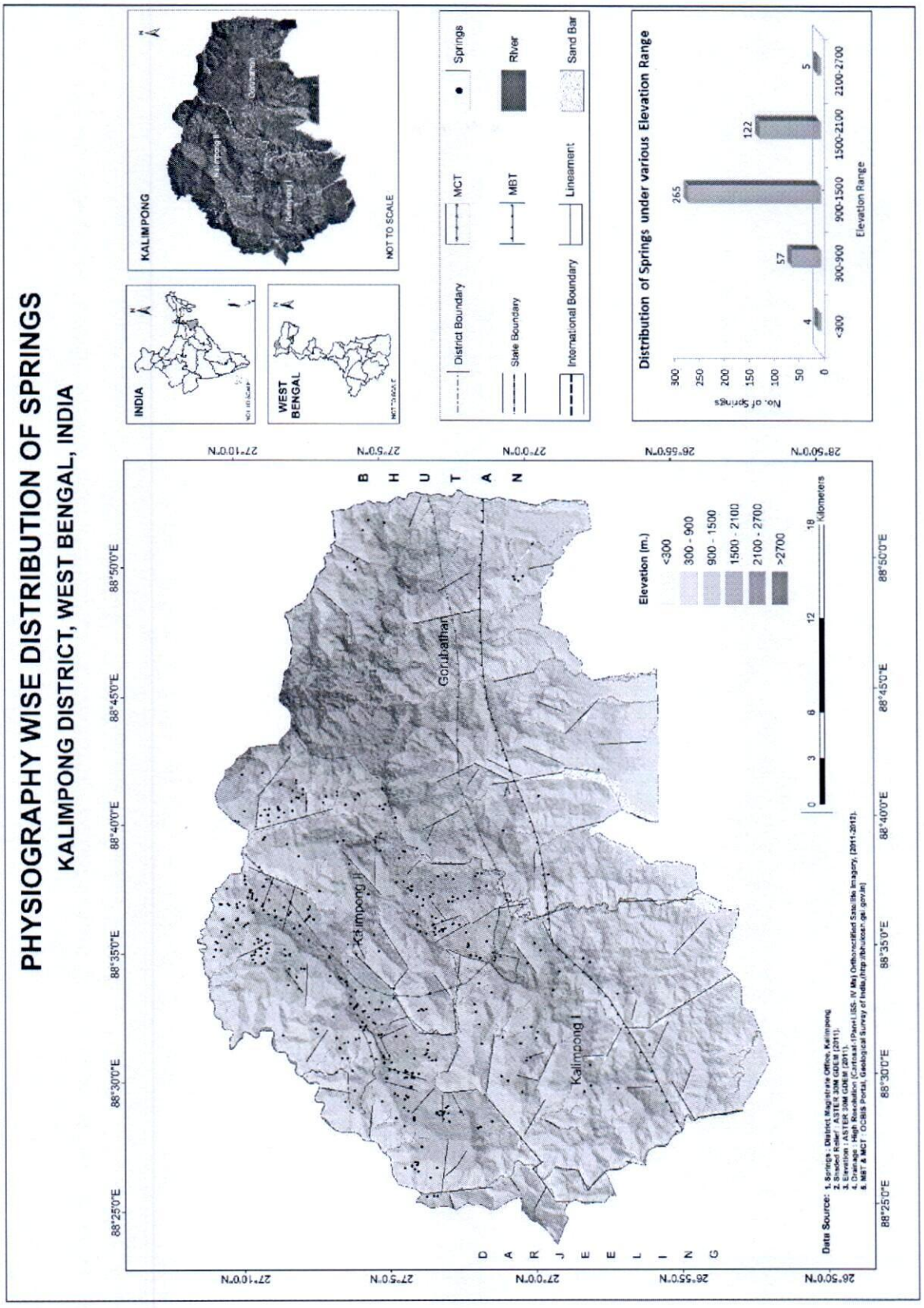


Fig. 20 Physiography wise distribution of springs, Kalimpong district, West Bengal

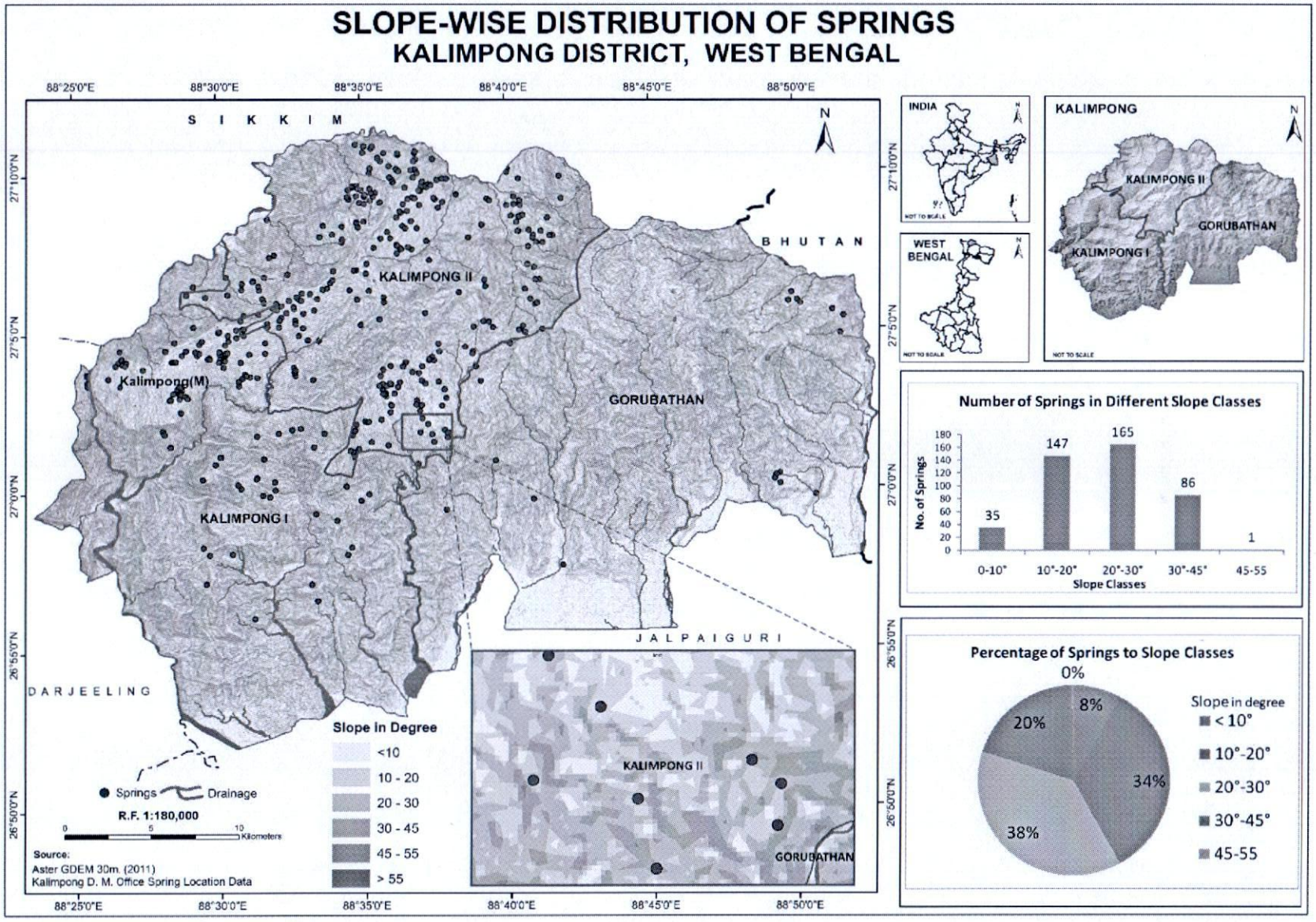


Fig. 21A Slope wise distribution of springs, Kalimpong district, West Bengal

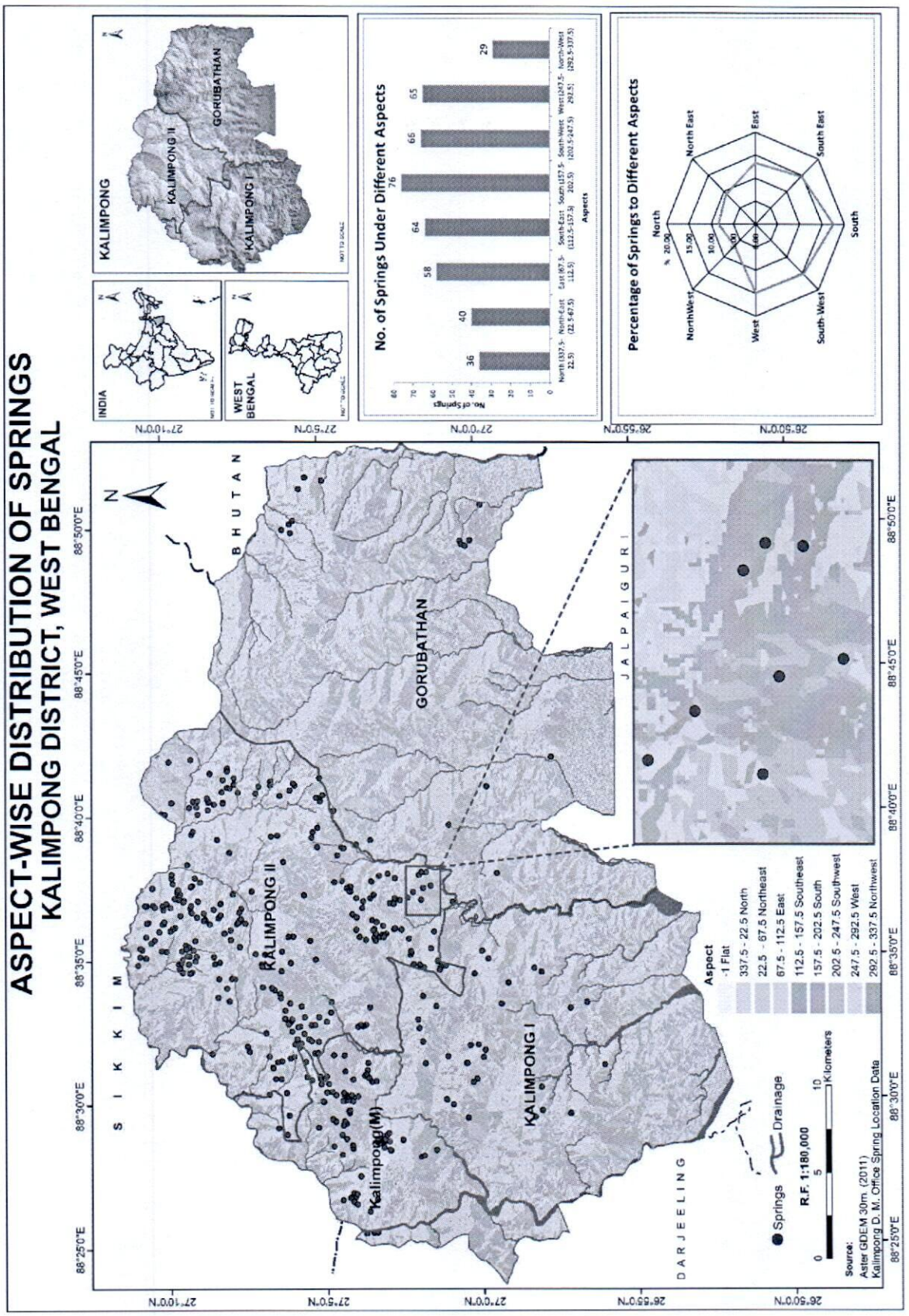


Fig. 21B Aspect wise distribution of springs, Kalimpong district, West Bengal

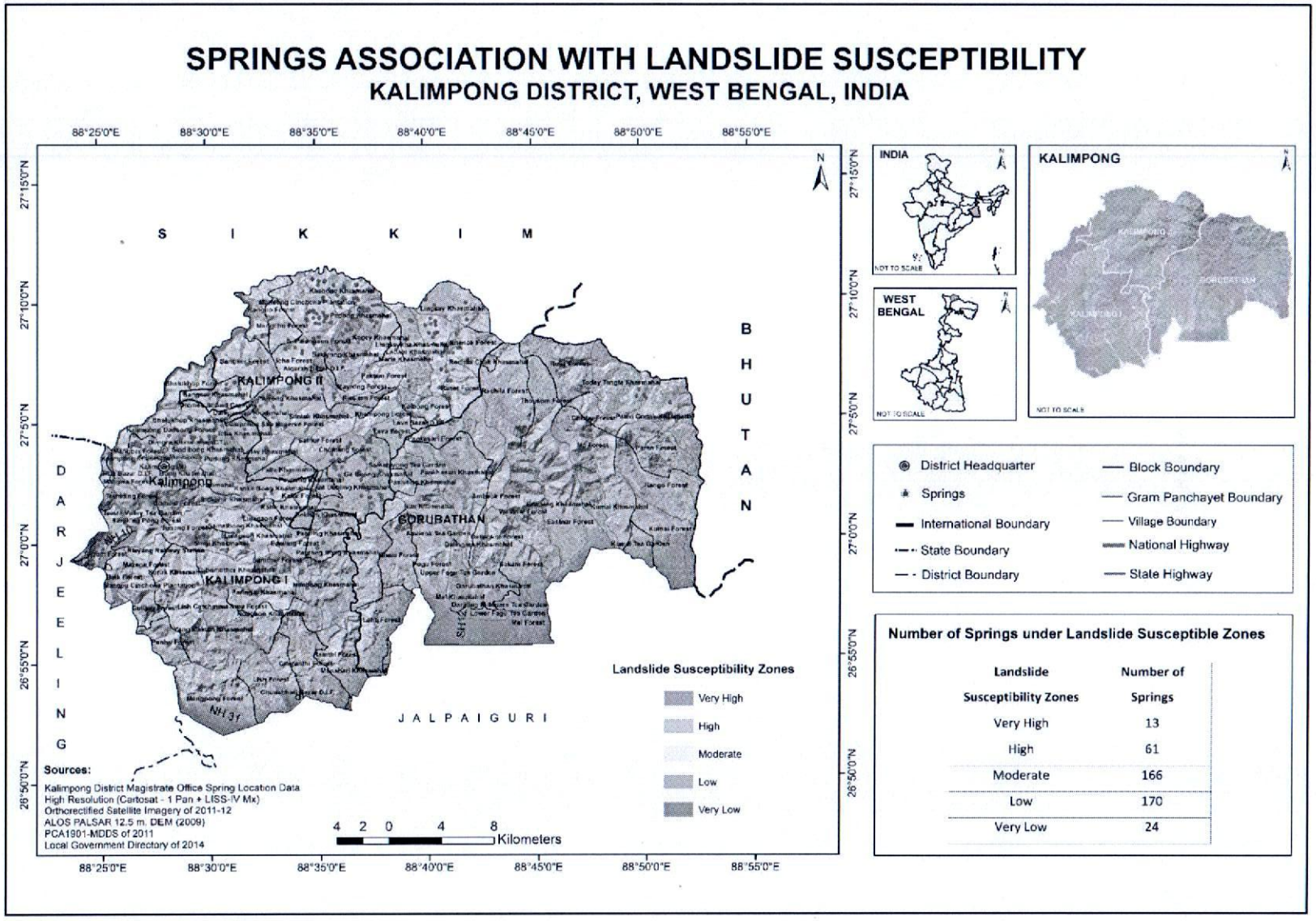


Fig. 22 Springs association with landslide susceptibility, Kalimpong district, West Bengal

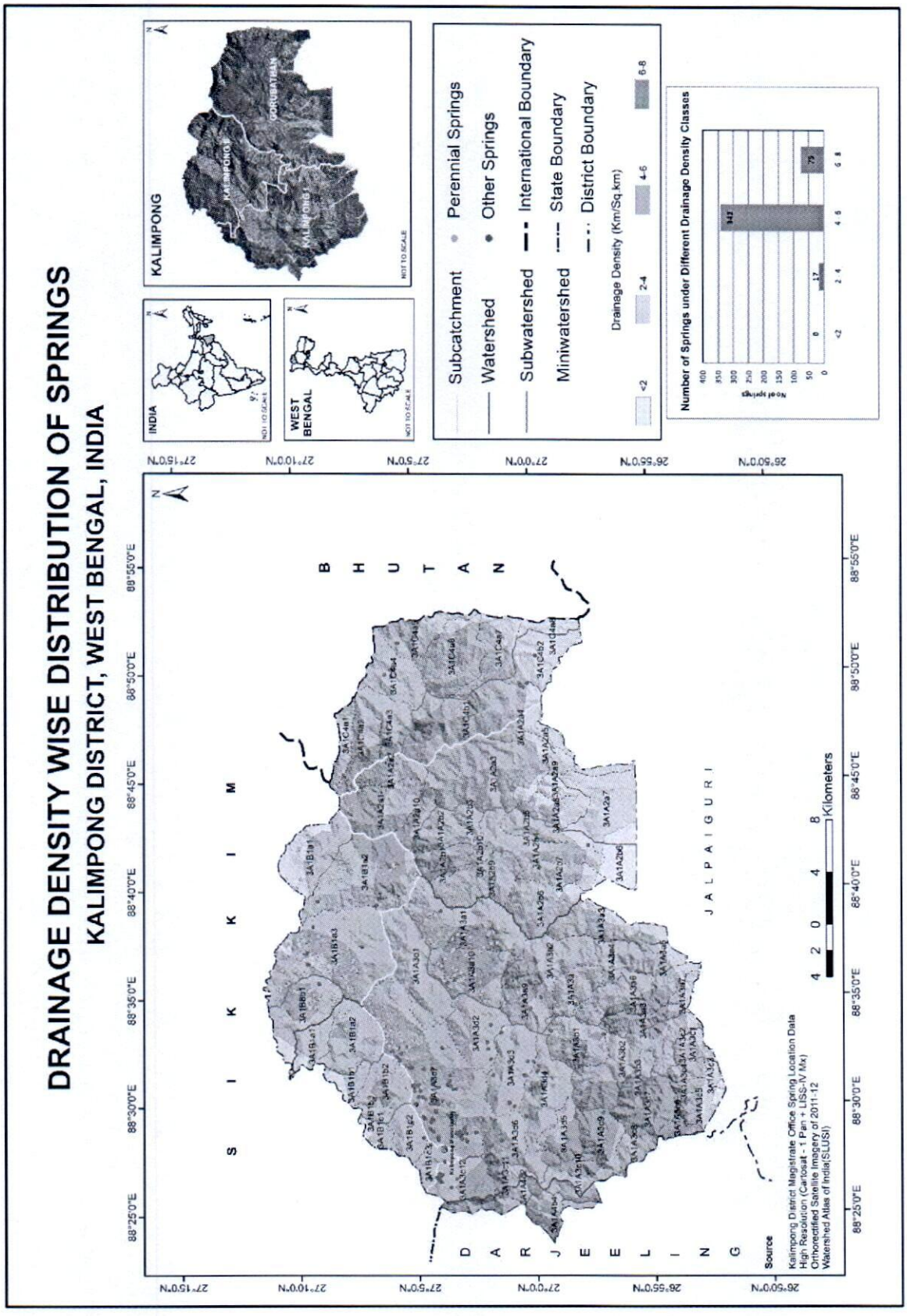


Fig. 23 Drainage density wise distribution of springs, Kalimpong district, West Bengal

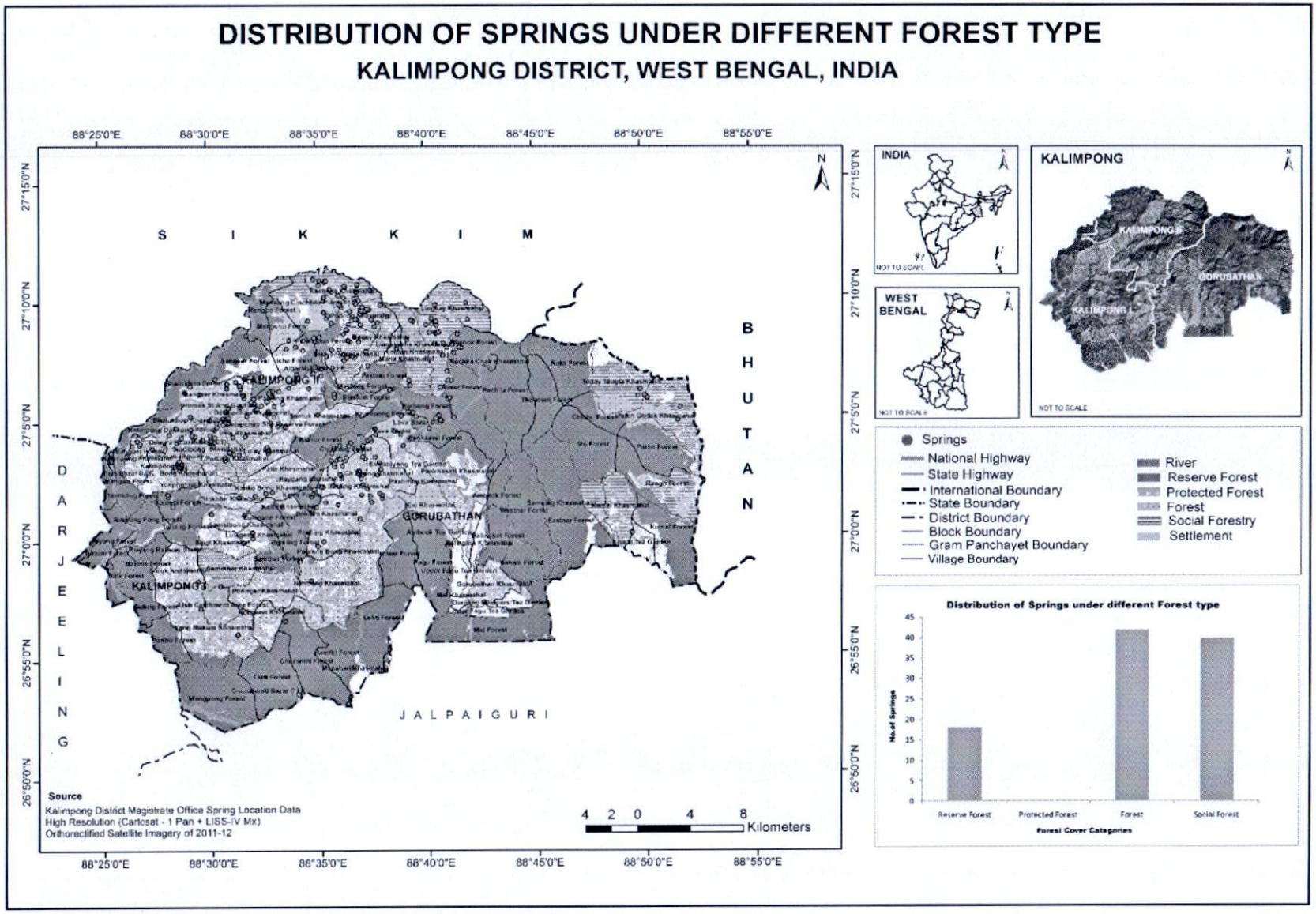


Fig. 24 Distribution of springs under different forest type, Kalimpong district, West Bengal

4.4 Methodologies to Manage Springs Water

Climate change induced irregular rainfall, rise in temperature, and lowered atmospheric humidity levels like events directly affect the water availability of springs in the Himalayas. Alongside, the spring discharges are decreasing, and there is an immediate need for revival. It is already reported that half of the perennial springs have already dried up or have become seasonal, resulting in an acute water shortage for drinking and other domestic purposes across hundreds of Himalayan villages (Shrestha et al. 2018/4; Siddique et al. 2019). Hence, methods for managing springs water and springshed is the need of the hour. In this context, some of the advanced methodologies e.g., Proximity Analysis from Inhabited Villages with No Springs, Proximity Analysis of Springs to Agricultural Lands and Settlements, Accessibility to Springs from Major Roads, Prioritisation of Water Management Zones using Hot Spot and Cold Spot Analysis and Spring Management Suitability Analysis through Thiessen Polygon have been taken into consideration. Here, for the aforesaid purposes the adopted techniques are the integration of geo-spatial technology along with field derived data and focus of these initiated techniques for spring water management necessarily co-related with community-management of sub-surface water resources. Involvement of the community in the development, monitoring and maintenance of springs is essential here, as there are cultural and religious beliefs that motivate people to protect springs

4.4.1 Block Wise Proximity Analysis from Inhabited Villages with No Springs

Village level distribution pattern analysis of springs expresses that there are certain villages with no springs. For the individual blocks i.e., Kalimpong I, Kalimpong II and Gorubathan, it has been identified that there are certain mountainous villages with no springs, even some of them having no source of water. With that being said, Block Wise Proximity Analysis has been performed from inhabited villages with no springs. This proximity tool is applied to discover proximity relationships between villages. This tools output information with multi-ring buffer features is utilized to delineate areas of influence in terms of distance from the geo-center of the inhabited villages with no springs. The multiring buffer classifies the areas around individual villages (inhabited villages with no springs) into the near and moderate distances for the analysis.

In the Kalimpong I block there are 120 springs serving 1851 HH in total but 18 villages are also present with no springs. The multi-ring buffer from the specified villages points out 42 within the 2 km distance, whereas upto 4 km distance there are 94 springs have been observed. Among these total 136 recognized springs, 21.32% of perennial sources and the rest 78.68% is seasonal/other types (**Fig. 25A**). The Kalimpong II block contains 290 springs that cater for a total of 4834 HH. From the concerned villages with no springs, there are 18 springs within 2 km distance while 78 springs have been identified at a distance of 4 km (**Fig. 25B**). The water availability condition for the Gorubathan block is much poorer than the other two blocks. In Gorubathan block, the lesser number of springs, 24, supports a large amount of HH 1846, and out of the total 38 villages, there are 17 villages in this block having no

springs. Alongside, there are 12 springs within 2 km, and 29 springs at a distance of 4 km exist from those villages with no spring. Out of the total available springs in this particular block, 58.54% is perennial and the rest of the 41.46% of spring is seasonal or already dried up. The picture of block wise village level spring water availability depicts an underprivileged state of rural HH, as in the Gorubathan block, the average HH pressure on spring is sometimes higher than 200 HH (**Fig. 25C**).

4.4.2 Proximity of Springs to Agricultural Lands and Settlements

Proximity assessment of springs to agricultural lands and settlements can be divided into two categories depending on the type of input. Though, the feature-based proximity tools vary in the types of output they produce. The tool adds a distance measurement attribute to the input features for analysing the nearness from spring water sources. The existence of agricultural land and related activity largely depends on springs in the hills. The relationship between these two, when plotted on the spatial map, established the fact well, and it is evident that almost 50% agricultural land of the Kalimpong district is located within the distance of 500m from springs. The percentage area in agriculture has decreased with increasing distance from the spring water points; only 4% of the farming lands are found beyond 3 km distance from the springs (**Fig. 26A**).

Likewise, lives on earth could not survive without the availability of water. It is a well-known fact that hills act as the primary water source for the entire plain below but could not hold the same for itself due to a higher degree of slope and extraordinary run-off. The people of hills, therefore, are seriously dependant on springs for daily water needs. One can find this statement well established in the Kalimpong hills also where it has been figure-out that almost 40% of settlements are located within a distance of 500m from springs. It may also be mentioned that the settlement areas decrease generally with the increasing distance from springs and it has been already observed that there are few villages in the Kalimpong hills that do not have any source of potable water within 2 km of it in spite of being inhabited e.g., Gorubathan Khasmahal, Paten Godak Khasmahal, Today Tangta Khasmahal etc. in the Gorubathan block and therefore, the hardships of this people regarding water collection can be felt (**Fig. 26B**).

4.4.3 Accessibility to Springs from Major Roads

Availability and accessibility to springs from major roads are other important concerns for the natives of Kalimpong district. It is one of the usual practices for the local people in the hills to collect water by some unrealistic unavoidable circumstances. There are earlier investigations limited to identification of newer water sources (tubewells, borewells etc.), development storage facilities, pipelines, tankers, etc.) and augmentation of the existing water sources, but still accessibility to water sources like springs distance from major roads NH, SH and further to district and village roads yet to be explored. At this juncture, this study synthesizes the accessibility information to springs from roads e.g., NH, SH, district roads, village roads etc. that are passing through and inter-connected in the Kalimpong district. It has

been identified from the accessibility analysis that within 1 km there are 7 total springs from the NH 10, 115 springs can be traced from the SH12 and 43 springs in proximity to district road. The accessibility distance to springs for the village roads has been reduced a little, and it is estimated that within 250 meter from the village roads there are 268 springs and inside 500 meters 339 springs have been found. Here, the accessibility measures with emphasis on village roads and their association with the vicinity from inhabited villages having springs might be instinctive to the local stakeholders (**Fig. 27**).

4.4.4 Prioritisation of Water Management Zones using Hot Spot and Cold Spot Analysis

Specific database creation pertaining to spring water management and potential zones identification was undertaken using the Hot Spot and Cold Spot Analysis (Getis-Ord Gi*) (Spatial Statistics). This tool identifies statistically significant spatial clusters (villages) of high HH pressure values on springs (hot spots) and spatial clusters with low HH pressure on springs (cold spots). It creates a new output feature class with a z-score, p-value, and confidence level bin (Gi-Bin) for each feature in the input feature class. After the primary analyses, an attempt has been made to prioritise the villages for water management based on availability of water in form of springs (both perennial and seasonal springs has been considered) versus the number of dependent households for the Kalimpong district. The outcome of this indexing may be divided into four (4) groups, viz. (i) Very High Priority villages requiring immediate Action. (**Table 10**, 9 villages in this category) (ii) High Priority Villages; Spring Management Programme should be taken up and other sources of water may be harnessed (**Table 11**, 22 villages), (iii) Moderate Priority Villages, phase wise rejuvenation programme for springs may be taken up (**Table 12**, 25 villages) and (iv) Low Priority Villages, spring rejuvenation may be taken up later (**Table 13**, 14 villages) (**Fig. 28**).

Photo plate 12 Village specific spring management programme work under Mahatma Gandhi National Employment Guarantee scheme in Bijanbari, Darjeeling-Pulbazar block, Darjeeling district. . Picture Courtesy: Prasari, Kalimpong

Table 10 Details of Very High Priority villages for spring water management

C.D Block Name	GP Name	Village Name	JL No.	Remarks
Gorubathan	Kumai	Kumai Forest	38	Immediate actions are required in these villages as to minimize household pressure on springs. Need to explore other water sources here to reduce water availability problem.
Gorubathan	Kumai	Kumai Khasmahal	36	
Gorubathan	Kumai	Kumai Tea Garden	37	
Gorubathan	Aahaley	Gorubathan Khasmahal	28	
Gorubathan	Paten Godak	Paten Godak Khasmahal	5	
Gorubathan	Todeytangta	Today Tangta Khasmahal	4	
Gorubathan	Pokhreybong	Pogu Forest	22	
Kalimpong II	Shangse	Rangpo Forest	1	
Kalimpong II	Shangse	Sangser Forest	25	

Table 11 Details of High Priority villages for spring water management

C.D Block Name	GP Name	Village Name	JL No.	Remarks
Kalimpong II	Shangse	Mangchu Forest	2	Villages of high priority also demand intense attention in spring water management as well may harness other sources of water.
Kalimpong II	Shangse	Mansong Cinchona Plantation	3	
Kalimpong I	Bhalukhop	Bhalukhop Forest	26	
Gorubathan	Gorubathan 2	Pankasari Forest	11	
Kalimpong II	Shangse	Icha Forest	24	
Gorubathan	Nim	Samabiyong Tea Garden	14	
Kalimpong I	Pabringtar	Churanthi Forest	88	
Kalimpong II	Lava-Gitabeong	Lava Bazar D.I.F.	15	
Kalimpong II	Shangse	Sangser Khasmahal	27	
Kalimpong II	Dalapchand	Dalapchan Ridge Reserve Forest	29	
Kalimpong II	Lava-Gitabeong	Lava Forest	16	
Kalimpong II	Lava-Gitabeong	Raset Forest	13	
Kalimpong I	Yangmakum	Yang Makum Khasmahal	82	
Kalimpong II	Kashyong	Kashone Khasmahal	4	
Kalimpong I	Dr. Graham's Home	Homes St. and Graihms	28	
Kalimpong II	Payong	Paiyong Khasmahal	32	
Kalimpong I	Bhalukhop	Bhalukhop Khasmahal	49	
Kalimpong I	Tista	Mangwa Forest	53	
Kalimpong I	Kalimpong	Kalimpong Khasmahal	55	
Kalimpong II	Dalapchand	Dalapchan Slip Reserve Forest	30	
Kalimpong I	Samthar	Suruk Khasmahal	80	
Kalimpong II	Lava-Gitabeong	Kolbong Forest	14	

Table 12 Details of Moderate Priority villages/census town (CT) for spring water management

C.D Block Name	GP Name	Village Name	JL No.	Remarks
Kalimpong I	Tista	Tista Bazar D.I.F.	52	Moderate priority villages are in a state where spring rejuvenation programme may be taken up in phased manner.
Kalimpong II	Lingse	Lingsay Khasmahal	10	
Kalimpong I	Pabringtar	Lish Catchment Area Forest	81	
Kalimpong I	Dungra	Dungra Khasmahal (CT)	48	
Kalimpong II	Dalapchand	Dalapachan Khasmahal	31	
Kalimpong I	Upper And Lower Echhey	Icha Khasmahal	45	
Kalimpong II	Lingse	Rhenok Forest	12	
Kalimpong II	Syakiyong	Sakiyong Khasmahal	21	
Kalimpong I	Kalimpong (M)	Kalimpong (M)		
Kalimpong II	Shantuk	Paiengaon Forest	22	
Kalimpong I	Pabringtar	Paringar Khasmahal	67	
Kalimpong I	Neembong	Nimbong Khasmahal	65	
Kalimpong II	Gitabling	Chumang Forest	35	
Kalimpong II	Kage	Kagey Khasmahal	7	
Kalimpong II	Lava-Gitabeong	Git Beong Khasmahal	36	
Gorubathan	Pokhreybong	Pagrang Bong Khasmahal	17	
Kalimpong I	Bong	Bong Khasmahal	39	
Kalimpong II	Shantuk	Rissium Forest	18	
Kalimpong II	Lingseykha	Lingsaykha Khasmahal	11	
Kalimpong II	Pedon	Pedong Khasmahal	6	
Kalimpong I	Sindepong	Sindibong Khasmahal	47	
Kalimpong I	Pudung	Pudung Khasmahal	46	
Kalimpong II	Kage	Ladam Khasmahal	9	
Kalimpong II	Kage	Maria Khasmahal	8	
Kalimpong II	Shantuk	Santuk Khasmahal	33	

Table 13 Details of Low Priority villages for spring water management

C.D Block Name	GP Name	Village Name	JL No.	Remarks
Kalimpong II	Gitabling	Paygang Khasmahal	38	These villages are not in a position of water shortage. The gap in water demand and supply is not so widened. However, spring rejuvenation may be considered for future water security.
Kalimpong I	Samthar	Samther Forest	68	
Kalimpong I	Samalbong	Singi Khasmahal	70	
Kalimpong I	Kaffer Kanke Bong	Lulagaon Khasmahal	61	
Kalimpong I	Seokbir	Slokbhir Khasmahal	59	
Kalimpong I	Samalbong	Samalbong Khasmahal	60	
Kalimpong I	Bong	Comesi Forest	72	
Kalimpong II	Gitabling	Git Dubling Khasmahal	37	
Kalimpong II	Gitabling	BokhimKhasmahal	22	
Kalimpong I	Neembong	PemlingKhasmahal	64	
Kalimpong II	Lole	Lolay Khasmahal	44	
Kalimpong I	Kaffer Kanke Bong	Kaffir Khasmahal	41	
Kalimpong I	Neembong	Pemling Forest	63	
Kalimpong I	Kaffer Kanke Bong	Kanke Bong Khasmahal	42	

4.4.5 Spring Management Suitability Analysis through Thiessen Polygon

Himalayan springs are unique due to their varied origin, and it is difficult to take a decision for their management. Mainly, most of the perennial flow of water comes from natural springs. On the other hand, bearing in mind the water shortage problems due to climate change of the Himalayan ecosystem we need to introduce proper management strategies for all the available natural sources of water. Hence, in this study, the Thiessen Polygon method has been used to analyse the level of suitability of Himalayan springs for management and intervention. A Thiessen polygon encloses all the space which is closer to the associated centre than to any other point. It is obvious that the borders of Thiessen polygons are the geometric places, which have the same distance to two centres and each Thiessen polygon contains only a single point input feature. This tool is used to divide the area covered by the input point features into proximal zones. All points are triangulated into a triangulated irregular network that meets the Delaunay criterion. The perpendicular bisectors for each triangle edge are generated, forming the edges of the Thiessen polygons.

Table 14 Indicators, indicator sub class and weight used in spring management suitability analysis

Sl No.	Indicators	Indicator Sub Class	Weight	Sl No.	Indicators	Indicator Sub Class	Weight
1	Average Slope (in degree)	<15°	10	5	Landslide Events (in numbers)	< 2.0	10
		15°-20°	7			2.0-8.0	7
		20°-25°	5			9.0-16.0	3
		25°-30°	4			17.0-32.0	2
		>30°	3			> 32.0	1
2	Relative Relief (in meter)	<200	10	6	Agricultural Land (in percentage)	< 10.0	2
		201-400	8			10.0-20.0	4
		401-600	7			20.0-30.0	6
		601-800	6			30.0-40.0	7
		800-1000	5			40.0-50.0	8
		> 1000	4			> 50.0	10
3	Slope Aspect (direction)	North	4	7	Settlement Area (in percentage)	< 10.0	2
		North-East	5			10.0-20.0	4
		East	6			20.0-30.0	6
		South-East	7			30.0-40.0	7
		South	10			40.0-50.0	8
		South-West	7			> 50.0	10
		West	8				
		North-West	3				

Table 14 cont.

Sl No.	Indicators	Indicator Sub Class	Weight	Sl No.	Indicators	Indicator Sub Class	Weight
4	Drainage Density (km/sq.km)	< 2.0	10	8	Dependent Households per Spring (in numbers)	< 10.0	5
		2.1-4.0	8			10.0-20.0	6
		4.1-6.0	7			21.0-30.0	7
		6.1-8.0	4			31.0-40.0	8
		> 8.0	2			> 41.0	10

4.4.5.1 Rationale behind Selection of Indicators

Spring suitability analysis for management of spring by involving significant regional factors were found to be crucial and active specifically in the hilly terrain. The rationales behind their involvement are well-articulated below;

- **Aspect of slope** reflects the moisture retention, vegetation growth and its relation to rain-bearing wind and sequence of rock bedding, which in turn influences the physical properties of slope material, soils and thereby it has the potential for groundwater. The role of bedding structure and geology in relation to an aspect is also noteworthy, and the slope aspect in the moisture regime seems to have played a determinant part for the groundwater spring potential.
- **Average slope** of a Thiessen polygon is generated from ASTER GDEM (30m spatial resolution) data. The Average slope of an area denotes average steepness or gradient. Being a part of the tropical monsoon climate the DHR gets the maximum amount of monsoon rainfall which is very much seasonal and the average slope of the region controls the amount of surface run-off, rate of infiltration to the rock strata, subsurface flow of water and vegetation cover.
- **Relative relief** denotes the range between the highest and lowest relief of a topography. Relative relief has been extracted for each and every Thiessen polygon to understand the nature of local relief in respect to each spring occurrence. It is related to the slope of surfaces within the polygon area and correspondingly to the gradient of streams present in the study area. Again the erosion and denudation processes are closely related to the relative relief of a unit of area, giving a particular emphasis for a polygon with high relative relief associated with landslide events that can be a challenge for spring intervention opportunity.
- **Drainage density** refers to the total length of all stream segments and rivers in a drainage basin divided by the total area of the drainage basin. Drainage density variation has revealed a number of factors viz., climate, geology, topography, soil infiltration capacity, vegetation that collectively influence stream density. High drainage density indicates a higher bifurcation ratio and it influences drainage basin stares which are surface or subsurface water repositories of significant quantities of water that may regulate the rate at which input feeds through to the output in form of springs.

- **Landslides** are quasi-natural phenomenon which is a serious threat to our studied region as observed there are a huge number of landslide events due to various natural influences like fragile lithology, incessant rainfall, toe erosion of riverbank, the geomorphic sinking of a watershed and a lot of anthropogenic activities like settlement and road construction, deforestation, rock quarrying, rat hole mining etc. In this work, nearly every Thiessen polygon a contains substantial number of landslide events, which is a grave concern to spring management that is why without giving importance to landslides for spring interventions; it may hasten a high magnitude of risk for the environment.
- **Percentage area of settlements** by considering settlement polygon which is basically representing human habitation. In this study, it has rationally assumed that a higher percentage of settlement area in respect to a particular Thiessen polygon probably contain a higher number of population and this big amount of population needs higher amount of potable water. In that very case, paying greater concentration on a higher percentage of settlement area ranked as 1 and has been given higher weight as 10.
- **Percentage area of agricultural land** in an area stands for water rigorous human practices. In the Himalayan ecosystem agriculture is a periodic practice that is mainly based on rainwater. But sometimes it can be seen that small scale agricultural activities are carried out based on spring water, though it is not necessary that spring water is the major contributor of water for agriculture of the region, however where it is available it is utilised for agricultural purposes. The Darjeeling Himalayan agriculture is fundamentally practiced for local demand (other than Tea, Mandarin, Cardamom and Ginger) and for this presence of a higher percentage of agricultural land in a particular Thiessen polygon is significant indicator of water demand.
- **Number of dependent household per spring** specifies the springs are major sources of household consumable water in the mountain communities. The magnitude of dependent households per spring indicates population pressure on a particular spring. Rural population of the Himalayan villages are at a great hindrance as most of the freshwater flowing through streams originating in the mountains is not readily accessible to them due to the terrain characteristics of the region. Thus, every single accessible spring is under huge population pressure to fulfil all single aspects of household consumption. Considering this reality number of households per spring has been considered as an important indicator to the measurement of priority and suitability of springs for its demand.

4.4.5.2 Weight Assignment to Indicators

The weights have been assigned based on available data of each indicator and their variation in sub classes, but the prime focus was on the required intervention strategy for springs. In this regard, quantification has been carried out in terms of the variability of spring number overlayed on each indicator layers data. Hybrid nature of indicators likewise Relative Relief, Average Slope, Drainage

Density and Landslide Events are sensitive or negative indicators for the management processes, thus highest weight has been given to that particular sub class of indicator which is less associated with springs. On the contrary, highest weight has been attributed to the water associated indicators like Aspects of slope and water demand related indicators like Percentage of agricultural land area, Percentage of settlement area and number of households, which are positively associated with springs and likely contribute to the management process. Thereafter, the sum of assigned weights of all sub-indicators classes (in a range of 10 point scale) has been calculated to get the suitability value of each Thiessen polygon.

4.4.5.3 Spring Suitability Map

Calculated suitability value of each Thiessen polygon has been considered to create the final Spring Suitability (management) Map **(Fig. 29)** by categorizing the values in three distinct classes based on the range of obtained values; Highly Suitable (>50), Moderately Suitable (40-50), Less Suitable (<40) and further to make a decision on spring interventions strategy. Results show that the springs of Highly Suitable class along the ridgeline from Durpin Dara to Pedong with the nearest proximity to the settlements under both the Kalimpong I and Kalimpong II blocks are seeking greater attention for interferences, whereas moderately suitable springs located at the southern fringe of these blocks. In the Gorubathan block, springs are mostly concentrated in south-eastern parts and seeking greater intervention to mitigate the water shortage problems of locals.

4.5 Micro Scale (Sub & Micro Watershed Level) Studies

In the past, most water conservation programmes in the IHR and elsewhere were based on the watershed concept. Watersheds are easy to demarcate and hold great appeal for policymakers and implementers alike. However, the watershed concept only accounts for surface water movement over slopes, while the movement of spring water which is groundwater, determined by underlying factors like geology, the nature and slope of such rocks underneath the surface. Hence, the concept of watershed, therefore, cannot account for water that travels outside watershed boundaries, through rock beds that slope towards an adjoining watershed. Thereafter, for spring restoration, springshed management is a worthy choice and this calls for a paradigm shift from watershed to springshed as an appropriate unit of intervention in the DHR. In general, a combination of watersheds and the underlying aquifers provides us with the understanding of springsheds, a concept that has significant implications not only in developing a conservation approach to mountain water but also in attributing a common pool nature to spring water. Thus, in a more detailed way micro-scale (sub and micro watershed level) studies have been correspondingly initiated during the ongoing course of NMSHE project for better appreciation towards sustainable water resource management. This incorporates Rangmuk Nadi Sub-Watershed (2B1D7t) with a spring Bar Dhara, and another one is Sangsey Micro-Watershed (3A1B1a2b) which contains Devithan Dhara.

4.5.2 Bar Dhara

The Bar dhara comes out from the Rangmuk Nadi Sub-Watershed which is the part of Balason sub-catchment (2B1D) area and falls within the Rangmuk Nadi sub-watershed (2B1D7t). More specifically, this particular spring located in the Okas Tea Garden village of the Lower Sonada II GP at the Jorebunglow-Sukhiapokhri block of Darjeeling district. The Bar dhara occurred on Central Crystalline Gneissic complex and associated with a geological structural element-lineament. Such lineament as discussed earlier, works as a water conduit for spring recharge. At a slope range 30° - 45° and in North-West direction the spring discharges round the year. A large part of the concerned sub-watershed is covered with Tea garden and agricultural plantation (**Fig. 30**).

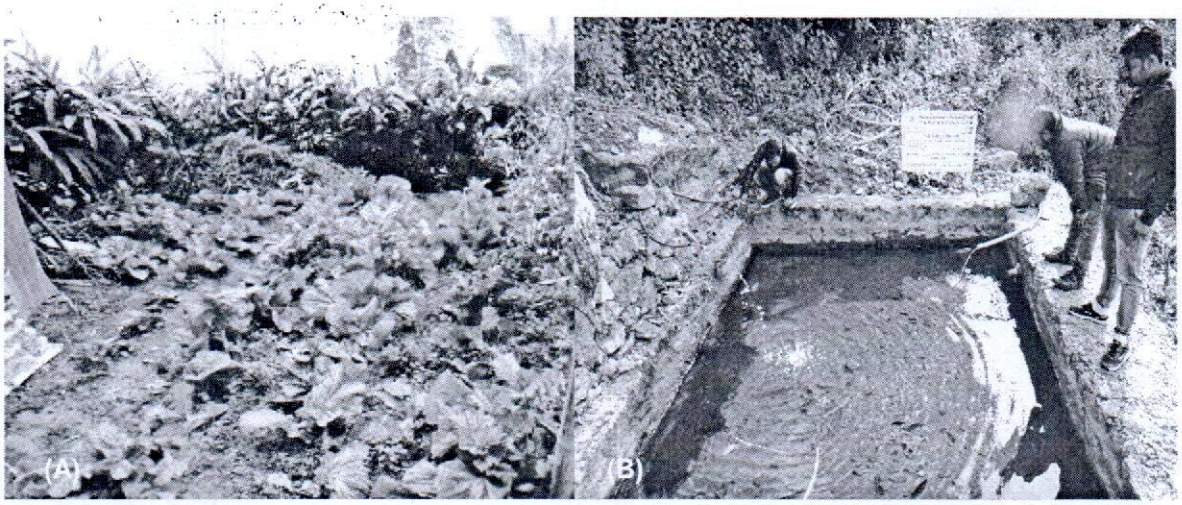


Photo plate 13 Climate change adaptation technique by springshed management programme to meet up the crisis of water scarcity and ensuring livelihood opportunities in form of (**A**) cultivation-orchards, (**B**) jhora fisheries, Upper Burmiak, Kalimpong II block, Kalimpong district

4.5.2 Sangsey Devithan Dhara

The Devithan dhara is a spring, located in the Upper Burmiak village of the Sangsey GP at the Kalimpong II block of Kalimpong district. It forms from a part of the Teesta upper sub-catchment (3A1B) area and falls within the micro-watershed (3A1B1b1b) of a small tributary that descends in the Teesta river. The area is well-known for its plantation activities nearby and about 35 families are dependent upon this spring for their required water. As information gathered and observations are made, natural events identical as changing pattern of rainfall due to climate change along with alteration in LULC practice in the micro-watershed region have been affecting the discharge of the spring since long before. But with the intervention of the local stakeholders, this spring was taken under the Mahatma Gandhi National Employment Guarantee scheme as a part of the Jharnadhara scheme in 2018-19 for spring water conservation and harvesting. Successful efforts towards the spring water management raised the water discharge rate as it become 5.6 ltr/min in 2020 from 2.5 litres/min in 2018. As a consequence, water reservoir/tanks have been constructed for storing this enhance discharge of water in the area and this has been successful in ensuring water security as well as the support of livelihood

of the community. Now, the spring discharge is not only used as drinking water; but also it promotes integrated agri-farm practices and fishing (**Fig. 31**).

With the help of the selected thematic database e.g. drainage with watershed boundaries, geology and landslide events, LULC and transport-settlement that has been prepared under NMSHE some cross-sectional analyses have been performed for the specific springs with the specified sub and micro-watershed boundary. Available spatial information on drainage shows these spring are fed by many small jhoras. Though, in the springshed management process, digging of percolation tanks is remarkably effective, but it is to be noticed from the lithological details and nearness to landslide events that. Hence, the method of spring rejuvenation through percolation tanks will appear with a gradual change in local hydrology in the area that may provide impetus to the landslide incidents in long term. Consequently, some alternative and sustainable measures should be looked for in rejuvenation process of the springs in near future.

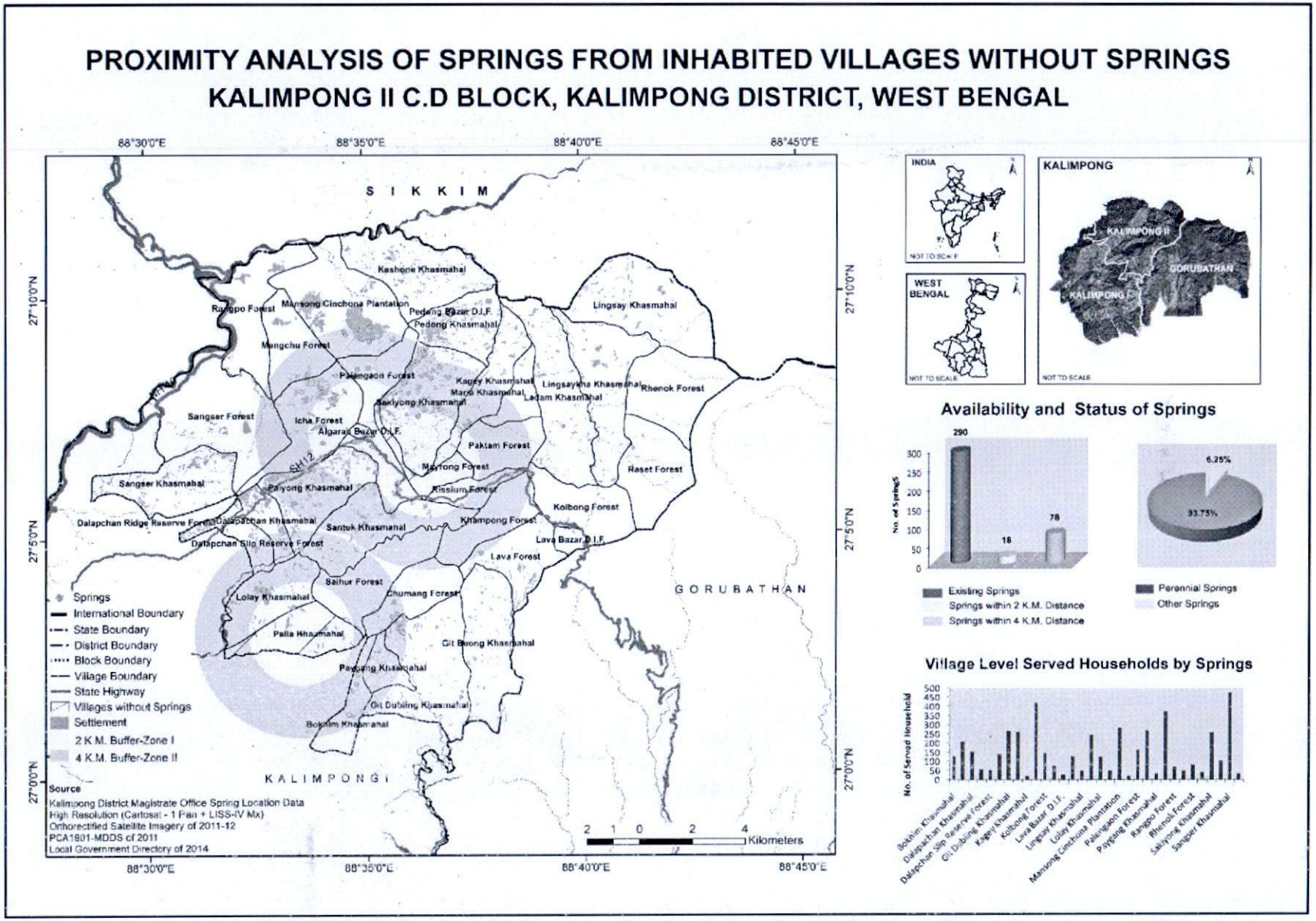


Fig. 25B Proximity analysis of springs from inhabited villages without springs, Kalimpong II C.D block, Kalimpong district, West Bengal

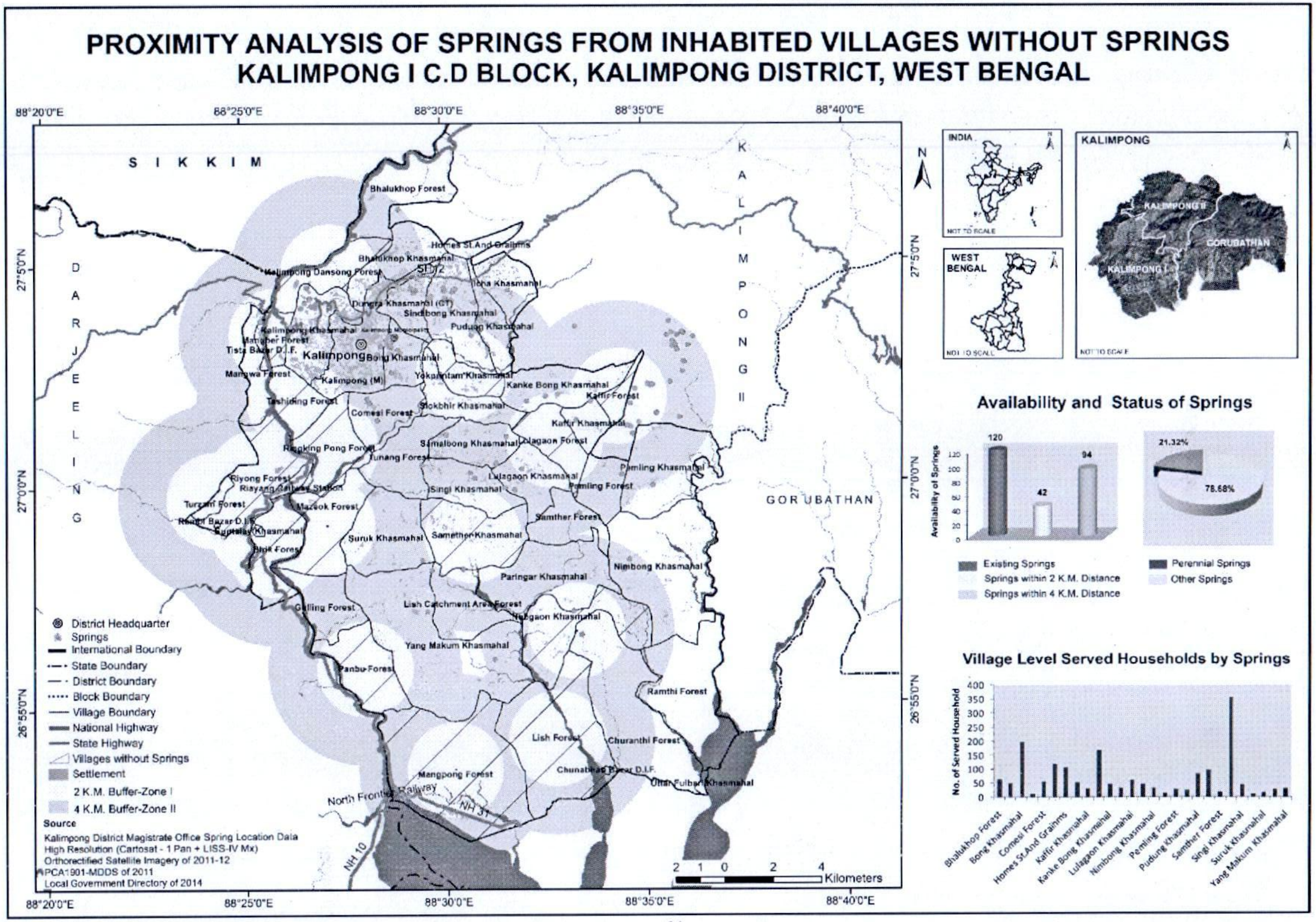


Fig. 25A Proximity analysis of springs from inhabited villages without springs, Kalimpong I C.D block, Kalimpong district, West Bengal

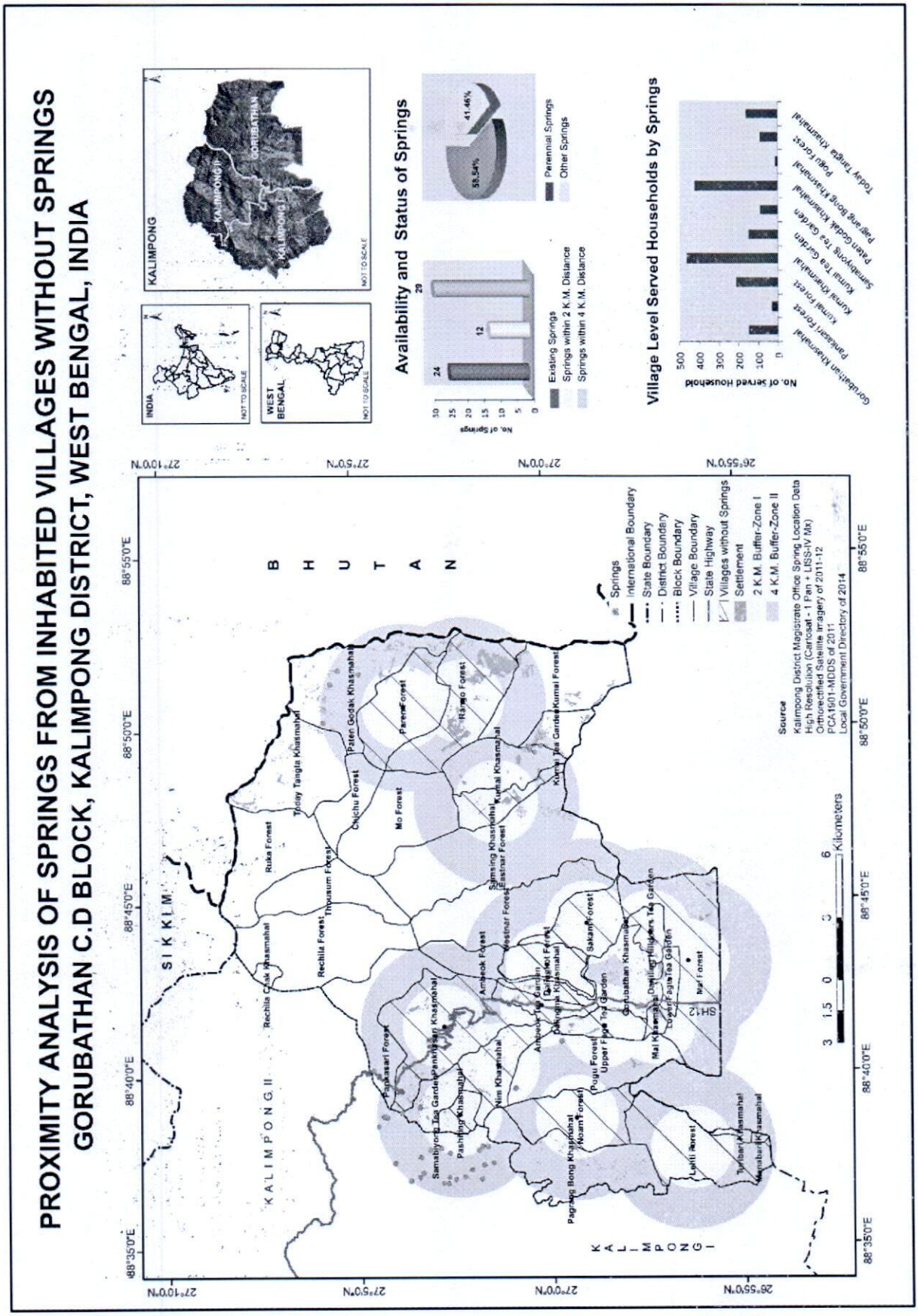


Fig. 25C Proximity analysis of springs from inhabited villages without springs, Gorubathan C.D block, Kalimpong district, West Bengal

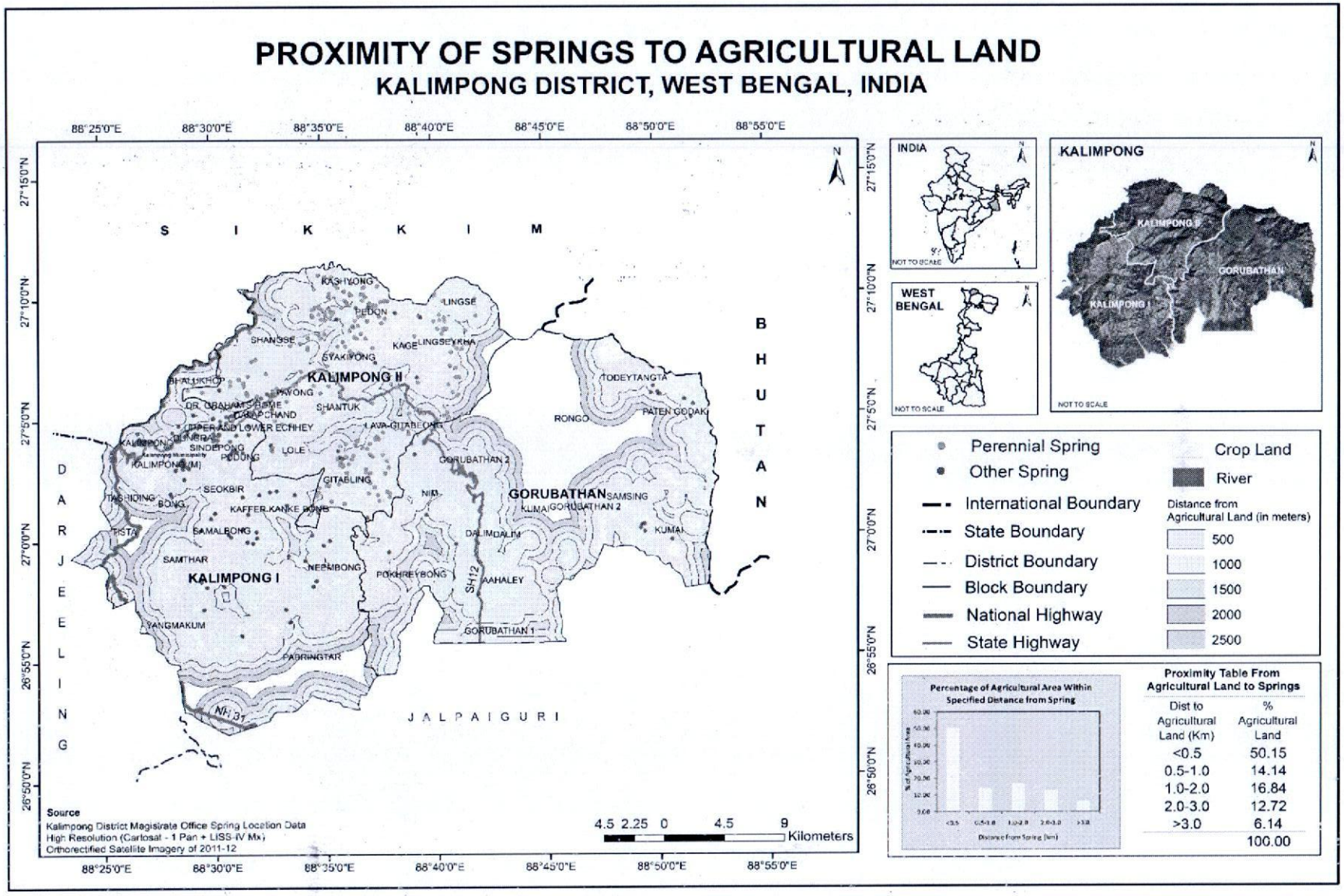


Fig. 26A Proximity of springs to agricultural land, Kalimpong district, West Bengal

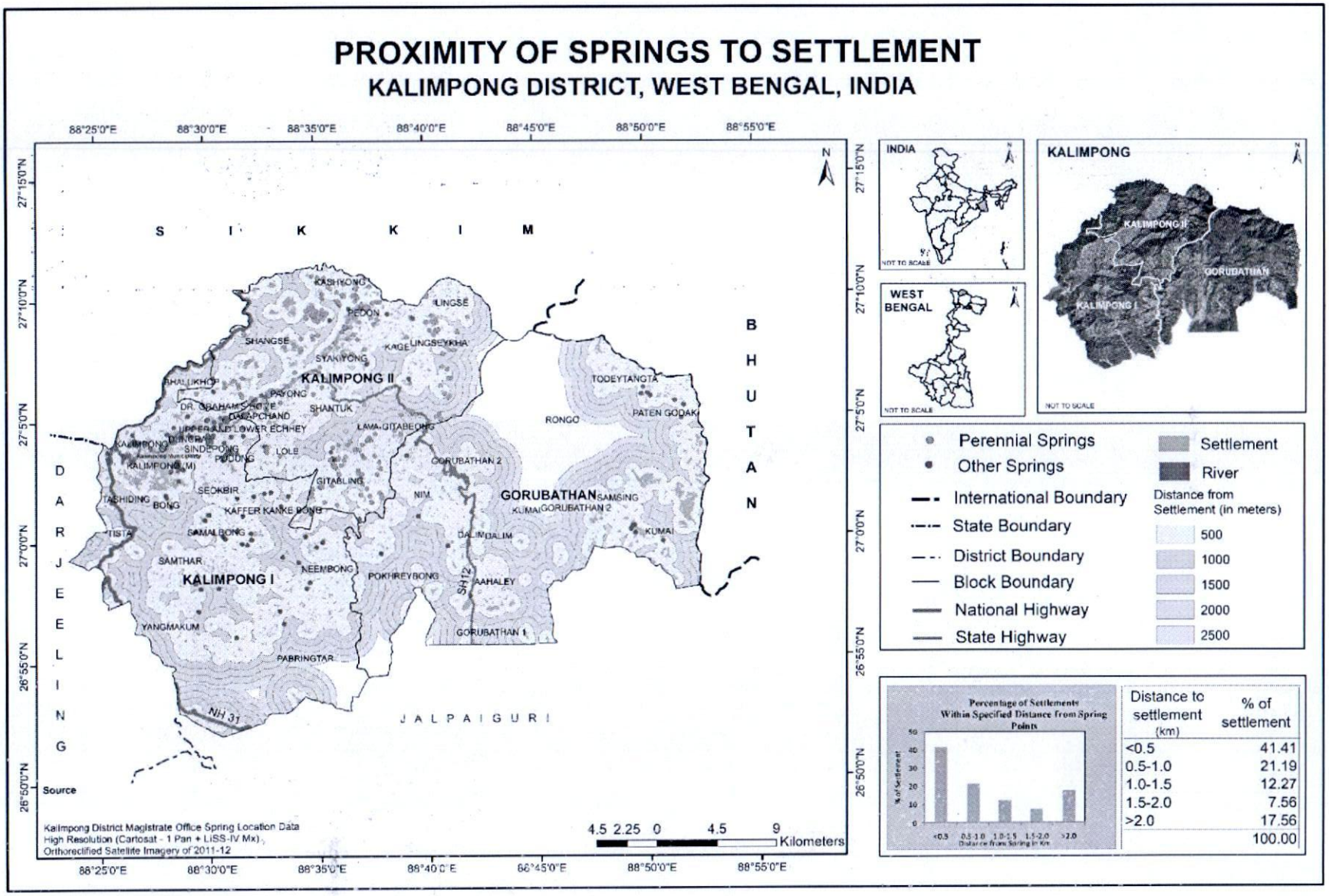


Fig. 26B Proximity of springs to settlement, Kalimpong district, West Bengal

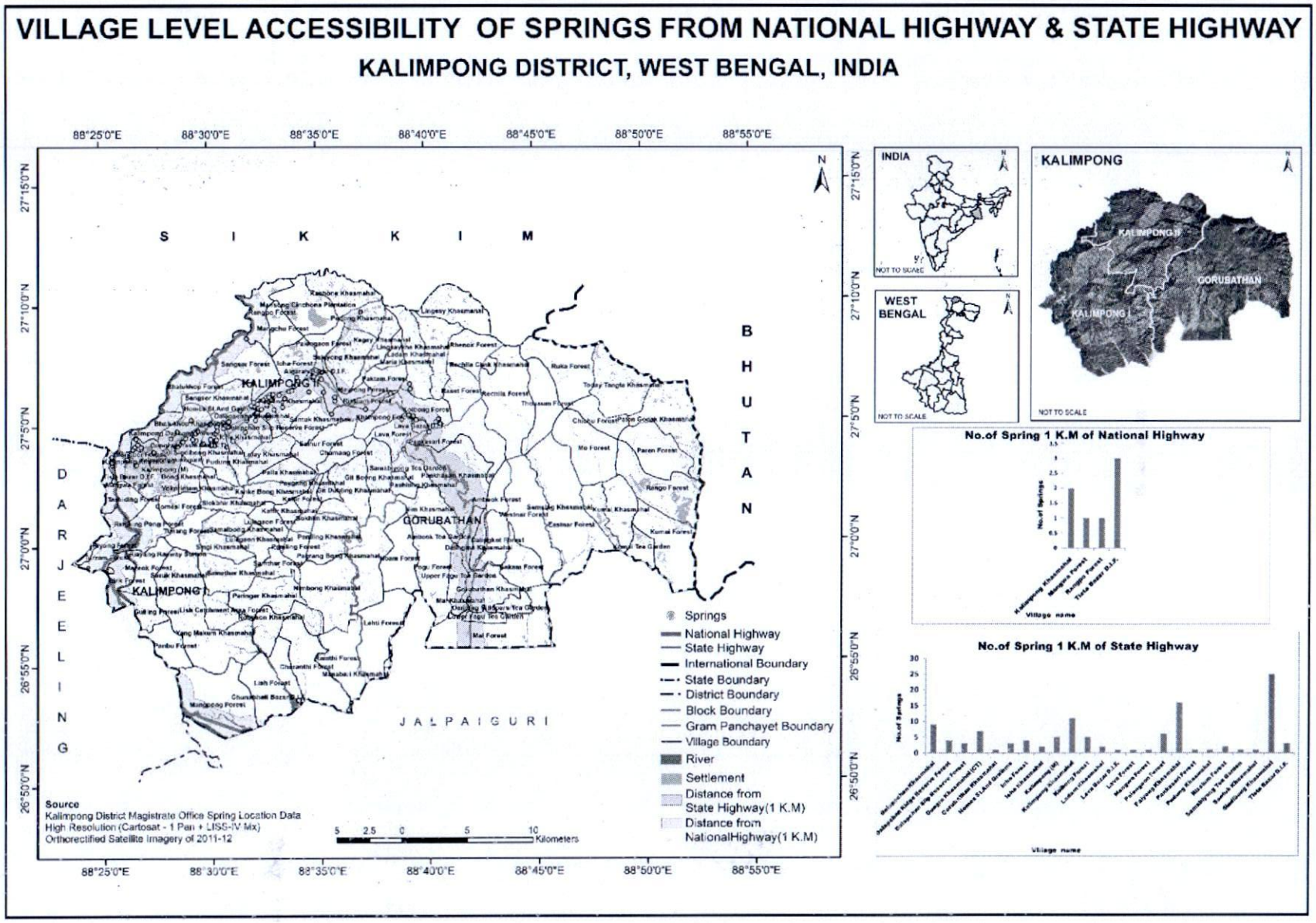


Fig. 27 Village level accessibility of springs from NH and SH, Kalimpong district, West Bengal

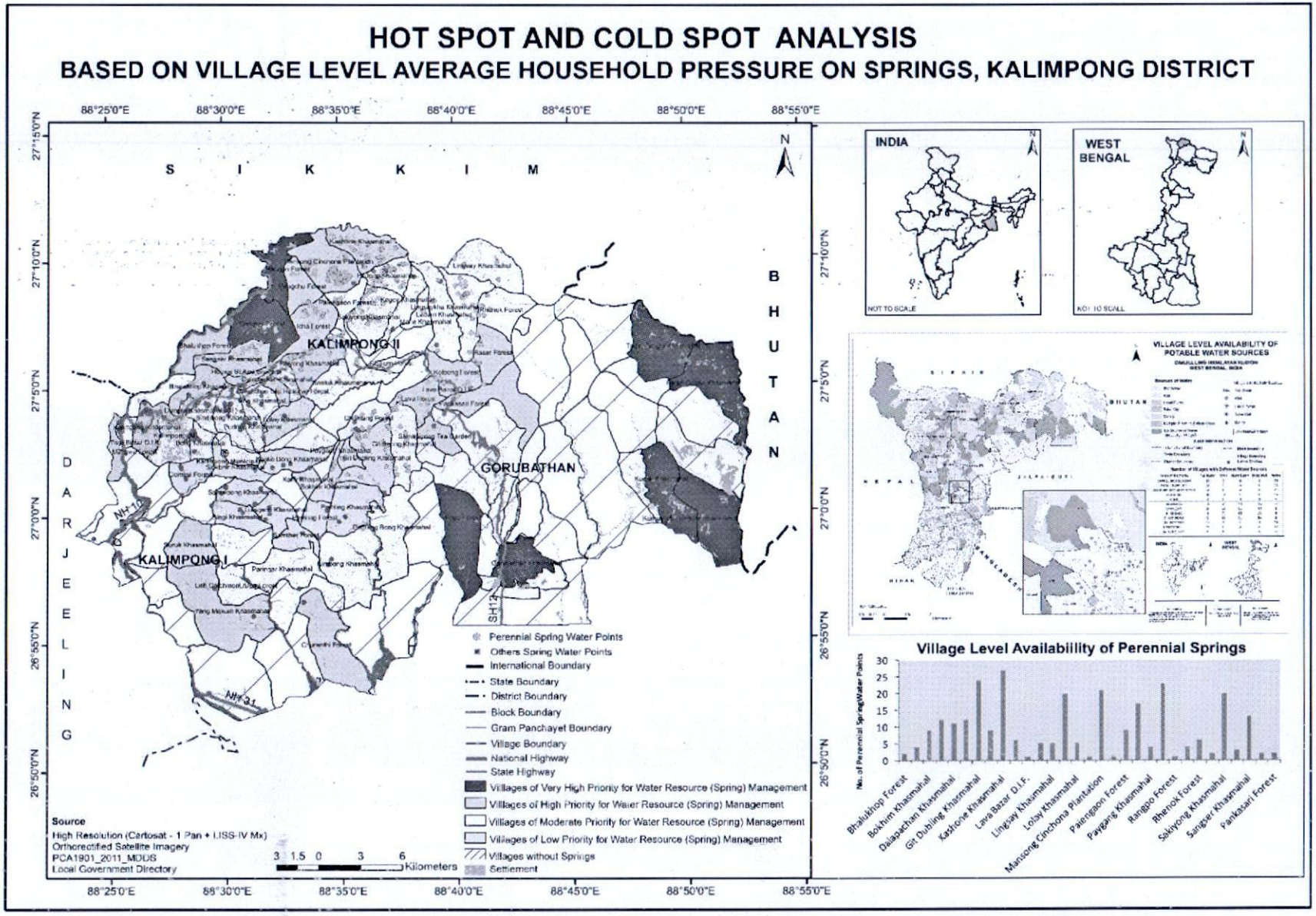


Fig. 28 Hot Spot and Cold Spot analysis based on village level average household pressure on springs, Kalimpong district, West Bengal

1613

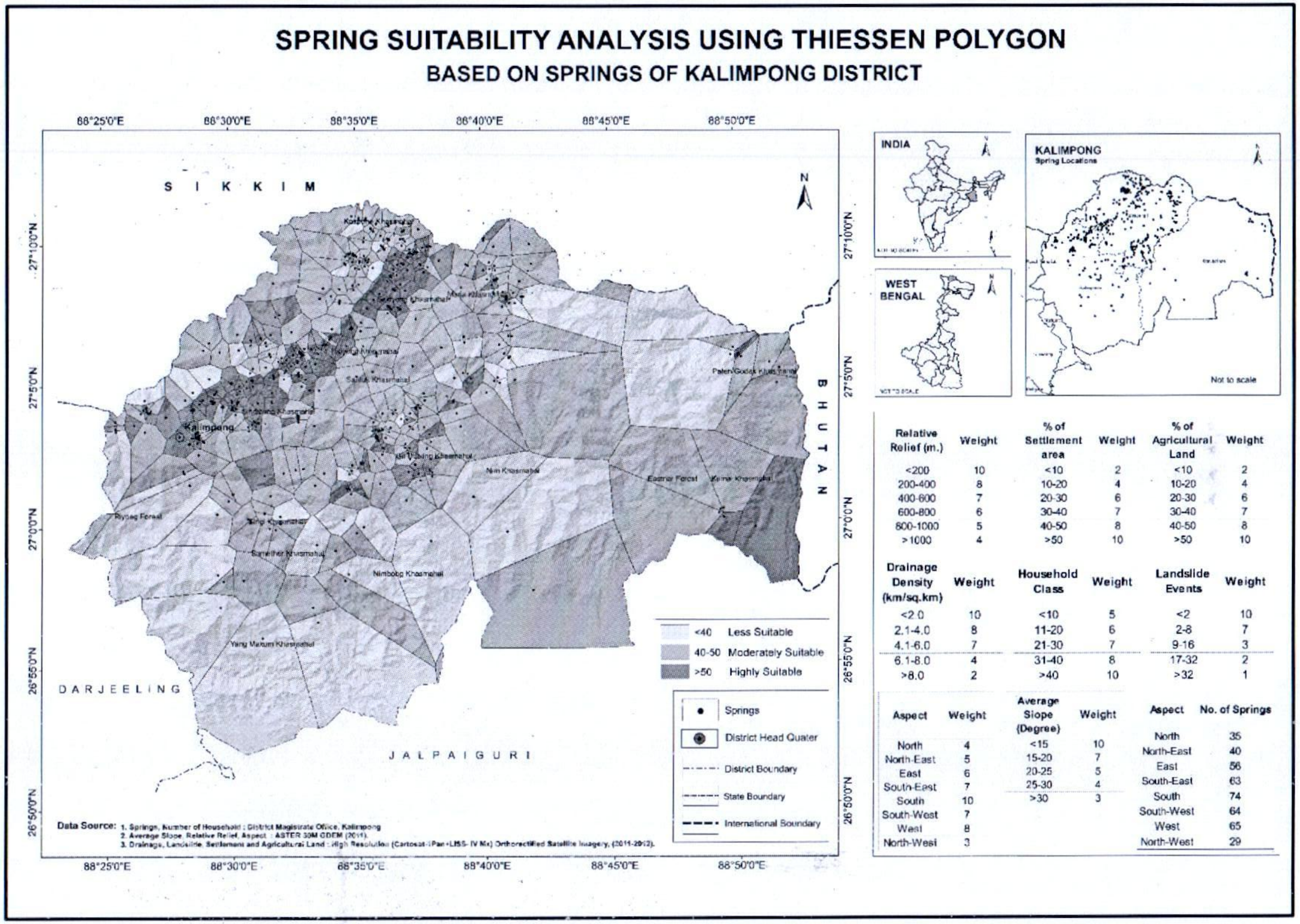


Fig. 29 Springs management suitability analysis using Thiessen polygon, Kalimpong district, West Bengal

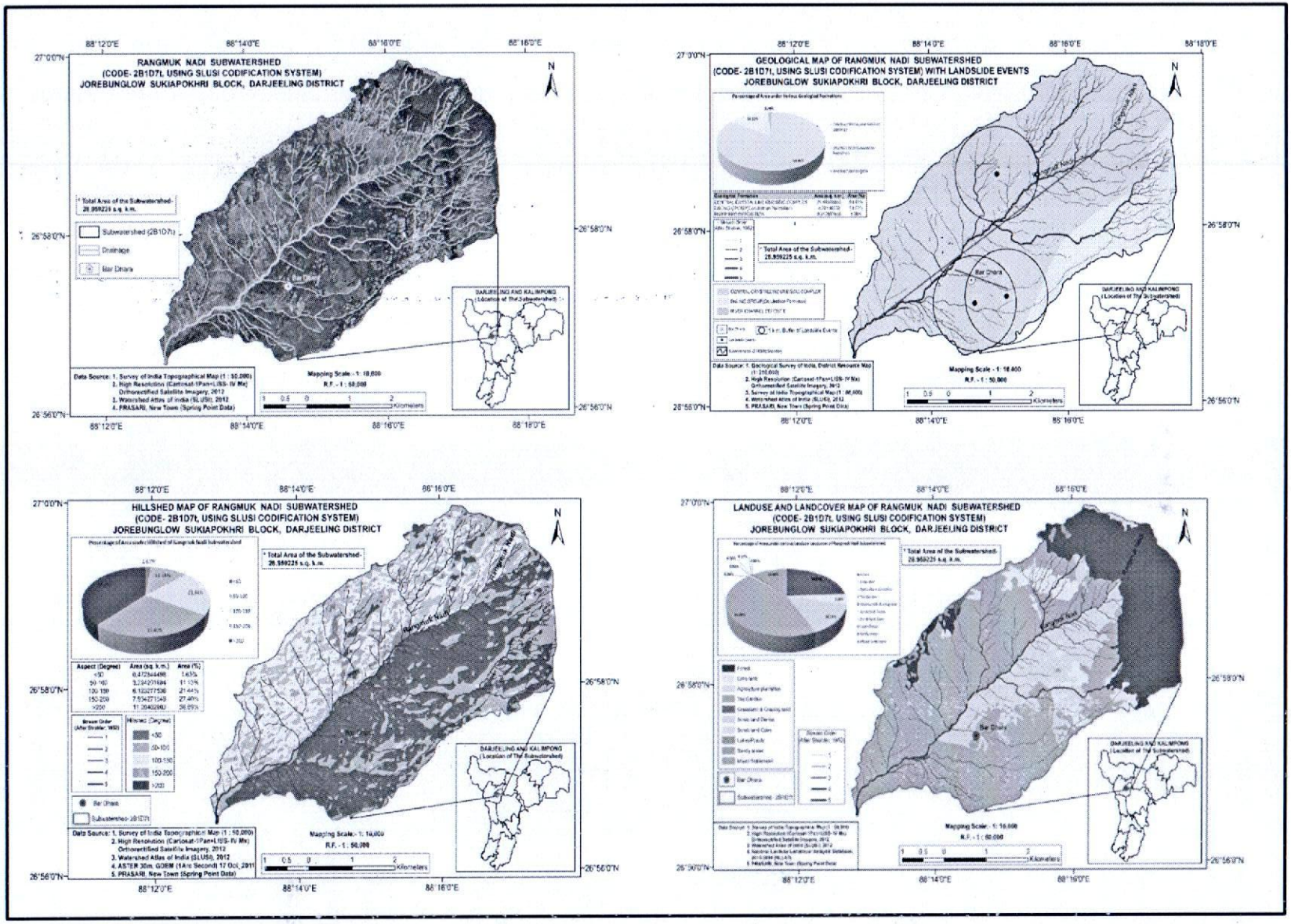


Fig. 30 Micro scale (sub-watershed level) study for better apprehension of springshed management, Bar dhara, Rangmuk nadi sub-watershed Darjeeling district, West Bengal

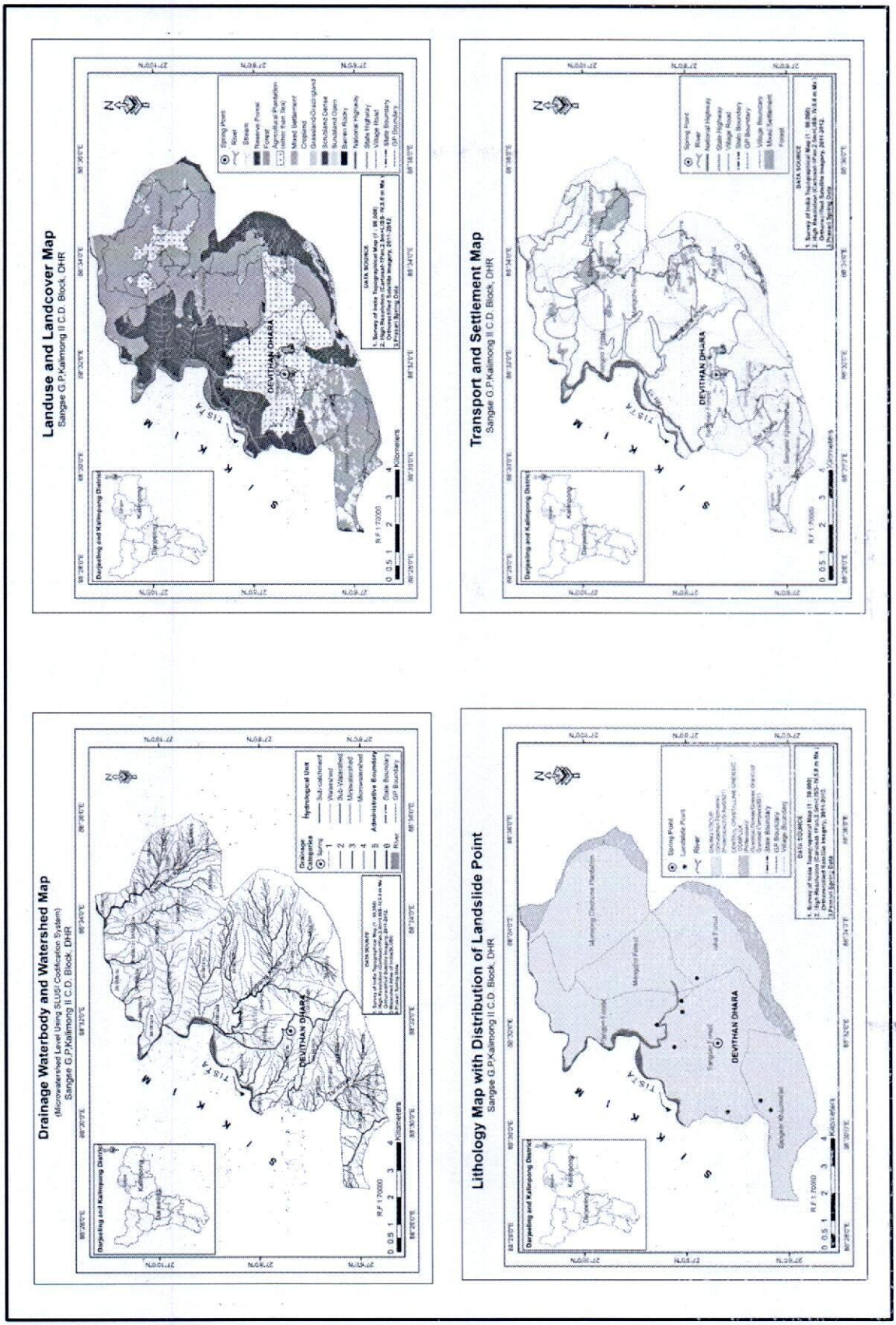


Fig. 31 Micro scale (micro-watershed level) study for better apprehension of springshed management practice, Devithan dhara micro watershed, Kalimpong district, West Bengal

Chapter 5

Key Findings and Way Forward

Investigation of spring outflow point, Forest Khasmahal, Kurseong block, Darjeeling

5.1 Key Findings

The magnitude of the water availability problem is exemplified by the high dependency of Darjeeling Himalayan populations on spring water on one hand and the deteriorating status of springs on the other (**Fig. 28** and **Annexure-Table 2**). The neglect of springs in the larger context of rivers, waterbodies and aquifers is also a reason for great concern as it has led to large gaps in practice and response to spring water management in the DHR. In this context, conducting taking up appropriate engineering solutions to enhance recharge are not enough. In addition, there is also a need to address the demand side challenges to ensure that water requirements are met in times of limited resource availability by augmenting the efficiency of water use. At a local scale, this implies the involvement of the community, especially the communities depending on spring water as well as those located in the recharge zone about resource protection, preventing contamination of the aquifer that supplies. Hence, social, economic and ecological sciences must also harmonise at the spring level to minimise the dependencies on springs (water demand) that is steeply rising up with time (**Fig. 29**). However, in mountainous regions like Darjeeling Himalaya, community mobilization around water can be challenging, energy intensive and arduous because of complex hydrogeology and the scattered nature of habitations. Thus, protection and conservation of springs in the mountains through watershed programmes must be taken into account as explained in **Fig. 30 and 31**. The purpose behind such efforts must be to impact spring discharge and quality to diversify livelihood and ecological security.

5.2 Way Forward

At present, the climate change is an immediate threat to human civilisation its related impact is pushing human society under serious menace. The ecosystem of the IHR is found to be more vulnerable due to the impact of climate change and facing environmental and socio-economic challenges-loss of biodiversity, drying up of perennial springs and jhoras, frequent flash flood, recurrent hazards due to landslides/mass movements leading to a decrease in agricultural productivity, acute shortage of potable water, increase in various health hazards, lack of employment opportunities etc. Thus, the water security planning, specifically spring water in the DHR may deploy this study as the base information for resource management principles, water, agricultural, forest, plantations and wasteland management etc. to achieve sustainable return goals.

5.2.1 Extensive and Detailed Large Scale Spring Mapping

The multifariousness of the DHR can also be epitomised by the very distinct socio-cultural characteristics which arise due to complex interaction and anthropogenic response to the inherent heterogeneity of the natural settings. But the decadal exaggeration of the population has created a cascade of environmental problems. People using natural springs water traditionally round the year for meeting drinking, domestic and agricultural needs but unfortunately in the last few decades these water sources are rapidly moving towards seasonality and had become sometimes even defunct. Thus, an extensive micro-scale (up to cadastral level) spring mapping is essential here that could meet the water demand of the people living in the remote rural hilly terrain by incorporating the thematic-spatial databases along with the filed derived data and for this purpose the tentative outline of the Activity Flow Chart on spring water management mechanism may be detailed out as demonstrated in **Fig. 32**.

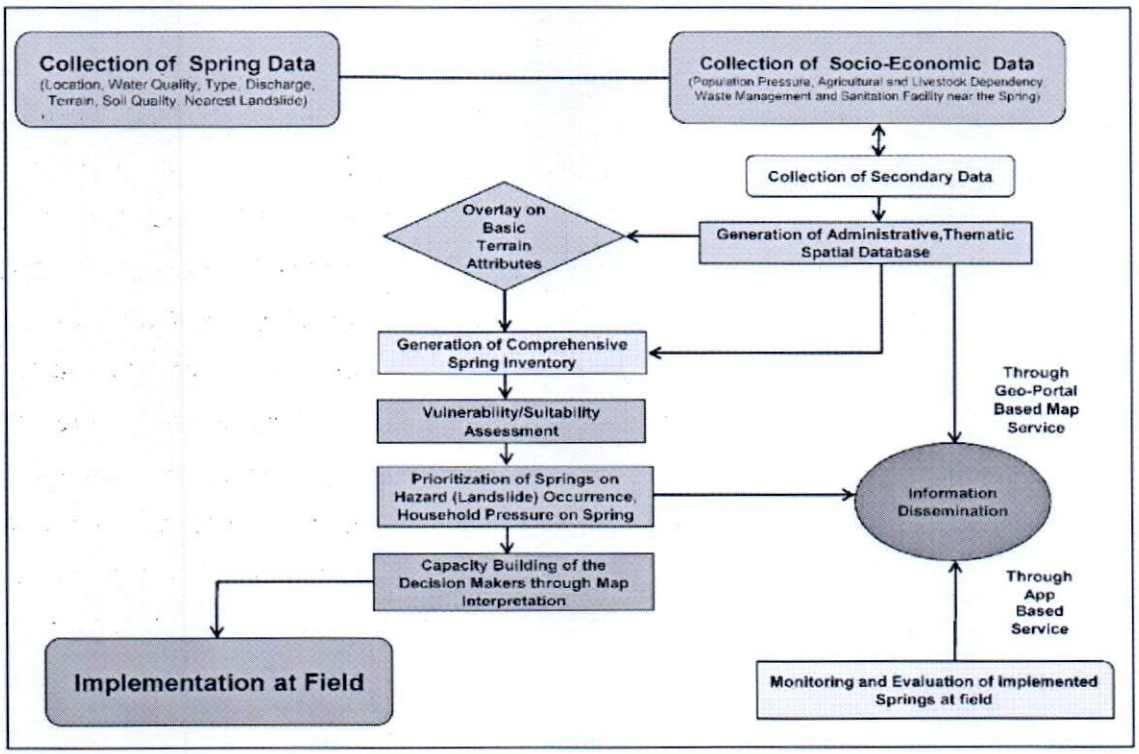


Fig. 32 Tentative outline of the Activity Flow Chart on spring water management

5.2.2 Hazard Management Approach

The Darjeeling Himalayan mountains are highly prone to landslides. Every year several thousands of slide events take place along the entire Himalayan ranges. Every consecutive year more than hundreds of new landslide events add to the landscape during the monsoon and immediate post-monsoon season. It is worth mentioning here that most of the landslides in DHR may be classified as a mass movement in soil masses or highly weathered rocks due to reactivation of unstable slopes by water rather than tectonic disturbances for the unique geology of the region which is fragile in nature. During the process of spring rejuvenation with digging trench around it, there occurs a five way change in geo-hydrology (Dryness- Dampness-Wetness-Dripping-Stream Flowing). Hence it may be taken care of that the entire process of spring rejuvenation with trenching method may ultimately lead to instability of the slope in the long term which may raise the risk of landslide. Though with geospatial technology the occurrence of landslides may be predicted earlier and such intellectual inputs will allow an end user to visualize the results, through maps as a realistic representation and to identify and manage the process through an easily comprehensible SDSS of spring water management that principally integrates the Activity Flow Chart (**Fig. 33**).

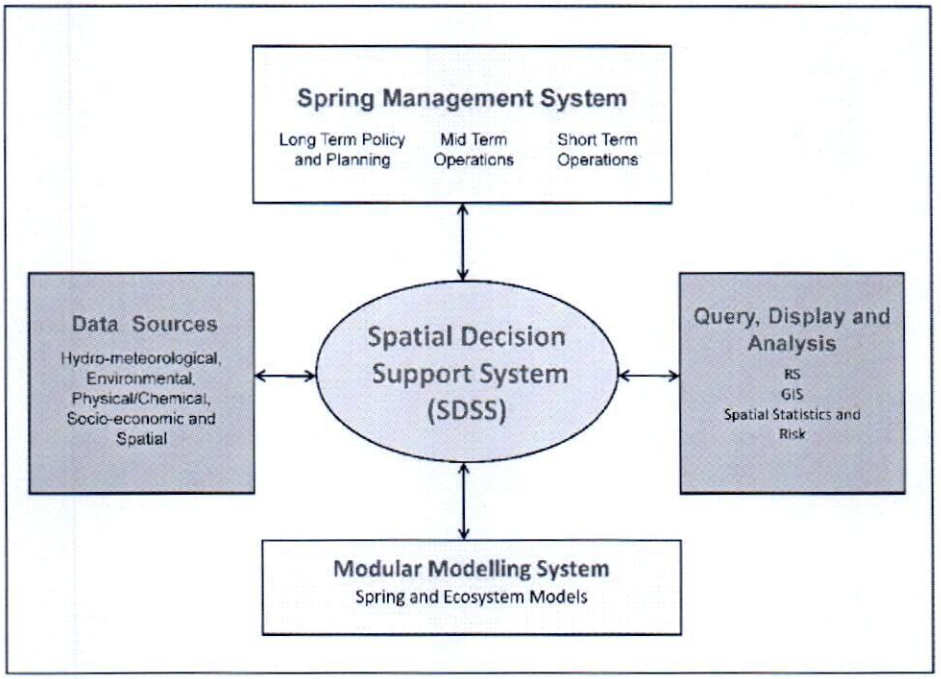


Fig. 33 Proposed framework of the Spatial Decision Support System methodology on spring water management

5.2.3 Ensuring Livelihood Opportunities

The SDSS methodology is an attempt to provide greater insight for transforming the springs as dependable sources of water in the DHR. Protection and proper management of natural springs are necessary to maintain springs quality and quantity especially for the period when its availability is less. Thereafter, there is a pressing need to ensure the effective participation of government departments, scientific institutes, policymakers, implementing agencies and most importantly, the local people (who

Photo plate 14 Community based participatory approach to ensure spring water and livelihood opportunities as perceived in Gorubathan block, Kalimpong district. Picture Courtesy: Prasari, Kalimpong

are the direct beneficiaries of the springs water at every step) to come together and share the data and best practices for the sustainable spring sanctuary development and this can be accomplished only by enabling both way communication wherein issues regarding climate change concerns are on the way to be exchanged in the form of adaptation technique of harnessing the spring water to meet up the crisis of water scarcity in the hills and ensuring livelihood opportunities in terms of cultivation, orchards, silvopasture, animal husbandry and jhora fisheries.

5.2.4 Equitable Access to Water and Sharing

Collecting water is a task that falls largely to women and girls as part of keeping house in the hills. The burden of water collection is not only felt by women themselves but has far-reaching effects on broader prosperity. The thousands of hours women spend every day collecting water is time that could be spent carrying out income generating activities and contributing to the economy; nevertheless, the time spent on this chore often means girls miss school and women miss out on the chance to earn a decent living. Predominantly, in water scares villages of the DHR women have to spend as long as four to five hours each day to secure drinking water but women, who need safe sanitation the most, are often left out of crucial sanitation-related decisions at households. Given these strong connections between lack of access to clean water and other development areas-including gender equality, identification of potential zone for spring water management by taking the help of SDSS would strengthen women's access to water and safeguard other household related problems like waste management, sanitation, hygiene etc.

References

- Department of Environment Government of West Bengal. (2017-2020). West Bengal state action plan climate change report (SAPCC). Kolkata, West Bengal

- Intergovernmental Panel on Climate Change (IPCC). (2014). Climate change 2014: synthesis report. Contribution of working groups I, II, and III to the fifth assessment report of the. Geneva, Switzerland

- Ministry of Urban Development, Government of India and The World Bank. (2015). City development plan for Siliguri-2041: Capacity building for urban development project report. New Delhi, India

- Primary Census Abstract. (2011). Census of India. New Delhi, Government of India

- NITI Aayog. (2018). Inventory and revival of springs in the Himalayas for water security. Report of Working Group I, Contributing to Sustainable Development in Indian Himalayan Region. New Delhi, India

- Shrestha R, T, Desai J, Mukherji A, Dhakal M, Kulkarni H and Acharya S. (2018). Application of eight-step methodology for reviving springs and improving springshed management in the mid-hills of Nepal. Research Programme of International Centre for Integrated Mountain Development on Water, Land and Ecosystem report. Kathmandu, Nepal

- Shrestha R, Desai J, Mukherji A, Dhakal M., Kulkarni, H, Mahamuni K, Bhuchar S and Bajracharya S. (2018/4). Protocol for reviving springs in the Hindu Kush Himalayas: A practitioner's manual. Research Programme of International Centre for Integrated Mountain Development, Kathmandu, Nepal

- Siddique M. I, Desai J, Kulkarni H, Mahamuni K. (2019). Comprehensive report on springs in the Indian Himalayan Region-status of springs, emerging issues and responses. Advanced Center for Water Resources Development and Management report under Indian Himalayas Climate Adaptation Programme

Annexure

Annexure-Table 1 Block level details of villages, number of villages with springs and other available information of the DHR. Source: District Census Handbook-Village Release 2011

Name of the Blocks	Total No. of Villages	No. of Villages with Spring Water Sources	No. of Villages with Perennial Springs	% of Perennial Spring to Total Number of Villages	No of Villages with Non-Perennial Springs	% of Non-perennial Spring to Total Number of Villages	No of Spring Available Villages within Forests	No of Spring Available Villages within Tea Gardens
Darjeeling-Pulbazar	43	33	28	65.12	28	65.12	9	17
Rangli Rangliot	29	23	15	51.72	19	65.52	6	6
Jorebunglow-Sukiapokhri	42	41	31	73.81	38	90.48	8	25
Kurseong	69	24	16	23.19	22	31.88	9	11
Mirik	21	14	9	42.86	10	0.00	8	9
Matigara	73	6	6	8.22	6	8.22	1	0
Naxalbari	93	1	1	1.08	1	1.08	1	0
Kharibari	74	0	0	0.00	0	0.00	0	0
Phansidewa	113	0	0	0.00	0	0.00	0	0
Kalimpong I	50	36	24	48.00	31	62.00	12	0
Kalimpong II	39	30	27	69.23	29	74.36	8	0
Gorubathan	38	13	6	15.79	12	31.58	7	3

Annexure-Table 2 Block level availability details of different potable water sources of the DHR. Source: District Census Handbook-Village Release 2011

Name of the Blocks	Number of Villages having Different Potable Water Sources					Total No. of Village	No Source
	Tap Water	Well	Hand Pump	Tube Well	Spring		
Darjeeling-Pulbazar	27	2	0	0	28	43	5
Rangli Rangliot	10	0	0	0	15	29	8
Jorebunglow-Sukiapokhri	26	0	0	0	31	42	7
Kurseong	30	10	4	0	16	69	17
Mirik	2	0	0	1	9	21	10
Matigara	18	54	54	36	6	73	1
Naxalbari	28	62	50	48	1	93	2
Kharibari	4	73	68	63	0	74	0
Phansidewa	5	91	91	84	0	113	8
Kalimpong I	17	2	1	1	24	50	12
Kalimpong II	13	0	0	0	27	39	3
Gorubathan	6	5	1	0	6	38	13

Annexure-Table 3 Block level availability details of different potable water sources (urban areas) of the DHR. Source: District Census Handbook-Village Release 2011

Name of the Block	Number of Urban Area (Municipal Corporation, Municipality, CT and Notified Area)									
	Total Number of Urban Area	Tap Water Treated	Tap Water Untreated	Well Covered	Well Uncovered	Hand Pump	Tubewell or Borehole	Spring	River/ Canal	Others
Darjeeling-Pulbazar	5	0	4	0	0	0	0	3	0	0
Rangli Rangliot	No Urban Area									
Jorebunglow-Sukiapokhri	4	1	1	0	0	0	0	3	0	0
Kurseong	2	0	0	0	0	0	0	1	0	1
Mirik	1	0	0	0	0	0	0	1	0	0
Matigara	7	6	0	4	4	5	5	1	1	0
Naxalbari	6	2	2	4	6	5	6	0	0	3
Kharibari	2	1	0	0	1	2	2	0	0	2
Phansidewa	No Urban Area									
Kalimpong I	2	0	1	0	0	0	0	2	0	0
Kalimpong II	No Urban Area									
Gorubathan	No Urban Area									

Annexure-Table 4 Village/CT/municipality level availability of springs, number of household served and springs type of the Kalimpong district. Source: Kalimpong District Magistrate Office 2018-19

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong I	Bhalukhop	Bhalukhop Forest	Ritha Botay Jhora	2	64	Perennial
			Rabilal Dhara			
		Bhalukhop Khasmahal	Barbotey	1	50	Na
	Bong	Bong Khasmahal	Jore Dhara	13	199	Na
			Pokhrel Dhara			
			Siktel Dhara			
			Ramesh Nepal Dhara			
			Morangey Dhara			
			Dikshit Dhara			
			Dangal Dhara			
			Tambey Dhara			
			Gurung Dhara			
			Bhakti Dhara			
			Subadarni Dhara			
			Devi Dhara			
			Amaley Dhara			
	Pabringtar	Churanthi Forest	Jaranti Jhora	1	12	Na
	Bong	Comesi Forest	Ghataney Dhara	3	56	Na
			Jugey Dhara			
			Sim Dhara			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong I	Dr. Graham's Home	Homes St.And Graihms	Pemba Dhara	4	108	Perennial
			Palden Jhora			
			Kurkuray Jhora			
			Sangsay Dhara			
	Upper and Lower Echhey	Icha Khasmahal	Bhalukhop Jhora	3	54	NA
			Devithan Jhora			
			Bholeynath Jhora			
	Kaffer Kanke Bong	Kaffir Khasmahal	Sanai Dhara	2	31	NA
			Angarey Dhara			
	Kalimpong(M)	Kalimpong(M)	Mahesh Dahal Dhara	8	121	NA
			Kafley Dhara			
			Adhikari Dhara			
			Kaji Dhara			
			Limbu Dhara			
			Raju Lama Dhara			
			Subedar Dhara			
			Devitha Jhora			
	Kalimpong	Kalimpong Khasmahal	Abdul Dhara	11	171	NA
			Khalyang Dhara			
			Sitting Jhora Near Micheal House at 8th Mile Jhora			
			Titiray Dhara			
			Kallepcha Dhara			
			Juge Dhara			
			Kuwapani Dhara			
			Jhor Dhara			
			Chandra Dhara			
			Gairee Dhara			
			Basnet Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong I	Kaffer Kanke Bong	Kanke Bong Khasmahal	Shiva Dhara	3	47	NA
			Minchu Jhora			
			Martin Jhora			
	Pabringtar	Lish Catchment Area Forest	Dodhi Khola	2	33	NA
			Ganjasing Jhora			
	Kaffer Kanke Bong	Lulagaon Khasmahal	Charkhol Dhara	4	61	NA
			Kyapchaki Jhora			
			Lampatey Gairi			
			Jukey Pani Dhara			
	Tista	Mangwa Forest	29 Primary school jhora	3	49	NA
			Forest Compound jhora			
			Krishna Jhora			
	Neembong	Nimbong Khasmahal	Goat Dara Dhara	2	35	NA
			Dhobi Dhara			
	Pabringtar	Paringar Khasmahal	Chumit Jhora	1	15	NA
	Neembong	Pemling Forest	Pataley Jhora	2	27	NA
			Rang Khola			
		Pemling Khasmahal	Kami Jhora	2	26	NA
			Dhobini Dhara			
	Pudung	Pudung Khasmahal	Aaitabarey Dhara	6	86	NA
			Lampatey Dhara			
			Jugey Dhara			
			Piwini Dhara			
			Jore Dhara			
			Simana Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong I	Samalbong	Samalbong Khasmahal	Protection work	6	98	NA
			Gjising Dhara			
			Devithan Dhara			
			Dharey Gaon			
			Devithan Jhora			
			Barpipal Jhora			
	Samthar	Samther Forest	Nimbong DIF Jhora	1	19	NA
	Sindepong	Sindibong Khasmahal	Kashiram Dhara	24	358	NA
			Balali Jhora			
			Mulpani Dhara			
			Pranami Mandir Dhara			
			Dhorey Dhara			
			Lazen Dhara			
			Lepcha Jhora			
			Lepcha Dhara			
			Tshering Jhora			
			Devithan Dhara			
			Diyali Jhora			
			Mani Kumar Jhora Gairi Goan Jhon			
			Quararicy Jhora			
			Tingkong Jhora			
			Koirala Dhara			
			Parajuli Dhara			
			Titung Dhara			
			Rishi Path Nagdhara To Lal bdr Chettri Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong I	Sindepong	Sindibong Khasmahal	Rishi Path Nagdhara To Lal bdr Chettri Jhora			
			Guddu Dhara			
			Hattibar Jhora			
			Dispensary Gaon Jhora			
			Chandra Tamang Jhora			
			Dinesh Darnal Jhora			
			Chanbari Dhara			
	Samalbong	Singi Khasmahal	Aaley Jhora	3	45	NA
			Singee Gairi Goaon			
			Suldhong Dhara			
	Seokbir	Slokbhir Khasmahal	Seokbir Dhara	1	12	NA
	Samthar	Suruk Khasmahal	Dokanay Khola Jhora	1	18	NA
	Tista	Tista Bazar D.I.F.	Madan Chettri House To Ganesh Thapa Jhora	2	28	NA
			Old Teesta Bridge Village Jhora			
	Yangmakum	Yang Makum Khasmahal	Denglali Jhora	2	30	NA
			Yang Khola			
	Dungra	Dungra Khasmahal (CT)	Kaman Dhara	7	119	NA
			Jore Dhara			
			Shiva Dhara			
			Kutir Dhara			
			Nagdhara			
Kalimpong II	Gitabling	Bokhim Khasmahal	Reoan Dhara	9	131	Perennial
			Varay Jhora			
			Tara Jhora			
			Linetar Jhora			
			Bhotay Jhora			
			Mandal Jhora			
			Sishnay Jhora			
			Lampatay Jhora			
			Barkhey Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Gitabling	Chumang Forest	Lain Jhora	12	210	Perennial
			Sita Khola			
			Panisas Dhara			
			Thray khola			
			Sri Krishna Jhora			
			Tenki Pakha Jhora			
			Deorali Jhora			
	Dalapchand	Dalapachan Khasmahal	Simsaray Jhora	11	156	Perennial
			Jor Dhara Kholsa			
			Cher-chery Jhora			
			Farm Jhora			
			Prachin Jhora-I			
			Salimary Jhora			
			Siva Jhora			
			Tamang Kholsa			
			Sukrabaray Jhora			
			Bhotay Jhora			
			Tamang Jhora			
		Dalapchan Ridge Reserve Forest	Prabin Ghatraj Jhora	4	60	NA
			Santu Chettri Jhora			
			Tshering Jhora			
			Ghimirey Jhora			
		Dalapchan Slip Reserve Forest	Sotang Jhora	4	54	NA
			Eachay Jhora			
			Koirala Jhora			
			Prachin Jhora-II			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Lava-Gitabeong	Git Beong Khasmahal	Adhari Jhora at Bhatti Dara	12	140	Perennial
			Nawlaytar Jhora at Lower Shankay Gaon			
			Amphy Dhara Jhora, Mandir Gaon			
			Machin Jhora			
			Bhaktay Jhora			
			Ghatay Jhora			
			Golay Jhora			
			Gumba Jhora			
			Dhap Jhora			
			Moktan Jhora			
			Chokpey Jhora			
			Bumthing Jhora			
	Gitabling	Git Dubling Khasmahal	Mistiry Jhora	24	265	Perennial
			Aalichi Jhora			
			Unick Jhora			
			Mawa Basay Jhora			
			Aadheray Jhora			
			Barbotay Jhora			
			Ghalay Jhora			
			Mandal Jhora			
			Chumang Khola			
			Kazi Jhora			
			Kaffer Jhora			
			Mawa Jhora			
			Ruchal Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Gitabling	Git Dubling Khasmahal	Sarkey Jhora			
			Sim Jhora			
			Simik Jhora			
			Mandir Jhora			
			Andur Jhora			
			Kalu Jhora			
			Mangalay Jhora			
			Devithan Jhora			
			Ghattay Jhora			
			Angkhuri Jhora			
			Rai Jhora			
	Shangse	Icha Forest	Kamaray Jhora	9	262	Perennial
			Sapkota Jhora			
			Bhujel Jhora			
			Kodo Dhara			
			Daldalay Jhora			
			Udai Jhora			
			Tarchu Jhora			
			Balbir Jhora			
			Sillary Dhara			
	Kage	Kagey Khasmahal	Malingany Jhora	2	21	Seasonal
			Ninguray Jhora			
	Kashyong	Kashone Khasmahal	Simsarey Jhora	27	421	Perennial
			Sikari Jhora			
			Ghumty Jhora			
			Bom Bdr Sardar Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II			Nechaly Jhora			
			Pathing Kholsa			
			Rong-gong Khola			
			Panishaj Jhora			
			Changa Jhora			
			Samsing Khola			
			Chamchung Kholsa			
			Khamdong Jhora			
			Samsing Jhora			
			Sipoy Jhora			
			Gishing Jhora			
			Gumba Jhora			
			Ongdi Tsh Jhora			
			Harsing Kholsa			
			Simsarey Jhora			
			Balubasay Jhora			
			Tali Jhora			
			Gotey Jhora			
			Silang Khazi Jhora			
			Sunarey Jhora			
			Devithan Jhora			
			Dhojbir Baraily Jhora			
			Thapa Jhora			
	Lava-Gitabeong	Kolbong Forest	Charcharay Jhora	6	147	Perennial
			Reset Jhora			
			Tuni Jhora			
			Chek Dem Jhora			
			9th Mile Jhora			
			Rateypani Spring water source			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Kage	Ladam Khasmahal	Jogi Jhora	5	73	Perennial & Seasonal
			Gurung Jhora			
			Arupatay Jhora			
			Sisnay Jhora			
			Pokhrel Jhora			
	Lava-Gitabeong	Lava Bazar D.I.F.	Buk Jhora	1	30	Perennial
		Lava Forest	Lepcha Jhora	7	131	Perennial
			Tulo Khola			
			Fulman Jhora			
			Lower Bukhim			
			Bukhim Jhora			
			Daldalay Jhora			
			Dhobi Jhora			
	Lingse	Lingsay Khasmahal	Doxing Jhora	5	52	Perennial
			Debithan Jhora			
			Upper Malingney			
			Nagey Dhara			
			Bhaskar Jhora			
	Lingseykha	Lingsaykha Khasmahal	Dhobi Khola	20	246	Perennial
			Bhalukhop Jhora			
			Dagyong Khola			
			Arkyo Spring Jhora			
			Thaluk Jhora			
			Barbot Jhora			
			Nak Tshering Jhora			
			Menchu Spring Jhora			
			Doksing Spring Jhora			
			Upper Bojini Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Lingseykha	Lingsaykha Khasmahal	Thotney Jhora			
			Dhokrey Jhora			
			Lower Bojini Jhora			
			Lalbir Spring Jhora			
			Balaram Jhora			
			Bulu Jhora			
			Buddhibal Jhora			
			Okharbotay Jhora			
			Rateypani Jhora			
			Koiraley Jhora			
	Lole	Lolay Khasmahal	Chaitay Jhora	5	125	Perennial
			Chaw Khola			
			Purohit Jhora			
			Bayang Jhora			
			Ketabaw Jhora			
	Shangse	Mangchu Forest	Kothi Jhora	1	50	Perennial
		Mansong Cinchona Plantation	Chyabari Khola	21	285	Perennial
			GattayKhola			
			Baral Jhora			
			Dobhi Khola			
			Pareng Khola			
			Pani Dhara			
			Rai Gaon Dhara			
			Devithan Dabai Khola			
			Kazi Dhara			
			Captain Dhara			
			Dal Khola			
			Phampal Gairi Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Shangse	Mansong Cinchona Plantation	Water source at Binoy Alaichi Bari			
			Pool Kholsa Sim			
			Sisirpa Gairo Dhara			
			Tarjan Jhora			
			Sanjay Jhora			
			Loho Maila Jhora			
			Dhanjit Jhora			
			Anderi Jhora			
			Paireni Jhora			
	Kage	Maria Khasmahal	Lalbir Jhora	1	20	Perennial
	Shantuk	Paiengaon Forest	Rinchen Jhora	9	166	Perennial
			Shivalaya Dhara			
			Palangbari Dhara			
			Bheri Goat Jhora			
			Nala Jhora			
			Damsang Jhora			
			Chipchipay Jhora			
			School Dhara			
			Sishnay Jhora			
	Gitabling	Paygang Khasmahal	Akeay Jhora	4	35	Perennial
			Paul Jhora			
			Lankoo Jhora			
			Deviithan Jhora			
	Shangse	Rangpo Forest	Tumlang Jhora	1	70	Perennial
	Lava-Gitabeong	Raset Forest	Chun Khola	4	51	Perennial
			Keraghari Spring water source			
			Raongel Jhora			
			Changay Khola			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Payong	Paiyong Khasmahal	Dari Jhora	17	270	Perennial
			Samrang Jhora			
			Pitlay Jhora			
			Gaddi Wal Jhora			
			Gurung Jhora			
			Gaiwala Jhora			
			Zhilkay Dhara			
			K B Jhora			
			Ghimiray Jhora			
			Box Cutting Jhora			
			Hitti Jhora			
			Pokhari Jhora			
			Menzong Dhara			
			Mangal Singh Jhora			
			Linemen Jhora			
			Khatiwara Jhora			
			Thapa Jhora			
	Lingse	Rhenok Forest	Middle Changay Jhora	6	82	Perennial
			Farang Khola			
			Byaksha Jhora			
			Rinchey Jhora			
			Nadi Jhora Jhora			
			Saksung Jhora			
	Shantuk	Rissium Forest	Sisney Jhora	2	40	Perennial
			Thukchuk Dhara			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Pedon	Pedong Khasmahal	Tunibotay Jhora	23	371	Perennial
			K B Jhora			
			Simsary Jhora			
			Sunder Jhora			
			Sukbir Jhora			
			House Khola Jhora			
			Dhobi Jhora			
			Arun Jhora			
			Mandol Jhora			
			Lamani Jhora			
			Simana Dhara			
			Aalay Pakha Jhora			
			Lama Jhora			
			N T Jhora			
			Ambakay Jhora			
			Khem Jhora			
			Dewan Jhora			
			Tamang Jhora			
			Tarnay Jhora			
			Naspati Jhora			
			Dal Bahadur Jhora			
			Simsary Jhora			
			Dharmay Jhora			
	Shantuk	Santuk Khasmahal	Rajen Jhora	2	35	Perennial
			Bhitey Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Syakiyong	Sakiyong Khasmahal	Deo Prakash Dhara	20	257	Perennial
			Prakash Jhora			
			Deepak Jhora			
			Memaycho Jhora			
			Napu Dhara			
			Palden Jhora			
			S L Jhora			
			Nir Dorjee Dhara			
			Chagay Khola			
			Nima Jhora			
			Gop Jhora			
			Hitti Jhora			
			Chopal Jhora			
			Suresh Kumar Jhora			
			Kharkadas Jhora			
			Sillay Jhora			
			Silk Route Jhora			
			Nakul Jhora			
			Tempo Jhora			
			Major Jhora			
	Shangse	Sangser Forest	Narak Jhora	3	105	Perennial
			Okharbotay Jhora			
			Devithan Jhora			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Kalimpong II	Shangse	Sangser Khasmahal	Suraj Jhora	13	473	Perennial
			Masing Jhora			
			Loktang Jhora			
			Kyamuna Jhora			
			Wakyong Jhora			
			Kami Dhara			
			Kakulay Jhora			
			Asharay Jhora			
			Dungdugay Jhora			
			Simalay Jhora			
			Padam Jhora			
			Lapsi Jhora			
			Kundung Jhora			
Gorubathan	Aahaley	Gorubathan Khasmahal	Ganesh Dhara	1	150	NA
	Gorubathan 2	Pankasari Forest	Gairi Bas	2	80	Perennial
			Dawla Jhora			
		Kumai Forest	Malibari Jhora	1	215	NA
	Kumai	Kumai Khasmahal	Bangala Tar	3	465	NA
			Mourey Jhora			
			Machar Jhora			
	Kumai	Kumai Tea Garden	Ardali Jhora	1	150	NA
	Nim	Samabiyong Tea Garden	Lambhu Jhora	3	92	NA
			Newar Jhora			
			Tharo Khola			

Annexure-Table 4 cont.

Block Name	GP Name	Village Name	Name of the Spring	No. of Springs	No. of Household Served	Type of Springs
Gorubathan	Paten Godak	Paten Godak Khasmahal	Bhupaley Khola	4	425	NA
			Bhareng Khola			
			Godak Khola			
			Chisang Khola			
	Pokhreybong	Pagrang Bong Khasmahal	Dhotrey Upper Mangzing	1	13	NA
		Pogu Forest	Kapray Jhora	4	91	NA
			Naya Kheti			
			Titiri Kolcha			
			Bikram Jhora			
	Todeytangta	Today Tangta Khasmahal	Khaharey Khola	4	165	NA
			Chichu Khola			
			Kapoor Jhora			
			Doring Khola			

Annexure-Table 5 Details of very high, high, moderate and low priority villages/CT with GiZ score as derived from Hot spot and Cold Spot analysis for spring water management

Block Name	GP Name	Village Name	JL No.	Average Household No. of Household Pressure on Springs	GiZ Score	Priority Zone for Management
Gorubathan	Kumai	Kumai Forest	38	215	6.725	Very High Priority
Gorubathan	Kumai	Kumai Khasmahal	36	155	6.725	Very High Priority
Gorubathan	Kumai	Kumai Tea Garden	37	150	6.725	Very High Priority
Gorubathan	Aahaley	Gorubathan Khasmahal	28	150	2.153	Very High Priority
Gorubathan	Paten Godak	Paten Godak Khasmahal	5	106.25	1.675	Very High Priority
Gorubathan	Todeytangta	Today Tangta Khasmahal	4	41.25	1.675	Very High Priority
Gorubathan	Pokhreybong	Pogu Forest	22	22.75	1.513	Very High Priority
Kalimpong II	Shangse	Rangpo Forest	1	70	0.611	Very High Priority
Kalimpong II	Shangse	Sangser Forest	25	35	0.009	Very High Priority
Kalimpong II	Shangse	Mangchu Forest	2	50	-0.054	High Priority
Kalimpong II	Shangse	Mansong Cinchona Plantation	3	13.571	-0.108	High Priority
Kalimpong I	Bhalukhop	Bhalukhop Forest	26	32	-0.197	High Priority
Gorubathan	Gorubathan 2	Pankasari Forest	11	40	-0.235	High Priority
Kalimpong II	Shangse	Icha Forest	24	29.111	-0.361	High Priority
Gorubathan	Nim	Samabiyong Tea Garden	14	30.667	-0.521	High Priority
Kalimpong I	Pabringtar	Churanthi Forest	88	12	-0.562	High Priority
Kalimpong II	Lava-Gitabeong	Lava Bazar D.I.F.	15	30	-0.658	High Priority

Annexure-Table 5 cont.

Block Name	GP Name	Village Name	JL No.	Average Household No. of Household Pressure on Springs	GiZ Score	Priority Zone for Management
Kalimpong II	Shangse	Sangser Khasmahal	27	36.385	-0.665	High Priority
Kalimpong II	Dalapchand	Dalapchan Ridge Reserve Forest	29	15	-0.665	High Priority
Kalimpong II	Lava-Gitabeong	Lava Forest	16	18.714	-0.670	High Priority
Kalimpong II	Lava-Gitabeong	Raset Forest	13	12.75	-0.683	High Priority
Kalimpong I	Yangmakum	Yang Makum Khasmahal	82	15	-0.732	High Priority
Kalimpong II	Kashyong	Kashone Khasmahal	4	15.592	-0.736	High Priority
Kalimpong I	Dr. Graham's Home	Homes St.And Graihms	28	27	-0.757	High Priority
Kalimpong II	Payong	Paiyong Khasmahal	32	15.882	-0.811	High Priority
Kalimpong I	Bhalukhop	Bhalukhop Khasmahal	49	50	-0.815	High Priority
Kalimpong I	Tista	Mangwa Forest	53	16.333	-0.837	High Priority
Kalimpong I	Kalimpong	Kalimpong Khasmahal	55	15.545	-0.843	High Priority
Kalimpong II	Dalapchand	Dalapchan Slip Reserve Forest	30	13.5	-0.863	High Priority
Kalimpong I	Samthar	Suruk Khasmahal	80	18	-0.880	High Priority
Kalimpong II	Lava-Gitabeong	Kolbong Forest	14	24.5	-0.880	High Priority

Annexure-Table 5 cont.

Block Name	GP Name	Village Name	JL No.	Average Household No. of Household Pressure on Springs	GiZ Score	Priority Zone for Management
Kalimpong I	Tista	Tista Bazar D.I.F.	52	14	-0.931	Moderate Priority
Kalimpong II	Lingse	Lingsay Khasmahal	10	10.401	-0.943	Moderate Priority
Kalimpong I	Pabringtar	Lish Catchment Area Forest	81	16.5	-0.982	Moderate Priority
Kalimpong I	Dungra	Dungra Khasmahal (CT)	48	17	-1.004	Moderate Priority
Kalimpong II	Dalapchand	Dalapachan Khasmahal	31	14.182	-1.030	Moderate Priority
Kalimpong I	Upper And Lower Echhey	Icha Khasmahal	45	18	-1.039	Moderate Priority
Kalimpong II	Lingse	Rhenok Forest	12	13.667	-1.040	Moderate Priority
Kalimpong II	Syakiyong	Sakiyong Khasmahal	21	12.851	-1.059	Moderate Priority
Kalimpong I	Kalimpong (M)	Kalimpong (M)		15.125	-1.060	Moderate Priority
Kalimpong II	Shantuk	Paiengaon Forest	22	18.444	-1.062	Moderate Priority
Kalimpong I	Pabringtar	Paringar Khasmahal	67	15	-1.091	Moderate Priority
Kalimpong I	Neembong	Nimbong Khasmahal	65	17.5	-1.095	Moderate Priority
Kalimpong II	Gitabling	Chumang Forest	35	17.5	-1.164	Moderate Priority
Kalimpong II	Kage	Kagey Khasmahal	7	10.5	-1.181	Moderate Priority
Kalimpong II	Lava-Gitabeong	Git Beong Khasmahal	36	11.667	-1.184	Moderate Priority
Gorubathan	Pokhreybong	Pagrang Bong Khasmahal	17	13	-1.188	Moderate Priority
Kalimpong I	Bong	Bong Khasmahal	39	15.307	-1.191	Moderate Priority

Annexure-Table 5 cont.

Block Name	GP Name	Village Name	JL No.	Average Household No. of Household Pressure on Springs	GiZ Score	Priority Zone for Management
Kalimpong II	Shantuk	Rissium Forest	18	20	-1.238	Moderate Priority
Kalimpong II	Lingseykha	Lingsaykha Khasmahal	11	12.300	-1.239	Moderate Priority
Kalimpong II	Pedon	Pedong Khasmahal	6	16.1304	-1.247	Moderate Priority
Kalimpong I	Sindepong	Sindibong Khasmahal	47	14.917	-1.250	Moderate Priority
Kalimpong I	Pudung	Pudung Khasmahal	46	14.333	-1.2899	Moderate Priority
Kalimpong II	Kage	Ladam Khasmahal	9	14.600	-1.318	Moderate Priority
Kalimpong II	Kage	Maria Khasmahal	8	20	-1.367	Moderate Priority
Kalimpong II	Shantuk	Santuk Khasmahal	33	17.5	-1.371	Moderate Priority
Kalimpong II	Gitabling	Paygang Khasmahal	38	8.75	-1.403	Low Priority
Kalimpong I	Samthar	Samther Forest	68	19	-1.410	Low Priority
Kalimpong I	Samalbong	Singi Khasmahal	70	15	-1.452	Low Priority
Kalimpong I	Kaffer Kanke Bong	Lulagaon Khasmahal	61	15.25	-1.455	Low Priority
Kalimpong I	Seokbir	Slokbhir Khasmahal	59	12	-1.469	Low Priority
Kalimpong I	Samalbong	Samalbong Khasmahal	60	16.333	-1.470	Low Priority
Kalimpong I	Bong	Comesi Forest	72	18.667	-1.478	Low Priority
Kalimpong II	Gitabling	Git Dubling Khasmahal	37	11.042	-1.490	Low Priority
Kalimpong II	Gitabling	Bokhim Khasmahal	22	14.556	-1.552	Low Priority
Kalimpong I	Neembong	Pemling Khasmahal	64	13	-1.563	Low Priority
Kalimpong II	Lole	Lolay Khasmahal	44	25	-1.588	Low Priority
Kalimpong I	Kaffer Kanke Bong	Kaffir Khasmahal	41	15.5	-1.6120	Low Priority
Kalimpong I	Neembong	Pemling Forest	63	13.5	-1.666	Low Priority
Kalimpong I	Kaffer Kanke Bong	Kanke Bong Khasmahal	42	15.667	-1.899	Low Priority

Detailed database of Springs of Kalimpong District, W.B

Object ID	Name of the block	Gram Panchayat	Local Name Spring Jhora	Longitude	Latitude	Lat_DD	Long_DD	Type	Village Name/Municipality/JL No	No of House
1	Kalimpong - I	Tashiding GP	Jhor Dhara	27 4 8.57	88 26 34.1	27.06904700000	88.44280600000	NA	Kalimpong KM JL No- 55	18
2	Kalimpong - I	Tashiding GP	Khalyang Dhara	27 3 37.02	88 26 12.61	27.06028300000	88.43683600000	NA	Kalimpong KM JL No- 55	19
3	Kalimpong - I	Tashiding GP	Kuwapani Dhara	27 4 7.61	88 26 51.6	27.06878100000	88.44766700000	NA	Kalimpong KM JL No- 55	14
4	Kalimpong - I	Tashiding GP	Gairee Dhara	27 4 14.43	88 26 42.49	27.07067500000	88.44513600000	NA	Kalimpong KM JL No- 55	12
5	Kalimpong - I	Tashiding GP	Abdul Dhara	27 3 22.81	88 26 37.49	27.05633600000	88.44374700000	NA	Kalimpong KM JL No- 55	15
6	Kalimpong - I	Tashiding GP	Basnet Jhora	27 3 88.76	88 26 37.49	27.07465600000	88.44374700000	NA	Kalimpong KM JL No- 55	13
7	Kalimpong - I	Tashiding GP	Titiray Dhara	27 4 1.34	88 26 28.34	27.06703900000	88.44120600000	NA	Kalimpong KM JL No- 55	19
8	Kalimpong - I	Tashiding GP	Chandra Dhara	27 4 14.17	88 26 41.37	27.07060300000	88.44482500000	NA	Kalimpong KM JL No- 55	14
9	Kalimpong - I	Tashiding GP	Juge Dhara	27 4 3.85	88 26 43.99	27.06773600000	88.44555300000	NA	Tashiding F V JL No- 54	16
10	Kalimpong - I	Tashiding GP	Kallepcha Dhara	27 4 1.77	88 26 49.38	27.06715800000	88.44705000000	NA	Tashiding F V JL No- 54	13
11	Kalimpong - I	Kalimpong GP	Sitting Jhora Near Micheal House at 8th Mile Jhora	27 3 53.84	88 27 26.19	27.06495600000	88.45727500000	NA	Kalimpong KM JL No- 55	18
12	Kalimpong - I	Upper Echhey	Bholeynath Jhora	27 4 57.3	88 30 55.03	27.08258300000	88.51528600000	NA	Echhey KM JL No - 45	19
13	Kalimpong - I	Upper Echhey	Ghimirey Jhora	27 05 44.89	88 32 4.67	27.09580300000	88.53463100000	NA	Echhey KM JL No - 45	14
14	Kalimpong - I	Upper Echhey	Tshering Jhora	27 5 18.73	88 31 43.56	27.08853600000	88.52876700000	NA	Echhey KM JL No - 45	16

15	Kalimpong - I	Dungra GP	Gurung Dhara	27 03 10.9	88 28 35.98	27.05302800000	88.47666100000	NA	Dungra KM JL No - 48	13
16	Kalimpong - I	Dungra GP	Subadarni Dhara	27 03 16.9	88 28 35.84	27.05469400000	88.47662200000	NA	Dungra KM JL No - 48	18
17	Kalimpong - I	Dungra GP	Devi Dhara	27 03 21.87	88 28 39.4	27.05607500000	88.47761100000	NA	Dungra KM JL No - 48	12
18	Kalimpong - I	Dungra GP	Shiva Dhara	27 04 20.15	88 29 17.68	27.07226400000	88.48824400000	NA	Dungra KM JL No - 48	13
19	Kalimpong - I	Dungra GP	Subedar Dhara	27 04 40.9	88 29 22.03	27.07802800000	88.48945300000	NA	Dungra KM JL No - 48	16
20	Kalimpong - I	Dungra GP	Deevitha Jhora	27 04 29.0	88 28 54.2	27.07472200000	88.48172200000	NA	Dungra KM JL No - 48	14
21	Kalimpong - I	Dungra GP	Subedar Dhara	27 04 45.0	88 28 30.6	27.07916700000	88.47516700000	NA	Dungra KM JL No - 48	18
22	Kalimpong - I	Dungra GP	Devitha Jhora	27 04 46.83	88 29 27.38	27.07967500000	88.49093900000	NA	Dungra KM JL No - 48	16
23	Kalimpong - I	Dungra GP	Kutir Dhara	27 04 23.94	88 29 21.87	27.07331700000	88.48940800000	NA	Dungra KM JL No - 48	24
24	Kalimpong - I	Dungra GP	Jore Dhara	27 04 20.4	88 28 45.8	27.07233300000	88.47938900000	NA	Dungra KM JL No - 48	18
25	Kalimpong - I	Dungra GP	Nagdhara	27 04 26.54	88 29 13.58	27.07403900000	88.48710600000	NA	Dungra KM JL No - 48	19
26	Kalimpong - I	Dungra GP	Kaji Dhara	27 04 8.01	88 28 25.73	27.06889200000	88.47381400000	NA	Dungra KM JL No - 48	14
27	Kalimpong - I	Dungra GP	Limbu Dhara	27 04 8.41	88 28 28.21	27.06900300000	88.47450300000	NA	Dungra KM JL No - 48	12
28	Kalimpong - I	Dungra GP	Kaman Dhara	27 04 8.7	88 28 32.51	27.06908300000	88.47569700000	NA	Dungra KM JL No - 48	15
29	Kalimpong - I	Lower Echhey	Simana Jhora	27 04 21.35	88 31 5.37	27.07259700000	88.51815800000	NA	Echhey KM JL No - 45	13
30	Kalimpong - I	Lower Echhey	Devithan Jhora	27 04 42.91	88 31 39.39	27.07858600000	88.52760800000	NA	Echhey KM JL No - 45	19
31	Kalimpong - I	Lower Echhey	Koirala Jhora	27 05 12.86	88 31 44.31	27.08690600000	88.52897500000	NA	Echhey KM JL No - 45	14
32	Kalimpong - I	Lower Echhey	Bhalukhop Jhora	27 04 22.55	88 31 38.74	27.07293100000	88.52742800000	NA	Echhey KM JL No - 45	16

33	Kalimpong - I	Sindebong	Diyali Jhora	27 04 13.43	88 29 39.39	27.07039700000	88.49427500000	NA	Sindebong KM JL -47	18
34	Kalimpong - I	Sindebong	Quararicy Jhora	27 04 20.6	88 30 16.13	27.07238900000	88.50448100000	NA	Sindebong KM JL -47	12
35	Kalimpong - I	Sindebong	Rishi Path Nagdhara To Lal bdr Chettri Jhora	27 04 39.61	88 30 15.66	27.07766900000	88.50435000000	NA	Sindebong KM JL -47	13
36	Kalimpong - I	Sindebong	Tingkong Jhora	27 04 22.04	88 30 4.09	27.07278900000	88.50113600000	NA	Sindebong KM JL -47	18
37	Kalimpong - I	Sindebong	Mani Kumar Jhora Gairi Goan Jhon	27 04 14.94	88 29 42.95	27.07081700000	88.49526400000	NA	Sindebong KM JL -47	19
38	Kalimpong - I	Sindebong	Lepcha Jhora	27 04 9.82	88 30 4.03	27.06939400000	88.50111900000	NA	Sindebong KM JL -47	14
39	Kalimpong - I	Sindebong	Tshering Jhora	27 04 12.56	88 30 4.63	27.07015600000	88.50128600000	NA	Sindebong KM JL -47	12
40	Kalimpong - I	Sindebong	Devithan Dhara	27 04 13.22	88 29 43.77	27.07033900000	88.49549200000	NA	Sindebong KM JL -47	15
41	Kalimpong - I	Sindebong	Titung Dhara	27 04 26.58	88 30 3.3	27.07405000000	88.50091700000	NA	Sindebong KM JL -47	13
42	Kalimpong - I	Sindebong	Koirala Dhara	27 04 24.32	88 30 16.82	27.07342200000	88.50467200000	NA	Sindebong KM JL -47	19
43	Kalimpong - I	Sindebong	Parajuli Dhara	27 04 24.64	88 30 20.1	27.07351100000	88.50558300000	NA	Sindebong KM JL -47	14
44	Kalimpong - I	Sindebong	Dhorey Dhara	27 04 7.14	88 30 2.41	27.06865000000	88.50066900000	NA	Sindebong KM JL -47	16
45	Kalimpong - I	Sindebong	Mulpani Dhara	27 03 57.38	88 30 12.19	27.06593900000	88.50338600000	NA	Sindebong KM JL -47	13
46	Kalimpong - I	Sindebong	Guddu Dhara	27 04 46.75	88 30 22.28	27.07965300000	88.50618900000	NA	Sindebong KM JL -47	18
47	Kalimpong - I	Sindebong	Lepcha Dhara	27 04 10.23	88 30 13.17	27.06950800000	88.50365800000	NA	Sindebong KM JL -47	12
48	Kalimpong - I	Sindebong	Lazen Dhara	27 04 9.62	88 30 14.9	27.06933900000	88.50413900000	NA	Sindebong KM JL -47	13
49	Kalimpong - I	Pudung	Jore Dhara	27 03 43.87	88 30 56.01	27.06218600000	88.51555800000	NA	Pudung KM JL No - 46	14

50	Kalimpong - I	Pudung	Jugey Dhara	27 03 38.68	88 31 6.96	27.06074400000	88.51860000000	NA	Pudung KM JL No - 46	12
51	Kalimpong - I	Pudung	Piwini Dhara	27 03 40.94	88 30 58.84	27.06137200000	88.51634400000	NA	Pudung KM JL No - 46	15
52	Kalimpong - I	Pudung	Pranami Mandir Dhara	27 04 6.41	88 30 47.7	27.06844700000	88.51325000000	NA	Pudung KM JL No - 46	13
53	Kalimpong - I	Pudung	Lampatey Dhara	27 03 37.28	88 31 21.96	27.06035600000	88.52276700000	NA	Pudung KM JL No - 46	19
54	Kalimpong - I	Pudung	Kashiram Dhara	27 03 22.11	88 30 43.59	27.05614200000	88.51210800000	NA	Pudung KM JL No - 46	14
55	Kalimpong - I	Pudung	Balali Jhora	27 03 30.08	88 30 42.87	27.05835600000	88.51190800000	NA	Pudung KM JL No - 46	16
56	Kalimpong - I	Pudung	Aaitabarey Dhara	27 03 35.96	88 30 50.68	27.05998900000	88.51407800000	NA	Pudung KM JL No - 46	13
57	Kalimpong - I	Nimbong	Nimbong DIF Jhora	26 59 19.13	88 33 22.41	26.98864700000	88.55622500000	NA	Nimbong KM JL - 65	19
58	Kalimpong - I	Nimbong	Pataley Jhora	26 59 06.05	88 34 5.77	26.98501400000	88.56826900000	NA	Pemling KM JL No - 64	12
59	Kalimpong - I	Nimbong	Rang Khola	27 0 10.44	88 34 25.91	27.00290000000	88.57386400000	NA	Nimbong KM JL - 65	15
60	Kalimpong - I	Nimbong	Kami Jhora	26 59 43.52	88 34 56.21	26.99542200000	88.58228100000	NA	Pemling KM JL No - 64	13
61	Kalimpong - I	Nimbong	Dhobi Dhara	26 58 15.62	88 34 35.98	26.97100600000	88.57666100000	NA	Pemling KM JL No - 64	19
62	Kalimpong - I	Nimbong	Reoan Dhara	27 1 6.27	88 34 42.91	27.01840800000	88.57858600000	NA	Nimbong KM JL - 65	14
63	Kalimpong - I	Nimbong	Goat Dara Dhara	26 58 2	88 34 27.63	26.96722200000	88.57434200000	NA	Pemling KM JL No - 64	16
64	Kalimpong - I	Nimbong	Dhobini Dhara	26 59 55.44	88 35 12.72	26.99873300000	88.58686700000	NA	Nimbong KM JL - 65	13
65	Kalimpong - I	Samther	Ganjasing Jhora	26 58 4.97	88 30 27.58	26.96804700000	88.50766100000	NA	Samther KM JL No - 69	19
66	Kalimpong - I	r Graham s Home	Prabin Ghatraj Jhora	27 05 9.02	88 30 51.24	27.08583900000	88.51423300000	NA	Homes St Andrew Colonial Graham s JL No - 28	18

67	Kalimpong - I	r Graham s Home	Santu Chettri Jhora	27 05 9.41	88 30 54.71	27.08594700000	88.51519700000	NA	Homes St Andrew Colonial Graham s JL No - 28	12
68	Kalimpong - I	r Graham s Home	Chandra Tamang Jhora	27 05 3.06	88 30 1.76	27.08418300000	88.50048900000	NA	Homes St Andrew Colonial Graham s JL No - 28	13
69	Kalimpong - I	r Graham s Home	Dinesh Darnal Jhora	27 05 3.71	88 30 2.31	27.08436400000	88.50064200000	NA	Homes St Andrew Colonial Graham s JL No - 28	18
70	Kalimpong - I	r Graham s Home	Dispensary Gaon Jhora	27 04 57.26	88 30 21.38	27.08257200000	88.50593900000	NA	Homes St Andrew Colonial Graham s JL No - 28	19
71	Kalimpong - I	r Graham s Home	Hattibar Jhora	27 04 52.97	88 30 39.03	27.08138100000	88.51084200000	NA	Homes St Andrew Colonial Graham s JL No - 28	14
72	Kalimpong - I	r Graham s Home	Chanbari Dhara	27 05 4.75	88 30 2.97	27.08465300000	88.50082500000	NA	Homes St Andrew Colonial Graham s JL No - 28	12
73	Kalimpong - I	r Graham s Home	Kami Dhara	27 05 74	88 30 21.15	27.10388900000	88.50587500000	NA	Homes St Andrew Colonial Graham s JL No - 28	13

74	Kalimpong - I	r Graham s Home	Rabilal Dhara	27 05 107	88 30 18.33	27.11305600000	88.50509200000	NA	Homes St Andrew Colonial Graham s JL No - 28	14
75	Kalimpong - I	r Graham s Home	Pemba Dhara	27 05 7.69	88 30 38.68	27.08546900000	88.51074400000	NA	Homes St Andrew Colonial Graham s JL No - 28	12
76	Kalimpong - I	Bhalukhop	Raju Lama Dhara	27 04 28.81	88 28 12.57	27.07466900000	88.47015800000	NA	BHALUKHOP KM JL NO-49	13
77	Kalimpong - I	Yangmakhum	Dokanay Khola Jhora	26 58 17.26	88 29 26.92	26.97146100000	88.49081100000	NA	Yangmakum KM JL No - 82	18
78	Kalimpong - I	Yangmakhum	Denglali Jhora	26 56 2.56	88 31 13.16	26.93404400000	88.52032200000	NA	Yangmakum KM JL No - 82	19
79	Kalimpong - I	Yangmakhum	Dodhi Khola	26 58 3.73	88 29 40.24	26.96770300000	88.49451100000	NA	Yangmakum KM JL No - 82	14
80	Kalimpong - I	Yangmakhum	Yang Khola	26 57 8.69	88 29 33.21	26.95241400000	88.49255800000	NA	Yangmakum KM JL No - 82	11
81	Kalimpong - I	Teesta	Old Teesta Bridge Village Jhora	27 03 29.97	88 25 28.89	27.05832500000	88.42469200000	NA	Teesta DIF JL No-52	15
82	Kalimpong - I	Teesta	Madan Chettri House To Ganesh Thapa Jhora	27 03 23.32	88 25 29.43	27.05647800000	88.42484200000	NA	Teesta DIF JL No-52	13
83	Kalimpong - I	Teesta	Krishna Jhora	27 03 44.4	88 25 27.83	27.06233300000	88.42439700000	NA	Teesta DIF JL No-52	19
84	Kalimpong - I	Teesta	29 Primary school jhora	27 03 43.98	88 25 27.48	27.06221700000	88.42430000000	NA	Teesta DIF JL No-52	14
85	Kalimpong - I	Teesta	forest Compound jhora	27 03 43.98	88 25 27.48	27.06221700000	88.42430000000	NA	Teesta DIF JL No-52	16
86	Kalimpong - I	Kaffer Kanke Pong	Sanai Dhara	27 01 25.29	88 33 19.17	27.02369200000	88.55532500000	NA	kaffer JL NO-41	13
87	Kalimpong - I	Kaffer Kanke Pong	Angarey Dhara	27 01 50.78	88 33 40.51	27.03077200000	88.56125300000	NA	kaffer JL NO-42	18

88	Kalimpong - I	Kaffer Kanke Pong	Minchu Jhora	27 01 58.18	88 32 33.68	27.03282800000	88.54268900000	NA	kaffer JL NO-41	13
89	Kalimpong - I	Kaffer Kanke Pong	Martin Jhora	27 02 0.53	88 32 51.66	27.03348100000	88.54768300000	NA	kaffer JL NO-42	15
90	Kalimpong - I	Kaffer Kanke Pong	Shiva Dhara	27 01 51.73	88 32 5.3	27.03103600000	88.53480600000	NA	kaffer JL NO-41	19
91	Kalimpong - I	Bong	Adhikari Dhara	27 03 8.64	88 28 27.2	27.05240000000	88.47422200000	NA	BONG KM JL No-72	14
92	Kalimpong - I	Bong	Bhakti Dhara	27 03 14.77	88 28 45.32	27.05410300000	88.47925600000	NA	BONG KM JL No-72	12
93	Kalimpong - I	Bong	Amaley Dhara	27 03 21.55	88 28 42.93	27.05598600000	88.47859200000	NA	BONG KM JL No-72	15
94	Kalimpong - I	Bong	Dikshit Dhara	27 03 7.57	88 28 40.26	27.05210300000	88.47785000000	NA	BONG KM JL No-72	13
95	Kalimpong - I	Bong	Tambey Dhara	27 03 9.35	88 28 41.99	27.05259700000	88.47833100000	NA	BONG KM JL No-72	19
96	Kalimpong - I	Bong	Dangal Dhara	27 03 7.05	88 28 41.96	27.05195800000	88.47832200000	NA	BONG KM JL No-72	14
97	Kalimpong - I	Bong	Morangey Dhara	27 03 6.48	88 28 44.05	27.05180000000	88.47890300000	NA	BONG KM JL No-72	16
98	Kalimpong - I	Bong	Pokhrel Dhara	27 02 58.43	88 28 40.2	27.04956400000	88.47783300000	NA	BONG KM JL No-72	13
99	Kalimpong - I	Bong	Ramesh nepal dhara	27 03 3.09	88 28 52.99	27.05085800000	88.48138600000	NA	BONG KM JL No-72	18
100	Kalimpong - I	Bong	Siktel Dhara	27 02 59.29	88 28 56.73	27.04980300000	88.48242500000	NA	BONG KM JL No-72	13
101	Kalimpong - I	Bong	Jore Dhara	27 02 32.65	88 28 42.87	27.04240300000	88.47857500000	NA	BONG KM JL No-72	23
102	Kalimpong - I	Bong	Sim Dhara	27 01 57.47	88 28 6.33	27.03263100000	88.46842500000	NA	BONG KM JL No-72	25
103	Kalimpong - I	Bong	Jugey Dhara	27 01 51.9	88 28 8.92	27.03108300000	88.46914400000	NA	BONG KM JL No-72	11
104	Kalimpong - I	Bong	Mahesh Dahal Dhara	27 02 55.7	88 28 20.7	27.04880600000	88.47241700000	NA	BONG KM JL No-72	24
105	Kalimpong - I	Bong	Ghataney Dhara	27 01 28.06	88 28 20.7	27.02446100000	88.47241700000	NA	BONG KM JL No-72	20
106	Kalimpong - I	Bong	Kafley Dhara	27 02 57.34	88 28 21.99	27.04926100000	88.47277500000	NA	BONG KM JL No-72	10
107	Kalimpong - I	Pabringtar	Jaranti Jhora	26 56 34.77	88 33 23.9	26.94299200000	88.55663900000	NA	Pabringtar KM JL No-67	12

108	Kalimpong - I	Pabringtar	Chumit Jhora	26 57 6.35	88 33 12.3	26.95176400000	88.55341700000	NA	Pabringtar KM JL No-67	15
109	Kalimpong - I	Samalbong	Kyapchaki Jhora	27 0 4.65	88 31 57.54	27.00129200000	88.53265000000	NA	samalbong km JL No 60	15
110	Kalimpong - I	Samalbong	Aaley Jhora	27 0 8.1	88 30 46.57	27.00225000000	88.51293600000	NA	Sinji km JL No-70	13
111	Kalimpong - I	Samalbong	Singee Gairi Goaon	27 0 15.34	88 30 40.09	27.00426100000	88.51113600000	NA	Sinji km JL No-70	19
112	Kalimpong - I	Samalbong	lampatey Gairi	26 59 54.81	88 31 31.62	26.99855800000	88.52545000000	NA	Sinji km JL No-70	14
113	Kalimpong - I	Samalbong	Gjising Dhara	27 0 28.17	88 31 19.41	27.00782500000	88.52205800000	NA	samalbong km JL No 60	16
114	Kalimpong - I	Samalbong	Mistiry Jhora	27 0 51.18	88 36.91	27.01421700000	88.61516700000	NA	samalbong km JL No 60	13
115	Kalimpong - I	Samalbong	Dharey Gaon	27 1 3.71	88 31 34.34	27.01769700000	88.52620600000	NA	Sinji km JL No-70	18
116	Kalimpong - I	Samalbong	Barpipal Jhora	27 1 7.86	88 30 4.79	27.01885000000	88.50133100000	NA	Sinji km JL No-70	12
117	Kalimpong - I	Samalbong	Devithan Jhora	27 1 7.35	88 30 3.62	27.01870800000	88.50100600000	NA	samalbong km JL No 60	13
118	Kalimpong - I	Samalbong	Devithan Dhara	27 0 54.18	88 29 53.49	27.01505000000	88.49819200000	NA	samalbong km JL No 60	20
119	Kalimpong - I	Samalbong	Jukey Pani Dhara	27 0 19.88	88 31 56.74	27.00552200000	88.53242800000	NA	samalbong km JL No 60	18
120	Kalimpong - I	Samalbong	Protection work	27 0 26.45	88 31 19.02	27.00734700000	88.52195000000	NA	samalbong km JL No 60	19
121	Kalimpong - I	Samalbong	Charkhol Dhara	26 59 51.63	88 31 46.2	26.99767500000	88.52950000000	NA	samalbong km JL No 60	14
122	Kalimpong - I	Samalbong	Suldhong Dhara	27 0 25.92	88 29 26.85	27.00720000000	88.49079200000	NA	samalbong km JL No 60	13
123	Kalimpong - I	Seokbir	Seokbir Dhara	27 1 47.11	88 31 20.01	27.02975300000	88.52222500000	NA	Seokbir KM JL No - 59	12
124	Kalimpong - II	Lingsay	Bhaskar Jhora	27 10 07.17	88 40 05 60	27.16865800000	88.66805600000	Perennial	Dabaipani	10
125	Kalimpong - II	Lingsay	Nagey Dhara	27 10 00.42	88 40 04.10	27.16678300000	88.66780600000	Perennial	Dabaipani	12
126	Kalimpong - II	Lingsay	Debithan Jhora	27 09 47.31	88 40 28.56	27.16314200000	88.67460000000	Perennial	Lingsay	9

127	Kalimpong - II	Lingsay	Doxing Jhora(1)	27 09 09.74	88 41 57.75	27.15270600000	88.69937500000	Perennial	Tagathang	11
128	Kalimpong - II	Lingsay	Upper Malingney	27 09 51.79	88 41 53.90	27.16438600000	88.69830600000	Perennial	Pithamchin	10
129	Kalimpong - II	Lingsekha	Dhokrey Jhora	27 08 36.69	88 40 28.99	27.14352500000	88.67471900000	Perennial	Changay	34
130	Kalimpong - II	Lingsekha	Upper Bojini Jhora	27 08 26.07	88 40 24.01	27.14057500000	88.67333600000	Perennial	Changay	10
131	Kalimpong - II	Lingsekha	Nak Tshering Jhora	27 08 08.84	88 40 28.18	27.13578900000	88.67449400000	Perennial	Changay	8
132	Kalimpong - II	Lingsekha	Byaksha Jhora	27 07 59.66	88 41 39.36	27.13323900000	88.69426700000	Perennial	Changay	28
133	Kalimpong - II	Lingsekha	Saksung Jhora	27 08 33.16	88 41 28.76	27.14254400000	88.69132200000	Perennial	Changay	14
134	Kalimpong - II	Lingsekha	Barbot Jhora	27 08 00.69	88 40 59.23	27.13352500000	88.68311900000	Perennial	Changay	10
135	Kalimpong - II	Lingsekha	Thaluk Jhora	27 07 55.63	88 40 57.56	27.13211900000	88.68265600000	Perennial	Changay	10
136	Kalimpong - II	Lingsekha	Middle Changay Jhora	27 07 46.89	88 41 18.66	27.12969200000	88.68851700000	Perennial	Changay	9
137	Kalimpong - II	Lingsekha	Nadi Jhora Jhora	27 08 08.59	88 41 15.12	27.13571900000	88.68753300000	Perennial	Changay	9
138	Kalimpong - II	Lingsekha	Arkyo Spring Jhora	27 07 39.38	88 40 48.42	27.12760600000	88.68011700000	Perennial	Changay	12
139	Kalimpong - II	Lingsekha	Farang Khola	27 07 47.14	88 41 05.45	27.12976100000	88.68484700000	Perennial	Changay	10
140	Kalimpong - II	Lingsekha	Menchu Spring Jhora	27 08 09.24	88 40 26.27	27.13590000000	88.67396400000	Perennial	Changay	14
141	Kalimpong - II	Lingsekha	Doksing Spring Jhora	27 08 10.58	88 40 50.04	27.13627200000	88.68056700000	Perennial	Changay	8
142	Kalimpong - II	Lingsekha	Lalbir Spring Jhora	27 08 37.75	88 40 32.82	27.14381900000	88.67578300000	Perennial	Changay	9
143	Kalimpong - II	Lingsekha	Rateypani Jhora	27 09 06.19	88 40 30.88	27.15171900000	88.67524400000	Perennial	Chuba	8
144	Kalimpong - II	Lingsekha	Okharbotay Jhora	27 08 59.43	88 40 18.81	27.14984200000	88.67189200000	Perennial	Chuba	9
145	Kalimpong - II	Lingsekha	Koiraley Jhora	27 09 13.75	88 40 18.12	27.15381900000	88.67170000000	Perennial	Chuba	10
146	Kalimpong - II	Lingsekha	Lower Bojini Jhora	27 08 37.87	88 40 12.73	27.14385300000	88.67020300000	Perennial	Chuba	10
147	Kalimpong - II	Lingsekha	Buddhibal Jhora	27 08 57.54	88 40 03.38	27.14931700000	88.66760600000	Perennial	Chuba	9
148	Kalimpong - II	Lingsekha	Thotney Jhora	27 08 35.63	88 40 30.06	27.14323100000	88.67501700000	Perennial	Chuba	11
149	Kalimpong - II	Lingsekha	Balaram Jhora	27 08 38.69	88 40 37.56	27.14408100000	88.67710000000	Perennial	Chuba	8

150	Kalimpong - II	Lingsekha	Rinchey Jhora	27 08 00.00	88 41 32.88	27.13333300000	88.69246700000	Perennial	Dagyoung/ Kolbung	12
151	Kalimpong - II	Lingsekha	Bhalukhop Jhora	27 07 00.03	88 41 00.08	27.11667500000	88.68335600000	Perennial	Dagyoung/ Kolbung	14
152	Kalimpong - II	Lingsekha	Raongel Jhora	27 06 37.06	88 41 11.02	27.11029400000	88.68639400000	Perennial	Dagyoung/ Kolbung	12
153	Kalimpong - II	Lingsekha	Dagyong Khola	27 07 05.78	88 40 46.04	27.11827200000	88.67945600000	Perennial	Dagyoung/ Kolbung	24
154	Kalimpong - II	Lingsekha	Rateypani Spring water source	27 05 50.56	88 41 02.01	27.09737800000	88.68389200000	Perennial	Dagyoung/ Kolbung	12
155	Kalimpong - II	Lingsekha	Changay Khola	27 06 37.43	88 41 02.51	27.11039700000	88.68403100000	Perennial	Dagyoung/ Kolbung	12
156	Kalimpong - II	Lingsekha	Keraghari Spring water source	27 06 00.34	88 40 51.84	27.10009400000	88.68106700000	Perennial	Dagyoung/ Kolbung	12
157	Kalimpong - II	Lingsekha	Dhobi Khola	27 06 19.61	88 40 40.60	27.10544700000	88.67794400000	Perennial	Dagyoung/ Kolbung	13
158	Kalimpong - II	Lingsekha	Chun Khola	27 05 53.38	88 41 06.12	27.09816100000	88.68503300000	Perennial	Dagyoung/ Kolbung	15
159	Kalimpong - II	Kagay	Lalbir Jhora	27 07 57.76	88 38 42.32	27.13271100000	88.64508900000	Perennial	Maria	20
160	Kalimpong - II	Kagay	Dhobi Jhora	27 05 09.25	88 38 52.06	27.08590300000	88.64779400000	Perennial	Maria	12
161	Kalimpong - II	Kagay	Bulu Jhora	27 08 57.07	88 39 91.94	27.14918600000	88.67553900000	Perennial	Pabak	15
162	Kalimpong - II	Kagay	Pokhrel Jhora	27 09 10.21	88 39 21.62	27.15283600000	88.65600600000	Perennial	Pabak	9
163	Kalimpong - II	Kagay	Ninguray Jhora	27 09 19.04	88 38 18.04	27.15528900000	88.63834400000	Seasonal	Pabak	12
164	Kalimpong - II	Kagay	Sisnay Jhora	27 09 07.01	88 39 27.54	27.15194700000	88.65765000000	Seasonal	Pabak	9
165	Kalimpong - II	Kagay	Arupatay Jhora	27 08 21.34	88 39 10.45	27.13926100000	88.65290300000	Perennial	Benda	18
166	Kalimpong - II	Kagay	Baral Jhora	27 09 05.49	88 35 40.25	27.15152500000	88.59451400000	Seasonal	Gyendong	15
167	Kalimpong - II	Kagay	Chagay Khola	27 07 52.37	88 37 15.77	27.13121400000	88.62104700000	Perennial	Duka	11
168	Kalimpong - II	Kagay	Jogi Jhora	27 06 25.21	88 39 17.15	27.10700300000	88.65476400000	Perennial	Rabeek	19
169	Kalimpong - II	Kagay	Malingany Jhora	27 07 15.94	88 37 21.05	27.12109400000	88.62251400000	Seasonal	Rabeek	9
170	Kalimpong - II	Kagay	Gurung Jhora	27 06 37.54	88 39 15.19	27.11042800000	88.65421900000	Seasonal	Lower Rabeek	18
171	Kalimpong - II	Pedong	Naspati Jhora	27 09 47.47	88 37 38.54	27.16318600000	88.62737200000	Perennial	Dalep	18
172	Kalimpong - II	Pedong	Dharmay Jhora	27 09 49.34	88 37 49.39	27.16370600000	88.63038600000	Perennial	Dalep	15

173	Kalimpong - II	Pedong	Simsary Jhora	27 09 48.95	88 37 58.03	27.16359700000	88.63278600000	Perennial	Dalep	16
174	Kalimpong - II	Pedong	Tamang Jhora	27 09 38.97	88 37 20.62	27.16082500000	88.62239400000	Perennial	Dalep	20
175	Kalimpong - II	Pedong	Dewan Jhora	27 09 38.23	88 37 25.76	27.16061900000	88.62382200000	Perennial	Dalep	12
176	Kalimpong - II	Pedong	Lama Jhora	27 09 33.41	88 37 17.03	27.15928100000	88.62139700000	Perennial	Dalep	15
177	Kalimpong - II	Pedong	N T Jhora	27 09 34.62	88 37 12.15	27.15961700000	88.62004200000	Perennial	Dalep	17
178	Kalimpong - II	Pedong	Khem Jhora	27 09 36.84	88 37 25.75	27.16023300000	88.62381900000	Perennial	Dalep	19
179	Kalimpong - II	Pedong	Ambakay Jhora	27 09 35.21	88 37 05.45	27.15978100000	88.61818100000	Seasonal	Upper Dalep	13
180	Kalimpong - II	Pedong	Lamani Jhora	27 09 26.08	88 37 03.99	27.15724400000	88.61777500000	Perennial	Dalep	16
181	Kalimpong - II	Pedong	Simsary Jhora	27 09 01.64	88 36 28.69	27.15045600000	88.60796900000	Perennial	Dalep	20
182	Kalimpong - II	Pedong	Simana Dhara	27 09 27.47	88 37 01.01	27.15763100000	88.61694700000	Perennial	Upper Pedong	22
183	Kalimpong - II	Pedong	Sishnay Jhora	27 08 29.91	88 35 06.34	27.14164200000	88.58509400000	Perennial	Upper Pedong	19
184	Kalimpong - II	Pedong	Aalay Pakha Jhora	27 09 33.39	88 36 32.44	27.15927500000	88.60901100000	Seasonal	Upper pedong	15
185	Kalimpong - II	Pedong	Tarnay Jhora	27 09 43.96	88 37 08.02	27.16221100000	88.61889400000	Perennial	Upper Pedong	13
186	Kalimpong - II	Pedong	Mandol Jhora	27 09 14.64	88 36 47.79	27.15406700000	88.61327500000	Perennial	Upper Newang Merong	12
187	Kalimpong - II	Pedong	Dhobi Jhora	27 09 12.28	88 36 52.56	27.15341100000	88.61460000000	Perennial	Upper Newang Merong	12
188	Kalimpong - II	Pedong	House Khola Jhora	27 09 11.47	88 36 38.06	27.15318600000	88.61057200000	Perennial	Upper Newang Merong	18
189	Kalimpong - II	Pedong	K B Jhora	27 08 59.77	88 37 01.97	27.14993600000	88.61721400000	Perennial	Upper Newang Merong	17
190	Kalimpong - II	Pedong	Sukbir Jhora	27 09 10.41	88 37 33.97	27.15289200000	88.62610300000	Perennial	Lower Newang Merong	20
191	Kalimpong - II	Pedong	Sunder Jhora	27 09 05.03	88 37 49.82	27.15139700000	88.63050600000	Perennial	Lower Newang Merong	20
192	Kalimpong - II	Pedong	Tunibotay Jhora	27 08 54.71	88 37 40.79	27.14853100000	88.62799700000	Perennial	Lower Newang Merong	14
193	Kalimpong - II	Pedong	Arun Jhora	27 09 13.04	88 37 31.91	27.15362200000	88.62553100000	Perennial	Lower Newang Merong	16
194	Kalimpong - II	Pedong	Dal Bahadur Jhora	27 09 47.47	88 37 38.54	27.16318600000	88.62737200000	Perennial	Lower Newang Merong	11
195	Kalimpong - II	Sakyong	Nakul Jhora	27 08 45.71	88 36 23.77	27.14603100000	88.60660300000	Perennial	Dokyong-I	30
196	Kalimpong - II	Sakyong	Tempo Jhora	27 08 48.36	88 36 21.52	27.14676700000	88.60597800000	Perennial	Dokyong-I	15
197	Kalimpong - II	Sakyong	Silk Route Jhora	27 08 37.12	88 36 14.17	27.14364400000	88.60393600000	Perennial	Dokyong-I	18

198	Kalimpong - II	Sakyong	Suresh Kumar Jhora	27 08 16.46	88 36 56.39	27.13790600000	88.61566400000	Perennial	Dokyong-II	12
199	Kalimpong - II	Sakyong	Hitti Jhora	27 08 09.70	88 35 55.15	27.13602800000	88.59865300000	Perennial	Dokyong-II	9
200	Kalimpong - II	Sakyong	Deo Prakash Dhara	27 07 29.09	88 36 14.80	27.12474700000	88.60411100000	Perennial	Lower Menchu	8
201	Kalimpong - II	Sakyong	Napu Dhara	27 07 39.66	88 36 21.08	27.12768300000	88.60585600000	Perennial	Lower Menchu	12
202	Kalimpong - II	Sakyong	Nir Dorjee Dhara	27 07 45.20	88 36 13.96	27.12922200000	88.60387800000	Perennial	Lower Menchu	14
203	Kalimpong - II	Sakyong	S L Jhora	27 07 42.90	88 36 16.35	27.12858300000	88.60454200000	Perennial	Lower Menchu	11
204	Kalimpong - II	Sakyong	Deepak Jhora	27 07 37.04	88 36 23.74	27.12695600000	88.60659400000	Perennial	Lower Menchu	11
205	Kalimpong - II	Sakyong	Kharkadas Jhora	27 08 20.73	88 36 26.58	27.13909200000	88.60738300000	Perennial	Mool Skayong-I	11
206	Kalimpong - II	Sakyong	Chopal Jhora	27 08 16.66	88 36 32.67	27.13796100000	88.60907500000	Perennial	Mool Skayong-I	15
207	Kalimpong - II	Sakyong	Sillay Jhora	27 08 29.51	88 36 44.71	27.14153100000	88.61241900000	Perennial	Mool Skayong-II	13
208	Kalimpong - II	Sakyong	Major Jhora	27 08 48.90	88 36 36.67	27.14691700000	88.61018600000	Perennial	Mool Sakyong-II	10
209	Kalimpong - II	Sakyong	Prakash Jhora	27 07 36.64	88 36 44.99	27.12684400000	88.61249700000	Perennial	Tendrabong	10
210	Kalimpong - II	Sakyong	Palden Jhora	27 07 40.35	88 36 37.99	27.12787500000	88.61055300000	Perennial	Tendrabong	14
211	Kalimpong - II	Sakyong	Nima Jhora	27 07 57.86	88 35 41.24	27.13273900000	88.59478900000	Perennial	Mairung FV	11
212	Kalimpong - II	Sakyong	Memaycho Jhora	27 07 40.08	88 35 26.50	27.12780000000	88.59069400000	Perennial	Chumerchin	10
213	Kalimpong - II	Sakyong	Gop Jhora	27 07 57.84	88 36 01.22	27.13273300000	88.60033900000	Perennial	Upper Menchu	12
214	Kalimpong - II	Kashyone	Simsarey Jhora	27 09 43.95	88 36 08.02	27.16220800000	88.60222800000	Perennial	Namchelakha-I	21
215	Kalimpong - II	Kashyone	Sikari Jhora	27 09 48.73	88 36 05.33	27.16353600000	88.60148100000	Perennial	Namchelakha-I	18
216	Kalimpong - II	Kashyone	Bom Bdr Sardar Jhora	27 09 52.75	88 36 00.64	27.16465300000	88.60017800000	Perennial	Namchelakha-I	14
217	Kalimpong - II	Kashyone	Khamdong Jhora	27 10 23.36	88 35 42.36	27.17315600000	88.59510000000	Perennial	Namchelakha-I	16
218	Kalimpong - II	Kashyone	Gumba Jhora	27 10 29.74	88 35 36.19	27.17492800000	88.59338600000	Perennial	Namchelakha-II	20
219	Kalimpong - II	Kashyone	Tali Jhora	27 10 40.07	88 35 05.78	27.17779700000	88.58493900000	Perennial	Namchelakha-II	17
220	Kalimpong - II	Kashyone	Rong-gong Khola	27 10 05.69	88 36 16.06	27.16824700000	88.60446100000	Perennial	Phurun-I	13
221	Kalimpong - II	Kashyone	Samsing Khola	27 10 08.36	88 36 15.28	27.16898900000	88.60424400000	Perennial	Phurun-I	10
222	Kalimpong - II	Kashyone	Pathing Kholsa	27 10 04.56	88 36 20.09	27.16793300000	88.60558100000	Perennial	Phurun-I	23

223	Kalimpong - II	Kashyone	Chamchung Kholsa	27 10 14.27	88 35 59.81	27.17063100000	88.59994700000	Perennial	Phurun-I	14
224	Kalimpong - II	Kashyone	Ongdi Tsh Jhora	27 10 34.68	88 36 18.87	27.17630000000	88.60524200000	Perennial	Phurun-II	18
225	Kalimpong - II	Kashyone	Harsing Kholsa	27 10 37.68	88 36 17.59	27.17713300000	88.60488600000	Perennial	Phurun-II	16
226	Kalimpong - II	Kashyone	Silang Khazi Jhora	27 10 47.43	88 35 22.85	27.17984200000	88.58968100000	Perennial	Kamjer	20
227	Kalimpong - II	Kashyone	Dhojbir Baraily Jhora	27 10 51.74	88 35 07.72	27.18103900000	88.58547800000	Perennial	Kamjer	13
228	Kalimpong - II	Kashyone	Sunarey Jhora	27 10 51.27	88 35 25.89	27.18090800000	88.59052500000	Perennial	Kamjer	15
229	Kalimpong - II	Kashyone	Devithan Jhora	27 10 51.27	88 35 25.89	27.18090800000	88.59052500000	Perennial	Kamjer	18
230	Kalimpong - II	Kashyone	Thapa Jhora	27 10 55.48	88 34 50.72	27.18207800000	88.58075600000	Perennial	Kamjer	16
231	Kalimpong - II	Kashyone	Balubasay Jhora	27 10 39.29	88 35 49.32	27.17758100000	88.59703300000	Perennial	Kamjer	14
232	Kalimpong - II	Kashyone	Sipoy Jhora	27 10 25.72	88 36 54.68	27.17381100000	88.61518900000	Perennial	Samdong	12
233	Kalimpong - II	Kashyone	Simsarey Jhora	27 10 38.15	88 36 53.06	27.17726400000	88.61473900000	Perennial	Samdong	17
234	Kalimpong - II	Kashyone	Gotey Jhora	27 10 41.33	88 36 53.71	27.17814700000	88.61491900000	Perennial	Samdong	12
235	Kalimpong - II	Kashyone	Samsing Jhora	27 10 22.59	88 36 50.66	27.17294200000	88.61407200000	Perennial	Samdong	10
236	Kalimpong - II	Kashyone	Changa Jhora	27 10 07.24	88 36 53.02	27.16867800000	88.61472800000	Perennial	Samdong	19
237	Kalimpong - II	Kashyone	Nechaly Jhora	27 10 00.23	88 36 57.47	27.16673100000	88.61596400000	Perennial	Samdong	14
238	Kalimpong - II	Kashyone	Ghumty Jhora	27 09 52.16	88 36 49.43	27.16448900000	88.61373100000	Perennial	Samdong	18
239	Kalimpong - II	Kashyone	Panishaj Jhora	27 10 05.95	88 36 45.14	27.16831900000	88.61253900000	Perennial	Samdong	10
240	Kalimpong - II	Kashyone	Gishing Jhora	27 10 26.75	88 37 29.65	27.17409700000	88.62490300000	Perennial	Samdong	13
241	Kalimpong - II	Kashyone	Anderi Jhora	27 10 01.01	88 35 18.61	27.16694700000	88.58850300000	Perennial	12 No Dhura	16
242	Kalimpong - II	Kashyone	Paireni Jhora	27 10 10.03	88 35 20.46	27.16945300000	88.58901700000	Perennial	12 No Dhura	11
243	Kalimpong - II	Kashyone	Sillary Dhara	27 08 20.95	88 34 20.95	27.13915300000	88.57248600000	Perennial	Sillary	12
244	Kalimpong - II	Kashyone	Chipchipay Jhora	27 08 19.19	88 34 54.51	27.13866400000	88.58180800000	Perennial	Sillary	17
245	Kalimpong - II	Kashyone	School Dhara	27 08 28.38	88 34 51.55	27.14121700000	88.58098600000	Perennial	Sillary	15
246	Kalimpong - II	Kashyone	GattayKhola	27 09 05.56	88 34 58.02	27.15154400000	88.58278300000	Perennial	Upper Kashyem	14
247	Kalimpong - II	Kashyone	Pareng Khola	27 09 11.86	88 34 35.51	27.15329400000	88.57653100000	Perennial	Upper Kashyem	16
248	Kalimpong - II	Kashyone	Dobhi Khola	27 09 09.08	88 35 20.63	27.15252200000	88.58906400000	Perennial	Upper Kashyem	13
249	Kalimpong - II	Kashyone	Chyabari Khola	27 09 03.22	88 35 07.55	27.15089400000	88.58543100000	Perennial	Upper Kashyem	14

250	Kalimpong - II	Kashyone	Phampal Gairi Jhora	27 09 23.95	88 35 31.18	27.15665300000	88.59199400000	Perennial	Upper Kashyem	12
251	Kalimpong - II	Kashyone	Devithan Dabai Khola	27 09 17.26	88 35 27.09	27.15479400000	88.59085800000	Perennial	Upper Kashyem	15
252	Kalimpong - II	Kashyone	Dal Khola	27 09 23.00	88 35 23.01	27.15638900000	88.58972500000	Perennial	Upper Kashyem	14
253	Kalimpong - II	Kashyone	Kazi Dhara	27 09 18.49	88 34 51.96	27.15513600000	88.58110000000	Perennial	Upper Kashyem	10
254	Kalimpong - II	Kashyone	Rai Gaon Dhara	27 09 16.78	88 35 08.02	27.15466100000	88.58556100000	Perennial	Upper Kashyem	12
255	Kalimpong - II	Kashyone	Sisirpa Gairo Dhara	27 09 31.62	88 35 19.52	27.15878300000	88.58875600000	Perennial	Upper Kashyem	10
256	Kalimpong - II	Kashyone	Captain Dhara	27 09 20.53	88 35 09.03	27.15570300000	88.58584200000	Perennial	Upper Kashyem	14
257	Kalimpong - II	Kashyone	Pani Dhara	27 09 16.09	88 34 33.07	27.15446900000	88.57585300000	Perennial	Upper Kashyem	13
258	Kalimpong - II	Kashyone	Water source at Binoy Alaichi Bari	27 09 29.67	88 35 01.29	27.15824200000	88.58369200000	Perennial	Middle Kashyem	18
259	Kalimpong - II	Kashyone	Dhanjit Jhora	27 09 37.59	88 34 52.32	27.16044200000	88.58120000000	Perennial	Lower Kashyem	11
260	Kalimpong - II	Kashyone	Sanjay Jhora	27 09 35.04	88 34 42.95	27.15973300000	88.57859700000	Perennial	Lower Kashyem	10
261	Kalimpong - II	Kashyone	Loho Maila Jhora	27 09 36.27	88 34 43.07	27.16007500000	88.57863100000	Perennial	Lower Kashyem	15
262	Kalimpong - II	Kashyone	Pool Kholsa Sim	27 09 30.14	88 34 34.83	27.15837200000	88.57634200000	Perennial	Lower Kashyem	18
263	Kalimpong - II	Kashyone	Tarjan Jhora	27 09 32.45	88 34 54.71	27.15901400000	88.58186400000	Perennial	Lower Kashyem	14
264	Kalimpong - II	Santook	Rinchen Jhora	27 05 57.56	88 35 46.88	27.09932200000	88.59635600000	Perennial	Mool Santook	25
265	Kalimpong - II	Santook	Bhitey Jhora	27 05 24.94	88 35 37.80	27.09026100000	88.59383300000	Perennial	Sirisay	15
266	Kalimpong - II	Santook	Rajen Jhora	27 05 15.13	88 34 58.68	27.08753600000	88.58296700000	Perennial	Lumbong	20
267	Kalimpong - II	Santook	Sisney Jhora	27 05 36.00	88 37 11.90	27.09333300000	88.61997200000	Perennial	East Pakthang	20
268	Kalimpong - II	Santook	Damsang Jhora	27 07 10.05	88 35 11.55	27.11945800000	88.58654200000	Perennial	Algarah	20
269	Kalimpong - II	Santook	Nala Jhora	27 06 58.41	88 34 49.73	27.11622500000	88.58048100000	Perennial	Mirik	15
270	Kalimpong - II	Santook	Zhilkay Dhara	27 06 02.72	88 34 52.02	27.10075600000	88.58111700000	Perennial	Algarah	20
271	Kalimpong - II	Santook	Kodo Dhara	27 06 57.15	88 34 02.45	27.11587500000	88.56734700000	Perennial	Algarah	15
272	Kalimpong - II	Santook	Palangbari Dhara	27 06 51.98	88 35 10.04	27.11443900000	88.58612200000	Perennial	Algarah	20
273	Kalimpong - II	Santook	Menzong Dhara	27 06 19.42	88 35 15.80	27.10539400000	88.58772200000	Perennial	Menzong	10
274	Kalimpong - II	Santook	Shivalaya Dhara	27 06 06.62	88 35 46.33	27.10183900000	88.59620300000	Perennial	Paiyong Forest Village	20

275	Kalimpong - II	Santook	Thukchuk Dhara	27 06 14.66	88 38 22.06	27.10407200000	88.63946100000	Perennial	Algarah	20
276	Kalimpong - II	Gitdabling	Tara Jhora	27 01 17.55	88 34 34.57	27.02154200000	88.57626900000	Perennial	Dabling	25
277	Kalimpong - II	Gitdabling	Varay Jhora	27 01 15.91	88 34 40.58	27.02108600000	88.57793900000	Perennial	Dabling	28
278	Kalimpong - II	Gitdabling	Unick Jhora	27 01 33.75	88 35 18.90	27.02604200000	88.58858300000	Perennial	Dabling	13
279	Kalimpong - II	Gitdabling	Mandal Jhora	27 01 21.52	88 34 52.67	27.02264400000	88.58129700000	Perennial	Dabling	10
280	Kalimpong - II	Gitdabling	Aalichi Jhora	27 01 27.49	88 35 53.40	27.02430300000	88.59816700000	Perennial	Dabling	9
281	Kalimpong - II	Gitdabling	Sishnay Jhora	27 01 47.62	88 34 39.92	27.02989400000	88.57775600000	Perennial	Pakang	8
282	Kalimpong - II	Gitdabling	Barkhey Jhora	27 02 06.97	88 34 46.96	27.03526900000	88.57971100000	Perennial	Pakang	12
283	Kalimpong - II	Gitdabling	Lankoo Jhora	27 02 13.07	88 35 06.11	27.03696400000	88.58503100000	Perennial	Pakang	9
284	Kalimpong - II	Gitdabling	Lampatay Jhora	27 01 55.38	88 34 44.87	27.03205000000	88.57913100000	Perennial	Pakang	9
285	Kalimpong - II	Gitdabling	Akeay Jhora	27 02 11.29	88 35 10.01	27.03646900000	88.58611400000	Perennial	Pakang	9
286	Kalimpong - II	Gitdabling	Paul Jhora	27 02 12.05	88 35 13.15	27.03668100000	88.58698600000	Perennial	Pakang	8
287	Kalimpong - II	Gitdabling	Sisnee Jhora	27 03 56.28	88 35 59.53	27.06563300000	88.59986900000	Perennial	Beong	26
288	Kalimpong - II	Gitdabling	Dharan Jhora	27 03 49.87	88 35 44.26	27.06385300000	88.59562800000	Perennial	Beong	15
289	Kalimpong - II	Gitdabling	Panisas Dhara	27 03 22.34	88 35 42.53	27.05620600000	88.59514700000	Seasonal	Beong	8
290	Kalimpong - II	Gitdabling	Devithan Jhora	27 03 19.07	88 35 50.98	27.05529700000	88.59749400000	Seasonal	Beong	8
291	Kalimpong - II	Gitdabling	Tenki Pakha Jhora	27 03 37.91	88 35 38.15	27.06053100000	88.59393100000	Seasonal	Beong	8
292	Kalimpong - II	Gitdabling	Kalu Jhora	27 03 10.75	88 35 43.50	27.05298600000	88.59541700000	Perennial	Beong	9
293	Kalimpong - II	Gitdabling	Lain Jhora	27 03 19.24	88 35 35.97	27.05534400000	88.59332500000	Perennial	Beong	9
294	Kalimpong - II	Gitdabling	Deviithan Jhora	27 02 15.55	88 35 39.63	27.03765300000	88.59434200000	Perennial	Beong	9
295	Kalimpong - II	Gitdabling	Andur Jhora	27 03 05.45	88 35 48.56	27.05151400000	88.59682200000	Perennial	Beong	10
296	Kalimpong - II	Gitdabling	Sarkey Jhora	27 02 58.98	88 35 50.39	27.04971700000	88.59733100000	Perennial	Beong	10
297	Kalimpong - II	Gitdabling	Sim Jhora	27 03 02.75	88 35 47.18	27.05076400000	88.59643900000	Perennial	Beong	10
298	Kalimpong - II	Gitdabling	Simik Jhora	27 03 03.97	88 35 43.34	27.05110300000	88.59537200000	Perennial	Beong	8
299	Kalimpong - II	Gitdabling	Aalay Jhora	27 03 55.47	88 37 04.60	27.06540800000	88.61794400000	Perennial	Tugong	9
300	Kalimpong - II	Gitdabling	Rai Jhora	27 03 42.61	88 36 57.59	27.06183600000	88.61599700000	Perennial	Tugong	8
301	Kalimpong - II	Gitdabling	Sri Krishna Jhora	27 03 26.05	88 36 18.49	27.05723600000	88.60513600000	Perennial	Tugong	9
302	Kalimpong - II	Gitdabling	Mangalay Jhora	27 03 17.17	88 36 14.58	27.05476900000	88.60405000000	Perennial	Tugong	8
303	Kalimpong - II	Gitdabling	Dhanesh Jhora	27 04 03.46	88 36 30.99	27.06762800000	88.60860800000	Perennial	Tugong	20
304	Kalimpong - II	Gitdabling	Paireney Jhora	27 03 55.32	88 36 24.93	27.06536700000	88.60692500000	Perennial	Tugong	16

305	Kalimpong - II	Gitdabling	Linetar Jhora	27 01 17.55	88 34 34.57	27.02154200000	88.57626900000	Perennial	Tugong	8
306	Kalimpong - II	Gitdabling	Mandir Jhora	27 03 04.64	88 36 06.84	27.05128900000	88.60190000000	Perennial	Tugong	8
307	Kalimpong - II	Gitdabling	Angkhuri Jhora	27 03 28.39	88 37 03.70	27.05788600000	88.61769400000	Perennial	Pochok	30
308	Kalimpong - II	Gitdabling	Ghattay Jhora	27 03 22.54	88 37 10.92	27.05626100000	88.61970000000	Perennial	Pochok	10
309	Kalimpong - II	Gitdabling	Aadheray Jhora	27 02 06.62	88 37 15.74	27.03517200000	88.62103900000	Perennial	Pochok	8
310	Kalimpong - II	Gitdabling	Mandal Jhora	27 02 32.10	88 36 59.43	27.04225000000	88.61650800000	Perennial	Pochok	25
311	Kalimpong - II	Gitdabling	Kazi Jhora	27 02 42.29	88 37 03.17	27.04508100000	88.61754700000	Perennial	Pochok	10
312	Kalimpong - II	Gitdabling	Ruchal Jhora	27 02 51.45	88 36 53.03	27.04762500000	88.61473100000	Perennial	Pochok	9
313	Kalimpong - II	Gitdabling	Bhotay Jhora	27 01 17.55	88 34 34.57	27.02154200000	88.57626900000	Perennial	Pochok	17
314	Kalimpong - II	Gitdabling	Deorali Jhora	27 03 44.41	88 36 44.04	27.06233600000	88.61223300000	Perennial	Pochok	30
315	Kalimpong - II	Gitdabling	Barbotay Jhora	27 02 17.45	88 37 03.86	27.03818100000	88.61773900000	Perennial	Pochok	9
316	Kalimpong - II	Gitdabling	Mawa Basay Jhora	27 01 51.47	88 37 00.05	27.03096400000	88.61668100000	Perennial	Pochok	10
317	Kalimpong - II	Gitdabling	Mawa Jhora	27 02 43.50	88 36 52.06	27.04541700000	88.61446100000	Perennial	Beong	8
318	Kalimpong - II	Gitdabling	Kaffer Jhora	27 02 43.84	88 35 59.52	27.04551100000	88.59986700000	Perennial	Beong	9
319	Kalimpong - II	Gitdabling	Ghalay Jhora	27 02 29.43	88 35 58.43	27.04150800000	88.59956400000	Perennial	Beong	8
320	Kalimpong - II	Gitdabling	Chumang Khola	27 02 42.11	88 36 01.34	27.04503100000	88.60037200000	Perennial	Gitdabling	15
321	Kalimpong - II	Gitdabling	Sita Khola	27 03 21.87	88 36 00.17	27.05607500000	88.60004700000	Perennial	Gitdabling	30
322	Kalimpong - II	Gitdabling	Thray khola	27 03 23.76	88 35 57.97	27.05660000000	88.59943600000	Perennial	Gitdabling	30
323	Kalimpong - II	Lava-Gitbeong	Amphy Dhara Jhora, Mandir Gaon	27 01 47.32	88 37 24.01	27.02981100000	88.62333600000	Perennial	Mandir Dara	15
324	Kalimpong - II	Lava-Gitbeong	Adhari Jhora at Bhatti Dara	27 01 32.72	88 37 28.12	27.02575600000	88.62447800000	Perennial	Mandir Dara	13
325	Kalimpong - II	Lava-Gitbeong	Nawlaytar Jhora at Lower Shankay Gaon	27 01 41.43	88 37 56.06	27.02817500000	88.63223900000	Perennial	Lower Shankay	18
326	Kalimpong - II	Lava-Gitbeong	Bhaktay Jhora	27 01 55.13	88 37 50.27	27.03198100000	88.63063100000	Perennial	Upper Shankay	15
327	Kalimpong - II	Lava-Gitbeong	Machin Jhora	27 01 50.08	88 37 56.94	27.03057800000	88.63248300000	Perennial	Lower Shankay	8
328	Kalimpong - II	Lava-Gitbeong	Gumba Jhora	27 03 11.43	88 37 50.63	27.05317500000	88.63073100000	Perennial	Passabong	8
329	Kalimpong - II	Lava-Gitbeong	Golay Jhora	27 02 55.02	88 37 54.20	27.04861700000	88.63172200000	Perennial	Passabong	10
330	Kalimpong - II	Lava-Gitbeong	Ghatay Jhora	27 02 41.06	88 37 44.8	27.04473900000	88.62911100000	Perennial	Passabong	12
331	Kalimpong - II	Lava-Gitbeong	Daldalay Jhora	27 04 37.73	88 37 38.54	27.07714700000	88.62737200000	Perennial	Gitkolbong	8
332	Kalimpong - II	Lava-Gitbeong	Fulman Jhora	27 04 22.85	88 37 40.49	27.07301400000	88.62791400000	Perennial	Gitkolbong	9

333	Kalimpong - II	Lava-Gitbeong	Chokpey Jhora	27 04 06.49	88 37 28.78	27.06846900000	88.62466100000	Perennial	Gitkolbong	8
334	Kalimpong - II	Lava-Gitbeong	Bumthing Jhora	27 04 13.52	88 37 25.10	27.07042200000	88.62363900000	Perennial	Gitkolbong	9
335	Kalimpong - II	Lava-Gitbeong	Moktan Jhora	27 04 06.03	88 37 18.90	27.06834200000	88.62191700000	Perennial	Gumba Dara	15
336	Kalimpong - II	Lava-Gitbeong	Lepcha Jhora	27 04 08.94	88 37 19.24	27.06915000000	88.62201100000	Perennial	Gumba Dara	12
337	Kalimpong - II	Lava-Gitbeong	Buk Jhora	27 05 07.73	88 39 32.48	27.08548100000	88.65902200000	Perennial	Lava DIF-II	30
338	Kalimpong - II	Lava-Gitbeong	Chek Dem Jhora	27 05 17.90	88 39 24.05	27.08830600000	88.65668100000	Perennial	Lava DIF-I	45
339	Kalimpong - II	Lava-Gitbeong	Gairi Bas	27 04 37.17	88 40 08.55	27.07699200000	88.66904200000	Perennial	Lava DIF-I	35
340	Kalimpong - II	Lava-Gitbeong	Bukhim Jhora	27 04 30.96	88 38 34.11	27.07526700000	88.64280800000	Perennial	Lava DIF-II	35
341	Kalimpong - II	Lava-Gitbeong	9th Mile Jhora	27 05 19.44	88 39 12.37	27.08873300000	88.65343600000	Perennial	Lava DIF-II	20
342	Kalimpong - II	Lava-Gitbeong	Dawla Jhora	27 05 3.58	88 41 16.39	27.08432800000	88.68788600000	Perennial	Lava DIF-I,II	45
343	Kalimpong - II	Lava-Gitbeong	Tuni Jhora	27 05 09.56	88 40 35.73	27.08598900000	88.67659200000	Perennial	Kolbong	25
344	Kalimpong - II	Lava-Gitbeong	Lower Bukhim	27 04 22.61	88 38 50.20	27.07294700000	88.64727800000	Perennial	Lava Forest Village	45
345	Kalimpong - II	Lava-Gitbeong	Charcharay Jhora	27 04 57.52	88 40 40.55	27.08264400000	88.67793100000	Perennial	Lava DIF-I	25
346	Kalimpong - II	Lava-Gitbeong	Reset Jhora	27 05 02.19	88 40 27.67	27.08394200000	88.67435300000	Perennial	Kolbong Forest Village	20
347	Kalimpong - II	Lava-Gitbeong	Dhap Jhora	27 03 26.31	88 37 38.52	27.05730800000	88.62736700000	Perennial	Upper Nokdara	9
348	Kalimpong - II	Lava-Gitbeong	Tulo Khola	27 04 18.18	88 38 49.19	27.07171700000	88.64699700000	Perennial	Lava Forest Village	10
349	Kalimpong - II	Lolay	Chaitay Jhora	27 03 32.11	88 33 18.48	27.05891900000	88.55513300000	Perennial	Mool Pala	22
350	Kalimpong - II	Lolay	Ketabaw Jhora	27 03 55.55	88 32 38.32	27.06543100000	88.54397800000	Seasonal	Takna	25
351	Kalimpong - II	Lolay	Chaw Khola	27 03 40.08	88 32 41.98	27.06113300000	88.54499400000	Perennial	Lower Lolay	35
352	Kalimpong - II	Lolay	Purohit Jhora	27 03 46.43	88 32 39.25	27.06289700000	88.54423600000	Perennial	Dhajay	28
353	Kalimpong - II	Lolay	Bayang Jhora	27 03 49.94	88 32 42.19	27.06387200000	88.54505300000	Perennial	Upper Lolay	15
354	Kalimpong - II	Sangsay	Kamaray Jhora	27 05 56.76	88 32 02.96	27.09910000000	88.53415600000	Perennial	Bhangay	10
355	Kalimpong - II	Sangsay	Sangsay Dhara	27 05 48.39	88 31 55.95	27.09677500000	88.53220800000	Perennial	Upper Bhangay	50
356	Kalimpong - II	Sangsay	Kundung Jhora	27 06 46.13	88 31 38.14	27.11281400000	88.52726100000	Perennial	Lower Bhangay	30
357	Kalimpong - II	Sangsay	Kakulay Jhora	27 06 22.12	88 31 27.69	27.10614400000	88.52435800000	Perennial	Bimbong	40
358	Kalimpong - II	Sangsay	Loktang Jhora	27 06 05.85	88 31 33.99	27.10162500000	88.52610800000	Perennial	Lower Bimbong	30
359	Kalimpong - II	Sangsay	Masing Jhora	27 05 58.80	88 31 36.81	27.09966700000	88.52689200000	Perennial	Bimbong	30
360	Kalimpong - II	Sangsay	Simalay Jhora	27 06 35.05	88 30 50.97	27.10973600000	88.51415800000	Perennial	Tumlabong	50
361	Kalimpong - II	Sangsay	Asharay Jhora	27 06 23.75	88 30 50.42	27.10659700000	88.51400600000	Perennial	Tumlabong	30
362	Kalimpong - II	Sangsay	Palden Jhora	27 05 24.96	88 30 47.77	27.09026700000	88.51326900000	Perennial	Kharka	6
363	Kalimpong - II	Sangsay	Suraj Jhora	27 05 34.56	88 30 54.52	27.09293300000	88.51514400000	Perennial	Kharka	50

364	Kalimpong - II	Sangsay	Kurkuray Jhora	27 05 36.52	88 31 25.71	27.09347800000	88.52380800000	Perennial	Kharka	40
365	Kalimpong - II	Sangsay	Lapsi Jhora	27 06 39.51	88 31 14.98	27.11097500000	88.52082800000	Perennial	Yogda	40
366	Kalimpong - II	Sangsay	Padam Jhora	27 06 38.88	88 31 13.36	27.11080000000	88.52037800000	Perennial	Yogda	30
367	Kalimpong - II	Sangsay	Dungdugay Jhora	27 06 29.82	88 31 25.96	27.10828300000	88.52387800000	Perennial	Yogda	40
368	Kalimpong - II	Sangsay	Wakyong Jhora	27 06 13.97	88 28 55.92	27.10388100000	88.48220000000	Perennial	Khamdong	60
369	Kalimpong - II	Sangsay	Ritha Botay Jhora	27 06 30.05	88 29 10.05	27.10834700000	88.48612500000	Perennial	Khamdong	50
370	Kalimpong - II	Sangsay	Kyamuna Jhora	27 06 09.78	88 29 35.38	27.10271700000	88.49316100000	Perennial	Khamdong	30
371	Kalimpong - II	Sangsay	Devithan Jhora	27 07 27.93	88 31 59.10	27.12442500000	88.53308300000	Perennial	Biruk Sangseer CP	30
372	Kalimpong - II	Sangsay	Okharbotay Jhora	27 07 23.82	88 31 48.94	27.12328300000	88.53026100000	Perennial	Upper Munsidhura	30
373	Kalimpong - II	Sangsay	Daldalay Jhora	27 07 50.26	88 34 20.04	27.13062800000	88.57223300000	Perennial	Burmaik Halpoo	60
374	Kalimpong - II	Sangsay	Udai Jhora	27 07 56.68	88 34 20.97	27.13241100000	88.57249200000	Perennial	Burmaik	40
375	Kalimpong - II	Sangsay	Kothi Jhora	27 08 23.06	88 33 42.25	27.13973900000	88.56173600000	Perennial	Burmaik	50
376	Kalimpong - II	Sangsay	Tarchu Jhora	27 08 01.30	88 33 34.36	27.13369400000	88.55954400000	Perennial	Burmaik	50
377	Kalimpong - II	Sangsay	Balbir Jhora	27 08 05.91	88 34 01.05	27.13497500000	88.56695800000	Perennial	Mangchu	35
378	Kalimpong - II	Sangsay	Tumlang Jhora	27 08 35.61	88 31 45.23	27.14322500000	88.52923100000	Perennial	Mangchu	70
379	Kalimpong - II	Sangsay	Narak Jhora	27 06 51.89	88 32 27.16	27.11441400000	88.54087800000	Perennial	Narak GCP	45
380	Kalimpong - II	Dalapchand	Tamang Jhora	27 06 02.04	88 32 29.72	27.10056700000	88.54158900000	Seasonal	Upper Dalapchand	18
381	Kalimpong - II	Dalapchand	Siva Jhora	27 05 39.02	88 32 24.63	27.09417200000	88.54017500000	Seasonal	Upper Dalapchand	16
382	Kalimpong - II	Dalapchand	Bhotay Jhora	27 05 52.10	88 32 13.94	27.09780600000	88.53720600000	Seasonal	Upper Dalapchand	11
383	Kalimpong - II	Dalapchand	Prachin Jhora-I	27 05 30.12	88 32 13.27	27.09170000000	88.53701900000	Perennial	Upper Dalapchand	12
384	Kalimpong - II	Dalapchand	Prachin Jhora-II	27 05 25.24	88 32 09.71	27.09034400000	88.53603100000	Perennial	Lower Dalapchand	14
385	Kalimpong - II	Dalapchand	Eachay Jhora	27 05 11.68	88 32 08.11	27.08657800000	88.53558600000	Perennial	Lower Dalapchand	10
386	Kalimpong - II	Dalapchand	Farm Jhora	27 05 24.81	88 32 42.67	27.09022500000	88.54518600000	Seasonal	Lower Dalapchand	14
387	Kalimpong - II	Dalapchand	Dari Jhora	27 04 45.91	88 33 30.67	27.07941900000	88.55851900000	Perennial	Bidyang	10

388	Kalimpong - II	Dalapchand	Salimary Jhora	27 05 37.53	88 32 59.39	27.09375800000	88.54983100000	Perennial	Bidyang	14
389	Kalimpong - II	Dalapchand	Sotang Jhora	27 04 55.65	88 32 49.39	27.08212500000	88.54705300000	Perennial	Bidyang	16
390	Kalimpong - II	Dalapchand	Cher-chery Jhora	27 05 17.92	88 32 43.05	27.08831100000	88.54529200000	Perennial	Bidyang	11
391	Kalimpong - II	Dalapchand	Simsaray Jhora	27 04 47.26	88 33 08.47	27.07979400000	88.55235300000	Perennial	Bidyang	12
392	Kalimpong - II	Dalapchand	Jor Dhara Kholsa	27 05 10.26	88 32 58.83	27.08618300000	88.54967500000	Perennial	Bidyang	11
393	Kalimpong - II	Dalapchand	Tamang Kholsa	27 05 46.33	88 32 40.07	27.09620300000	88.54446400000	Seasonal	Bidyang	16
394	Kalimpong - II	Paiyong	Gaddi Wal Jhora	27 06 01.97	88 32 53.62	27.10054700000	88.54822800000	Perennial	West Lower Pagang	20
395	Kalimpong - II	Paiyong	Bheri Goat Jhora	27 06 57.70	88 34 45.47	27.11602800000	88.57929700000	Perennial	Upper Gairi Gaon-I	15
396	Kalimpong - II	Paiyong	Linemen Jhora	27 06 22.44	88 33 40.73	27.10623300000	88.56131400000	Perennial	East Lower Pagang	22
397	Kalimpong - II	Paiyong	Pokhari Jhora	27 06 15.55	88 32 56.90	27.10431900000	88.54913900000	Perennial	Upper Pagang	16
398	Kalimpong - II	Paiyong	Gaiwala Jhora	27 06 02.93	88 32 52.55	27.10081400000	88.54793100000	Perennial	Bidhyang	17
399	Kalimpong - II	Paiyong	K B Jhora	27 06 05.03	88 32 49.03	27.10139700000	88.54695300000	Perennial	Upper Pagang	20
400	Kalimpong - II	Paiyong	Samrang Jhora	27 05 43.24	88 33 22.04	27.09534400000	88.55612200000	Perennial	Bidhyang	15
401	Kalimpong - II	Paiyong	Hitti Jhora	27 06 14.29	88 33 13.38	27.10396900000	88.55371700000	Perennial	West Lower Pagang	16
402	Kalimpong - II	Paiyong	Sapkota Jhora	27 06 34.79	88 33 56.21	27.10966400000	88.56561400000	Perennial	Upper Gairi Gaon West	22
403	Kalimpong - II	Paiyong	Box Cutting Jhora	27 06 08.96	88 32 45.18	27.10248900000	88.54588300000	Perennial	Upper Pagang	21
404	Kalimpong - II	Paiyong	Bhujel Jhora	27 06 39.59	88 34 00.48	27.11099700000	88.56680000000	Perennial	Upper Gairi Gaon-I	18
405	Kalimpong - II	Paiyong	Mangal Singh Jhora	27 06 20.75	88 34 35.76	27.10576400000	88.57660000000	Perennial	Lower Gairi Gaon	15
406	Kalimpong - II	Paiyong	Sukrabaray Jhora	27 05 50.11	88 32 38.77	27.09725300000	88.54410300000	Perennial	West Lower Pagang	21
407	Kalimpong - II	Paiyong	Pitlay Jhora	27 06 01.65	88 32 54.41	27.10045800000	88.54844700000	Perennial	West Lower Pagang	16
408	Kalimpong - II	Paiyong	Gurung Jhora	27 06 01.97	88 32 55.44	27.10054700000	88.54873300000	Perennial	West Lower Pagang	15
409	Kalimpong - II	Paiyong	Thapa Jhora	27 06 24.35	88 33 48.50	27.10676400000	88.56347200000	Perennial	East Lower Pagang	11

410	Kalimpong - II	Paiyong	Khatiwara Jhora	27 06 22.71	88 33 39.97	27.10630800000	88.56110300000	Perennial	East Lower Pagang	15
411	Kalimpong - II	Paiyong	Ghimiray Jhora	27 06 04.96	88 33 28.90	27.10137800000	88.55802800000	Perennial	East Lower Pagang	11
412	Gorubatha	Tode Tangta	Doring Khola	27.11715	88.82977	27.11715000000	88.82977000000	NA	Mouza- Tode Tangta, JL No 004	45
413	Gorubatha	Tode Tangta	Kapoor Jhora	27.10215	88.83177	27.10215000000	88.83177000000	NA	Mouza-Tode Tangta, JL No 004	30
414	Gorubatha	Tode Tangta	Chichu Khola	27.09815	88.83501	27.09815000000	88.83501000000	NA	Mouza- Tode Tangta, JL No 004	65
415	Gorubatha	Tode Tangta	Khaharey Khola	27.09765	88.83001	27.09765000000	88.83001000000	NA	Mouza- Tode Tangta, JL No 004	25
416	Gorubatha	Tode Tangta	Chisang Khola	27.09636	88.83689	27.09636000000	88.83689000000	NA	Border of Mouza JL No 004 & 005	230
417	Gorubatha	Tode Tangta	Godak Khola	27.09293	88.85548	27.09293000000	88.85548000000	NA	Mouza- Paten Godak, JL No 005	65
418	Gorubatha	Tode Tangta	Bhareng Khola	27.08959	88.86201	27.08959000000	88.86201000000	NA	Mouza-Paten Godak, JL No 005	30
419	Gorubatha	Tode Tangta	Bhupaley Khola	27.08056	88.86011	27.08056000000	88.86011000000	NA	Mouza- Paten Godak, JL No 005	100
420	Gorubatha	Kumai	Ardali Jhora	27.007322	88.824150	27.00732200000	88.82415000000	NA	Mouza- 36	150
421	Gorubatha	Kumai	Bangala Tar	27.00198	88.824272	27.00198000000	88.82427200000	NA	Mouza- 36	180
422	Gorubatha	Kumai	Malibari Jhora	26.996172	88.845032	26.99617200000	88.84503200000	NA	Mouza- 37	215
423	Gorubatha	Kumai	Machar Jhora	27.006611	88.822159	27.00661100000	88.82215900000	NA	Mouza- 36	196
424	Gorubatha	Kumai	Mourey Jhora	27.004503	88.821144	27.00450300000	88.82114400000	NA	Mouza- 38	89
425	Gorubatha	Samsing	Barbotey	27.08713	88.48608	27.08713000000	88.48608000000	NA	Mouza- 36	50
426	Gorubatha	Nim	Lambhu Jhora	27.05742	88.651543	27.05742000000	88.65154300000	NA	Samabeong T E	45
427	Gorubatha	Nim	Newar Jhora	27.05742	88.651543	27.05742000000	88.65154300000	NA	Samabeong T E	30
428	Gorubatha	Nim	Bikram Jhora	27.015631	88.659828	27.01563100000	88.65982800000	NA	Suntalay	17

429	Gorubatha	Nim	Kapray Jhora	26.995128	88.681966	26.99512800000	88.68196600000	NA	Godamtar, Upper Fagu T E	25
430	Gorubatha	Nim	Naya Kheti	26.995128	88.681966	26.99512800000	88.68196600000	NA	School Line, Upper Fagu T E	27
431	Gorubatha	Nim	Titiri Kolcha	26.995128	88.681966	26.99512800000	88.68196600000	NA	Upper Fagu T E	22
432	Gorubatha	Nim	Tharo Khola	27.065112	88.649038	27.06511200000	88.64903800000	NA	Kolbong	17
433	Gorubatha	Pokhrebong	Dhotrey Upper Mangzing	26.990202	88.631267	26.99020200000	88.63126700000	NA	Pokhrebong	13
434	Gorubatha	Gorubathan- I	Ganesh Dhara	26.960527	88.698528	26.96052700000	88.69852800000	NA	Gorubathan	150

Annexure-VIII

GOVERNMENT OF WEST BENGAL
OFFICE OF THE DISTRICT MAGISTRATE
KALIMPONG

Memo No. 38/ENV

Dated : 09 / 01/2026

To,

The Chief Environment Officer
Environment Department (Govt. of West Bengal)
Prani Sampad Bhawan, 5th Floor, LB-2, Sector – III
Salt Lake , Kolkata- 700106

Subject : Compliance of the Order dated 30.01.2025 in the matter M.A. No. 14/2024 in O.A. No. 178/2022 with O.A. No. 475/2024, Principal Bench,reg.

Ref : Your office Memo No .2572/ENV – 15016/4/2024 Dated 31/12/2025.

Enclosed please find herewith the report in relation with above mentioned subject and memo .

This is for your kind information and necessary action.

09/1/26

For District Magistrate
Kalimpong

OFFICE OF THE DISTRICT MAGISTRATE KALIMPONG

Point of Action	Responsible Agency	Remarks / Action Taken
1. Impact of Tourism a) Need for carrying capacity assessment for Darjeeling and key tourist destinations. b) Promotion of nature-based tourism.	Tourism Dept.	• In **Kalimpong District**, homestays are being developed as an integral part of sustainable, nature-oriented tourism, with emphasis on community participation and environmental protection. As on date, 1,170 homestays have been registered in the district, contributing to income generation for local households and promoting responsible tourism practices in rural and forest-adjacent areas. • The district administration is encouraging the growth of eco-friendly tourism models through homestays, village-based tourism, trekking, bird-watching, and cultural experiences. These initiatives aim to provide visitors with authentic local experiences while ensuring the protection of natural landscapes, biodiversity, and traditional lifestyles. • Efforts are being made to strengthen the capacity of homestay owners, local guides, and tourism service providers through training and awareness programmes, focusing on hygiene, hospitality standards, waste management, and environmentally sustainable operations. Such initiatives are intended to improve service quality while maintaining ecological balance. • Cultural heritage and local traditions are being integrated into tourism promotion through local festivals, zero-waste harvest celebrations, and community-led cultural programmes, thereby enhancing visitor engagement and encouraging wider community involvement. • Preference is being given to local tourist guides, and the documentation and dissemination of indigenous knowledge relating to flora, fauna, traditional practices, and local history are being promoted to add value to nature-based tourism experiences. • To address environmental concerns, plastic waste collection points have been installed at strategic roadside locations near major tourist destinations under the Swachh Bharat Mission (SBM). A total of 42 such collection points have been established to support proper waste disposal and maintain cleanliness in tourism zones. • For promotion of Nature-Based Tourism Projects, the Tourism Department, in coordination with local stakeholders, is actively promoting nature-based tourism projects. Several initiatives are already operational, while others are at various stages of development. Recently some tourism projects have been forwarded from the district to Department, which are expected to significantly contribute to the promotion of nature-based tourism:
2. Lack of comprehensive hazardous waste management	1. UD&MA Dept.	NA

Point of Action	Responsible Agency	Remarks / Action Taken
plan; uncontrolled growth and waste dumping.		
3. Rising MSW generation; gaps in segregation & processing. a) No central composting facility. b) Need for additional segregation centres.	1. District Magistrate 2. UD&MA Dept.	• Strengthened segregation at source through sustained awareness campaigns, community participation, and strict enforcement mechanisms. • Renovation of a centralized composting/ biomethanation unit is under processing. • Segregation centre is operative under Kalimpong Municipality. • IEC campaigns strengthened to promote 100% segregation at source. • Augmenting processing capacity by establishing adequate composting, recycling, and waste-to-energy facilities based on scientific waste assessment. • Improving door-to-door collection systems and integration of informal waste pickers into formal waste management frameworks. • Promoting reduction of waste at source, especially single-use plastics, through regulatory and economic measures. • Regular monitoring, data-driven planning, and capacity building of urban local bodies to bridge the gap between MSW generation and processing. • Single used plastic bag below 120 micron has been banned and it has been enforced by Kalimpong Municipality and local bodies by conducting raids. • Public awareness is also done for plantation of tress to minimize carbon contents of the environment. • To alleviate pressure on tourism as a source of employment, the horticulture department is distributing poly houses to promote horticulture activities as an alternative source of engagement.
4. Impact on Water Quality – Mirik Lake a) Untreated sewage inflow. b) High anthropogenic pressure due to tourism.	1. UD&MA Dept. 2. DM Darjeeling & NBDD 3. DSTBT	NA
5. Impact on Forest, Biodiversity & Eco-sensitive Areas a) Deforestation due to development pressure. b) Rhododendron nearing extinction. c) Red Panda habitat risk. d) Waste altering feeding habits of wildlife.	1. Forest Dept. 2. UD&MA Dept.	NA
6. Impact on Air Quality a) Need to control tourist vehicle numbers.	1. Transport Dept. 2. Tourism	NA

Point of Action	Responsible Agency	Remarks / Action Taken
b) Promotion of carbon-neutral transport. c) Ban on non-Bharat VI vehicles. d) Studies required on vehicular pollution.	Dept.	
7. Need for Carrying Capacity Assessment & Zonal/Tourism Master Plans in ESZs	3. Tourism Dept. 4. DM (Concerned Districts)	1. The matter was deliberated in the meeting of the District Tourism Development Committee, Kalimpong, with all concerned stakeholders, namely hoteliers, homestay owners, and representatives of the taxi union. The views and suggestions of the stakeholders were solicited regarding the promotion of nature-based tourism with a view to preventing the deterioration of the fragile environment. 2. Five (5) tourism projects have been forwarded by the district to the Department which are expected to make a significant contribution towards the promotion of nature-based tourism.
8. Expansion of institutional capacity of local governments for climate change planning.	1. Environment Dept. 2. DMs	• Capacity-building workshops conducted for ULB and Panchayat officials. • GSI has conducted 5 days awareness & training campaign with local Officials of local Governments & PRIs • NGOs are also performing awareness and training programme on Environment in co-ordination with Government Officials. • DM & CD Department is also performing awareness and training programme on Earthquake, mitigation of Landslide, Lightning etc.
9. Efforts to increase forest cover in Himalayan Region.	Forest Dept.	NA
10. Initiatives for effective solid waste management in the Himalayas and climate resilience.	1. UD&MA Dept. 2. P & RD Department	NA

09/1/26.

For District Magistrate
Kalimpong