

Project: Estimation and Mapping Of The Soil Nutrient Status In Various Forest Compartments Of North Bengal Plains.



Final Report submitted by The Research Wing
Directorate Of Forest,
Government of West Bengal
to
THE WEST BENGAL FOREST AND
BIODIVERSITY CONSERVATION SOCIETY

PREFACE

Forests are a dynamic structure and sustain life through a complex system that has societal significance because they can be managed, maintained, and conserved. Forestry research entails the measurement and analysis of the natural systems and its components. This aids in promoting evolution and sound forest management practices.

All terrestrial life is dependent on soil. The irreversible degradation of this resource due to natural and anthropogenic reasons leads to grave perturbation of the biota. Overexploitation of natural resources, especially land; the prevalence of acidic soils that limit the uptake of nutrients and faulty management practices have led to reduced productivity and slowed down the growth of plantation forestry. Widespread deficiencies in secondary and micronutrients are a cause for concern among researchers, policymakers and development departments. Reversing this trend calls for soil testing to go hand in hand with the adoption and implementation of good practices that can achieve desired results. Thus, research has to be focussed on the maintenance and rehabilitation of soil.

The importance of soil health in supporting society and ensuring plantation output and future environmental stability, as well as to identify significant concerns and research needs, that are connected to sustainable development of the forest compartments can hardly be overemphasized. To realize this feat of paramount importance, this project for the estimation & mapping of the soil nutrient status in various forest compartments of north bengal plains is deemed indispensable towards ameliorating the soil of the forest compartments before undertaking any plantation activities.

The information gleaned from the deployment of the project will furnish information regarding the recommendations, selection and preparation of plantation species to augment microplanning activities in the plantation areas of North Bengal plains. However, similar project need to be undertaken for North Bengal Hills and South Bengal.


Principal Chief Conservator of Forests
Research, Monitoring and Development
West Bengal

ACKNOWLEDGEMENT

Forest soil nutrients are essential components of forest tree. Forests growth and development, and their availability to the forest is determined by their state in the soil. The distribution of forest soil nutrients is directly related to the growth and health of forests and has an important influence on forest ecosystem restoration and sustainable management. Available nutrients are water-soluble and exchangeable elements in the soil. They can be directly absorbed and used by plants or quickly exchanged from soil colloid for plant use. Availability of alkali-hydro-nitrogen, phosphorus and potassium, have a significant correlation with soil fertility. Organic matter (OM) is all kinds of carbon-containing organic compounds in the soil, one of the primary sources of plant nutrition. Thus, soil nutrient maps, which gives a picture of nutrient availability are a major factors for forest culture, forest management policies, regional soil degradation, and climate change study.

The project on Estimation of Soil Nutrient in Forest Soil of North Bengal Plains was started on 2018 funded by JICA (WBFBCP). Firstly we thank to The Principal Chief Conservator of Forests (Research, Monitoring & Development) Dr. Jose T. Mathew, IFS to conceptualise the proposal for doing such type of Research Work and initiated the work in the field and in laboratory. Thanks to the Chief Project Director of WBFBCP, Sri Debal Roy, IFS who approved the project. Thanks to The Principal Chief Conservator of Forests, Research, Monitoring & Development, Shri V.K. Yadav, IFS for his kind support and permission to compile the research finding and compilation of the report. Thanks to the Additional PCCF, R&M, SmtPratibha Raj, IFS for going through the project document and getting it approved in the Committee for Scrutiny and approval of the final project report. Thanks to the Chief Conservator of Forests, R&D Shri D. Mallick, IFS for guidance and Dr S C Das, IFS, Chief Conservator of Forest, Soil Conservation for their support to compile the findings of the experimental work. Thanks to Shri B. Sarkar, IFS, Conservator of Forest, Research Circle, West Bengal for guidance to the field work and data collection.

Thanks to the Scientists, Research Associates and Field Staffs of SLUSI for data compilation and making of the soil nutrition availability map.

Contribution of Sri T. T Bhutia, IFS to soil sample collection and testing of the sample in the laboratory for estimation of the nutrient which is acknowledged. Thanks to Sri DebashisChakraborty,FR, Range Officer of Salugara Soil Lab Range, Sri Subrata Roy, Soil Chemist and other staff of the Range and all the staff of Silviculture (North) Division who worked hard for this project from the beginning to till end.



Divisional Forest officer
Silviculture North Division

PROJECT PROFILE

1. Title of the Project:-Project on Estimation & Mapping of the Soil Nutrient Status in various Forest compartments of North Bengal Plains.

2. Implementing Team – Silviculture North Division

| | | |
|---------------------------|---------------------------|-----------------------------|
| Principal Investigator | Divisional Forest Officer | Silviculture North Division |
| Co-Principal Investigator | Debashis Chakraborty, FR | Salugara Soil Lab Range |
| | Subrata Bhowmik | Soil Chemist, Salugara Lab |
| Support Staff | Sujit Roy | Assistant Soil Chemist |
| | Madhumanti Sarkar | Lab Assistant |
| | Subir Sarkar, DrFR | Beat officer |
| | Banashree Das | Forest Guard |
| | Shambhu Pal | Forest Guard |

SLUSI -

| | |
|-------------------|--|
| Chief Coordinator | Smt. Rajni Taneja, Chief Soil Survey Officer |
| Coordinator | Dr. S. Roychowdhury, Soil Survey Officer |
| Co-Coordinator | Mrs. D. C. Sarkar, Field Officer Ms. P. P. Mitra Nag, Sr.C.A Sk .Mohitpasha S.S., Asstt. Field Officer Ms. Surama Neogi, Asstt. Field Officer |

3. Project Location - Forest Compartments of the following Divisions -

| Sl No | Division | District | No of Compartment |
|-------|----------------------------------|------------|-------------------|
| 1 | Baikunthapur Division | Jalpaiguri | 88 No |
| 2 | Jalpaiguri Division | Jalpaiguri | 101 No |
| 3 | Coochbehar Division | Coochbehar | 30 No |
| 4 | Kurseong Division | Darjeeling | 27 No |
| 5 | Jaldapara Wildlife Division | Alipurduar | 39 No |
| 6 | Buxa Tiger Reserve West Division | Alipurduar | 81 No |
| 7 | Buxa Tiger Reserve East Division | Alipurduar | 37 No |

4. Project Commencement Date – June, 2018

5. Project Completion Date – November, 2021

6. Project Cost – 28,20,000.00

7. Funding Agency – West Bengal Forest and Biodiversity Conservation Project

1. INTRODUCTION:

Soil is the biologically active loose surface material that covers the majority of the land made up of both inorganic and organic particles. Soil provides structural support to plants as well as a source of water and nutrients through the global ecosystem. The chemical and physical properties of soils vary greatly.

Soil structure is important for soil and plant health because it allows water and air to move into and through the soil profile. While some soils are naturally better structured than others, good management can change some physical characteristics of soils. To understand soil condition, it is critical to monitor the physical characteristics of soil. With the augment of forestry, there has arisen a necessity of practical awareness of soil and their management. Soil is an essential component of forest and woodland ecosystems because it regulates critical ecosystem processes such as nutrient uptake, decomposition, and water availability. Soils provide anchorage, water, and nutrients to trees. With the clearance of tree vegetation and the subsequent loss of millions of hectares of productive land, the significance of these effects has frequently been overlooked in the past. Furthermore, as forests continue to be cleared, exposing the land to direct wind and rain attack, soil erosion and land degradation continue to erode plantation's resource base. We must protect our trees and forests in order to protect our soils. The relationship between soils and forests is far more complex and extensive. Soils and forests are inextricably linked, with significant effects on each other and the wider environment. The interactions between forests and forest soils contribute to the preservation of the environmental conditions required for production. These positive effects have far-reaching consequences, ultimately ensuring a productive food system, improved rural livelihoods, and a healthy environment in the face of change.

Soil status report is important information for forest management, choice of species, microplanning, biodiversity conservation etc. As a ready reckoner, soil nutrient status map is useful for ameliorative measure before plantation activity.

OBJECTIVE:

- To prepare compartment-wise soil nutrient status report

- Preparation of soil nutrient status map for the forest areas
- To prescribe compartment-wise recommendation of any amelioration before plantation activity is taken up
- To provide information to working plan wing for selection of species and preparation of micro-plans

PROJECT AREA:

Soil sample has been collected from all the Divisions of North Bengal plain where plantations are likely to be taken up. For territorial Divisions, sample collected from all the compartments and for the wildlife division it only from the buffer areas. The details of the area are as

| Sl No | Name of Division | No of Compartment | Total Sample collected |
|-------|------------------------------|-------------------|------------------------|
| 1. | Baikunthapur Forest Division | 88 No | 381 No |
| 2. | Jalpaiguri Forest Division | 101 No | 434 No |
| 3. | BTR West Division | 81 No | 518 No |
| 4. | BTR East Division | 37 No | 227 No |
| 5. | Kurseong Forest Division | 27 No | 143 No |
| 6. | Jaldapara Wildlife Division | 39 No | 164 No |
| 7. | Coochbehar Forest Division | 30 No | 133 No |

TOTAL NO. OF COMPARTMENTS =403

TOTAL NO. OF SOIL SAMPLES=2000

TOTAL NO. OF ESTIMATION=16000

NO. OF PARAMETERS=8

VARIOUS SOIL PARAMETERS FOR EACH SAMPLE TESTED AT SALUGARA SOIL LABORATORY UNDER SILVICULTURE (N) DIVISION

- Soil pH
- Organic Carbon
- Available Phosphorus
- Available Nitrogen
- Available Sulfur
- Available Potassium
- Exchangeable Calcium
- Exchangeable Magnesium

2. METHODOLOGY

For Soil Nutrient mapping was done in three different steps

A.Collection of Soil Samples as per guidelines of National Bureau of Soil Survey and Landuse Planning (NBSS/LUP)

- Each sample was collected by trained person.
- Soil samples were collected from 3-4 places in each compartment with GPS reading.
- First 15cm of surface soil having decomposed and half decomposed materials, pebbles were removed from the place of soil sample collection.
- At each place sample to be collected by digging 60cm deep pit (45cm x 45cm) and chiseling the soil from 15cm-60cm deep uniformly.
- About 1 kg soil was collected for each sample in a packet having zipper/ air lock..

B. Analysis of Soil Sample

- In laboratory informations of Soil samples was entered in SLR lab soil register.
- Before sending the soil for analysis, the soil was kept for air-drying for 4-5 days
- After drying soil was passed through 2 mm seive and was stored for analysis.
- Presence of soil parameters namely- Ph, Total Nitrogen, Available Nitrogen, Available phosphorus, Available Potassium, Available Sulphur, exchangeable Calcium & Magnesium and Organic Carbon are to be tested in each sample.

C. Preparation of Soil sample Map

- Soil nutrient status map will be prepared by Soil and Land Use Survey of India, Govt. of India on the basis of nutrients present at location and GPS reading of that location.



Soil samples for air-dry



Soil samples in airlock packets
with proper tag

3.SOIL ANALYSIS

1. Soil pH

It refers to the degree of acidity & alkalinity. It is determined by electrometric method using pH Meter.

2. Available Nitrogen

Nitrogen is important because it is the major component of chlorophyll and amino acid to build proteins. It is determined by alkaline potassium permanganate method using Kjeldahl distillation unit (semi automatic) model- CLASSIC- DX VATS B

3. Available Phosphorus

Phosphorus helps in photosynthesis, protein synthesis and root development. It is determined by Bray's 1 method using photo Electric colorimeter/Spectrophotometer

4. Available Potassium

Potassium is essential for formation of carbohydrate, proteins as well as it regulates the water content within the plant cell. It is determined by Flame photometric method.

5. Available sulfur

Sulfur is required in synthesis of vitamins. It is determined by Turbidimetric method using photo electric colorimeter/ Spectrophotometer.

6. Organic Carbon

It is a source of nutrients and essential for improving soil physical properties. It is determined by Walkley and Black rapid titration method.

7. Exchangeable Calcium

Calcium is needed mainly for cell division is important constituent of chlorophyll. It is determined by Complexometric titration with EDTA di-sodium salt.

8. Exchangeable Magnesium

Magnesium is important constituent of chlorophyll. It is determined by Complexometric titration with EDTA di-sodium salt.

4. LIST OF FOREST COMPARTMENTS OF VARIOUS DIVISIONS FROM WHERE SOIL SAMPLES WERE COLLECTED

1. Baikunthapur Division

| SI No | | SI No | | SI No | | SI No | |
|-------|--------------|-------|---------------------|-------|-------------|-------|--------------|
| 1 | Dabgram-2 | 24 | Farabari-1 | 47 | Adabari-1 | 69 | SMG-2 |
| 2 | Dabgram -3 | 25 | Farabari-2 | 48 | Adabari -2 | 70 | SMG-4 |
| 3 | Dabgram -5 | 26 | Farabari-3 | 49 | Adabari -3 | 71 | SMG-5 |
| 4 | Dabgram -6 | 27 | Farabari-4 | 50 | Adabari -4 | 72 | SMG-7 |
| 5 | Dabgram -7 | 28 | Farabari-5 | 51 | Adabari -5 | 73 | SMG-3 |
| 6 | Dabgram -8 | 29 | Farabari-6 | 52 | Adabari -6 | 74 | SMG-6 |
| 7 | Dabgram -9 | 31 | Farabari-7 | 53 | Adabari -7 | 75 | SMG-10 |
| 8 | Dabgram -10 | 32 | Farabari -9 | 54 | Adabari -8 | 76 | SMG-11 |
| 9 | Dabgram -11 | 33 | Farabari -10 | 55 | Adabari -9 | 77 | SMG-12 |
| 10 | Dabgram -12 | 34 | Farabari -11 | 56 | Chengmari-1 | 78 | Phuljhora-1 |
| 11 | Dabgram -13 | 35 | Farabari -12 | 57 | Chengmari-2 | 79 | Phuljhora-2 |
| 12 | Dabgram -14 | 36 | Mantadari-2 | 58 | Chengmari-3 | 80 | Phuljhora-3 |
| 13 | Hanskhali-1 | 37 | Mantadari -3 | 59 | Chengmari-4 | 81 | Phuljhora-4 |
| 14 | Hanskhali-2 | 38 | Mantadari -4 | 60 | Chengmari-5 | 82 | Phuljhora-5 |
| 16 | Hanskhali-3 | 39 | Mantadari -5 | 61 | Sealdoba-1 | 83 | Apalchand-1 |
| 17 | Hanskhali-4 | 40 | Mantadari -6 | 62 | Sealdoba-2 | 84 | Apalchand -3 |
| 18 | Batasivita-1 | 41 | Saraswatipur-1 | 63 | Sealdoba-3 | 85 | Apalchand -4 |
| 19 | Batasivita-2 | 42 | Saraswatipur -2 | 64 | Gourikon-1 | 86 | Oodlabari-2 |
| 20 | Batasivita-3 | 43 | Saraswatipur -3 | 65 | Gourikon -2 | 87 | Oodlabari-3 |
| 21 | Chelriver-1 | 44 | Saraswatipur -4 | 66 | Gourikon -3 | 88 | Oodlabari-4 |
| 22 | Chelriver-2 | 45 | Churabhija-2a | 67 | Oodlabari-1 | | |
| 23 | Churabhija-1 | 46 | Oodlabari Extension | 68 | SMG-1 | | |

2. Jalpaiguri Division

| SI No | | SI No | | SI No | | SI No | |
|-------|---------------|-------|--------------|-------|--------------------|-------|--------------------|
| 1 | Lataguri-1 | 27 | Sipchu-1 | 53 | Central Moraghat-1 | 78 | KhoriaBander-1 |
| 2 | Lataguri -2 | 28 | Sipchu-2 | 54 | Centre Moraghat-2 | 79 | KhoriaBander-2 |
| 3 | Lataguri-3 | 29 | Chapramari-1 | 55 | Centre Moraghat-3 | 80 | Choraimahal-1 |
| 4 | Lataguri-4 | 31 | Central-1 | 56 | Centre Moraghat-4 | 81 | Choraimahal-2 |
| 5 | Lataguri-5 | 32 | Central-2 | 57 | Centre Moraghat-5 | 82 | North Moraghat-1. |
| 6 | Lataguri-6 | 33 | Central-3 | 58 | Centre Moraghat-6 | 83 | North Moraghat -2. |
| 7 | Bichabhanga-1 | 34 | Reti-1 | 59 | Centre Moraghat-7 | 84 | North Moraghat -3. |
| 8 | Bichabhanga-2 | 35 | Reti-2 | 60 | Centre Moraghat-8 | 85 | North Moraghat -4. |
| 9 | Sursuti-1 | 36 | Udlajhora-2 | 61 | Centre Moraghat-9 | 86 | B.C Tondur res |
| 10 | Sursuti-2 | 37 | Udlajhora-3 | 62 | Centre Moraghat-10 | 87 | Nepania Res |
| 11 | Sursuti-3 | 38 | Udlajhora-4 | 63 | Centre Moraghat-11 | 88 | Bandapani res |
| 12 | Sursuti-4 | 39 | Udlajhora-5 | 64 | Centre Moraghat-12 | 89 | Bandapani res |
| 13 | Sursuti-5 | 40 | Hillajhora-1 | 65 | South Moraghat-1. | 90 | Aibhil Resume |
| 14 | Khairanti | 41 | Hillajhora-2 | 66 | South Moraghat -2 | 91 | Kathalguri res |
| 16 | Panjhora-1 | 42 | Hillajhora-3 | 67 | South Moraghat -3. | 92 | Dheklapara res |

| | | | | | | | |
|----|--------------|----|---------------|----|---------------------|-----|-------------------|
| 17 | Panjhora-2 | 43 | Hillajhora-4 | 68 | South Moraghat -4. | 93 | DalgaonSalbari |
| 18 | Panjhora-3 | 44 | Central Diana | 69 | South Moraghat -5. | 94 | Kalabari resumed |
| 19 | Panjhora-4 | 45 | South Diana | 70 | South Moraghat -6. | 95 | Red Bank Res |
| 20 | Panjhora-5 | 46 | North Diana | 71 | South Moraghat -7. | 96 | Saogaon resumed |
| 21 | Panjhora-6 | 47 | Dalgaon-1. | 72 | South Moraghat -8. | 97 | Surti resumed |
| 22 | Panjhora-7 | 48 | Dalgaon-2. | 73 | South Moraghat -9. | 98 | Makrapara |
| 23 | North Indong | 49 | Dalgaon-3. | 74 | South Moraghat -10. | 99 | Dalmore Resume |
| 24 | Ramshai | 50 | Dalgaon-4. | 75 | South Moraghat -11. | 100 | Jaldhaka-1 |
| 25 | Gossaihat 1 | 51 | Gossaihat 3 | 76 | Gossaihat 5 | 101 | JaldhakaultaDanga |
| 26 | Gossaihat-2 | 52 | Gossaihat-4 | 77 | | | |

3. Buxa Tiger West Division

| SI No | | SI No | | SI No | | SI No | |
|-------|------------|-------|-------------|-------|-------------|-------|---------------|
| 1 | NRVK-10 | 22 | Checo -6 | 42 | Damanpur -1 | 62 | Raimatong-1 |
| 2 | N.R.V.K-11 | 23 | Checo -7 | 43 | Damanpur-2 | 63 | Raimatong -2 |
| 3 | N.R.V.K-15 | 24 | Checo -8 | 44 | Damanpur -3 | 64 | Raimatong -3 |
| 4 | NRVK-16 | 25 | Checo -9 | 45 | Damanpur -4 | 65 | Raimatong -4 |
| 5 | Dima 1 | 26 | Gadadhar-1 | 46 | Damanpur -5 | 66 | Raimatong -5 |
| 6 | Dima 2 | 27 | Gadadhar -2 | 47 | Damanpur -6 | 67 | Raimatong -6 |
| 7 | Dima 3 | 28 | Gadadhar -3 | 48 | Damanpur -7 | 68 | Raimatong -7 |
| 8 | Dima 4 | 29 | Gadadhar -4 | 49 | Damanpur -8 | 69 | Raimatong -8 |
| 9 | Dima RL | 30 | Gadadhar -5 | 50 | Damanpur -9 | 70 | Raimatong -9 |
| 10 | SRVK-1 | 31 | Gadadhar -6 | 51 | Poro -1 | 71 | Raimatong -10 |
| 11 | SRVK-2 | 32 | Panbari -4 | 52 | Poro -2 | 72 | Adma-1 |
| 12 | SRVK-7 | 33 | Panbari -5 | 53 | Poro-3 | 73 | Adma -2 |
| 13 | SRVK-8 | 34 | Panbari-10 | 54 | Poro -4 | 74 | Adma -3 |
| 14 | SRVK-9 | 35 | Nimati-1 | 55 | Poro -5 | 75 | Godamdabri-3 |
| 16 | SRVK-10 | 36 | Nimati -2 | 56 | Poro -6 | 76 | Godamdabri -2 |
| 17 | SRVK-15 | 37 | Nimati -3 | 57 | Poro -7 | 77 | Godamdabri -1 |
| 18 | SRVK-16 | 38 | Nimati -4 | 58 | Poro -8 | 78 | Godamdabri -4 |
| 19 | Checo -3 | 39 | Nimati -5 | 59 | Poro -9 | 79 | BHUTRI-5 |
| 20 | Checo-4 | 40 | Nimati -6 | 60 | Poro -10 | 80 | BHUTRI-3 (P) |
| 21 | Checo -5 | 41 | Nimati -7 | 61 | Poro -11 | 81 | Phoskadanga |

4. Buxa Tiger East Division

| SI No | | SI No | | SI No | | SI No | |
|-------|-----------|-------|---------------|-------|----------------|-------|---------------------|
| 1 | NRVK-1 | 11 | Phaskhawa 1 | 21 | South Rydak -2 | 31 | SBH-2 |
| 2 | NRVK-2 | 12 | Phaskhawa-2 | 22 | South Rydak -3 | 32 | SBH-3 |
| 3 | NRVK-3 | 13 | Phaskhawa-3 | 23 | South Rydak -4 | 33 | SBH-4 |
| 4 | NRVK-4 | 14 | Dhawla-1 | 24 | South Rydak -5 | 34 | SBH-5 |
| 5 | NRVK-5(B) | 15 | Dhawla-2 | 25 | South Rydak -6 | 35 | SBH-6 |
| 6 | NRVK-6(B) | 16 | Dhawla-3 | 26 | South Rydak -7 | 36 | Madhya Haldibari |
| 7 | NRVK-8 | 17 | Hatipota-2 | 27 | Sankosh-3 | 37 | NBH-4 |
| 8 | NRVK-9 | 18 | Rydak USF | 28 | NBH-3 | | |
| 9 | NBH-1 | 19 | NBH-2 | 29 | Kumargram-2 | | |
| 10 | NBH-5 | 20 | South Rydak-1 | 30 | SBH-1 | | |

5. Jaldapara Wildlife Division

| SI No | | SI No | | SI No | | SI No | |
|-------|---------------|-------|--------------|-------|--------------|-------|--------------|
| 1 | Borodabri 1a | 8 | Bania-7 | 15 | Borodabri-4 | 22 | Khairbari-1 |
| 2 | Borodabri-3 | 9 | Bania-6 | 16 | Borodabri-5 | 23 | Khairbari-2a |
| 3 | Borodabri-6a | 10 | Bania-5 | 17 | Borodabri-8 | 24 | Khairbari-2b |
| 4 | Borodabri-7a | 11 | Mandabari-1 | 18 | TiTi EXT. | 25 | Khairbari-3 |
| 5 | Chilapata -3a | 12 | Mandabari-2 | 19 | Huntupara RL | 26 | Dumchi-2 |
| 6 | Chilapata -4a | 13 | MandabariEXT | 20 | Gargunda RL | 27 | Dumchi-1 |
| 7 | Bania-8a | 14 | Nilpara | 21 | Lankapara RL | | |

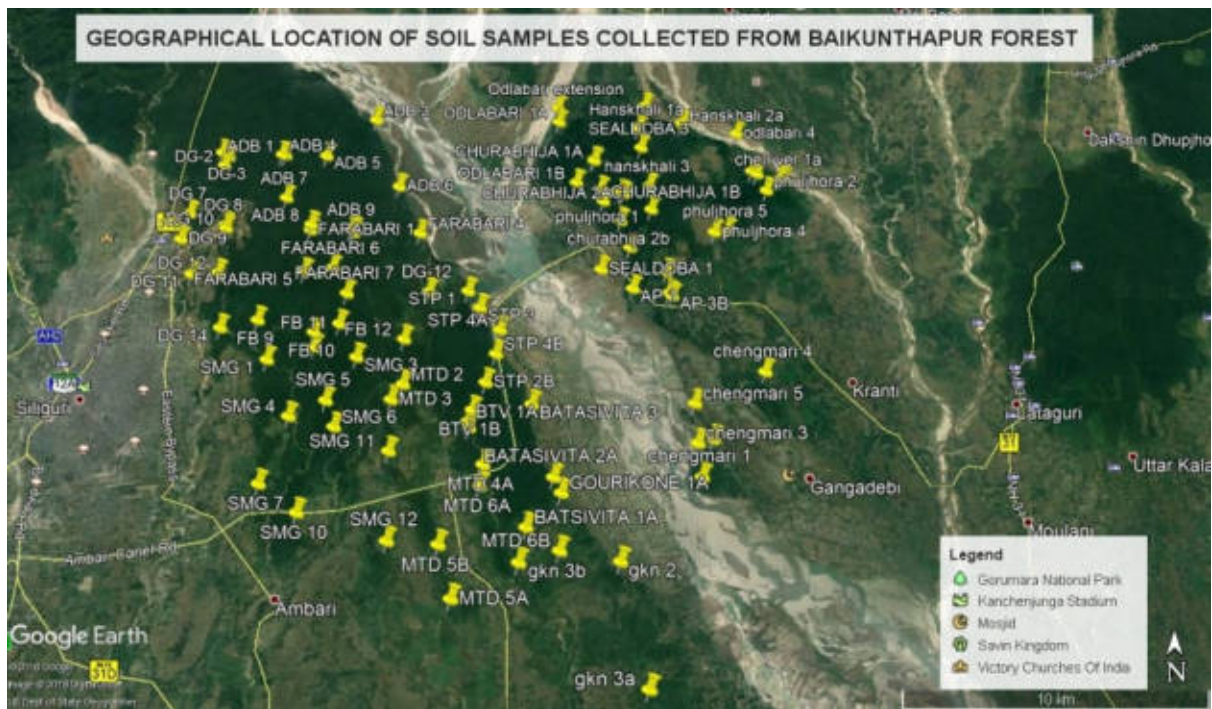
6. Kurseong Division

| SI No | | SI No | | SI No | | SI No | |
|-------|-----------|-------|------------|-------|-------------------|-------|---------------------|
| 1 | Bagdogra | 11 | Pantapuri | 21 | Central Mechi | 31 | ChotaChenga Resumed |
| 2 | Harrulia | 12 | Taipu | 22 | Upper Mechi | 32 | Kolabari |
| 3 | Rishabari | 13 | Dauhara | 23 | Gurabadi | 33 | Tukriajhar |
| 4 | Bengdubi | 14 | Kadma | 24 | Surajbar | 34 | SabaiMauza R.L |
| 5 | Lalfa | 15 | Bauhara | 25 | Lower Mechi | 35 | Dangerbhita |
| 6 | Central | 16 | Tirihana | 26 | Nepania | 36 | Rangeli |
| 7 | Multa | 17 | Borobhita | 27 | Nepania-3 | 37 | Uttam C.C |
| 8 | Dalka | 18 | Boiranti | 28 | Khairbari | 38 | Naxalbari Resume |
| 9 | Tarabari | 19 | Panighatta | 29 | Rongmohan Resumed | 39 | Phargomia |
| 10 | Latua | 20 | Lohagarh | 30 | Bora Chenga | | |

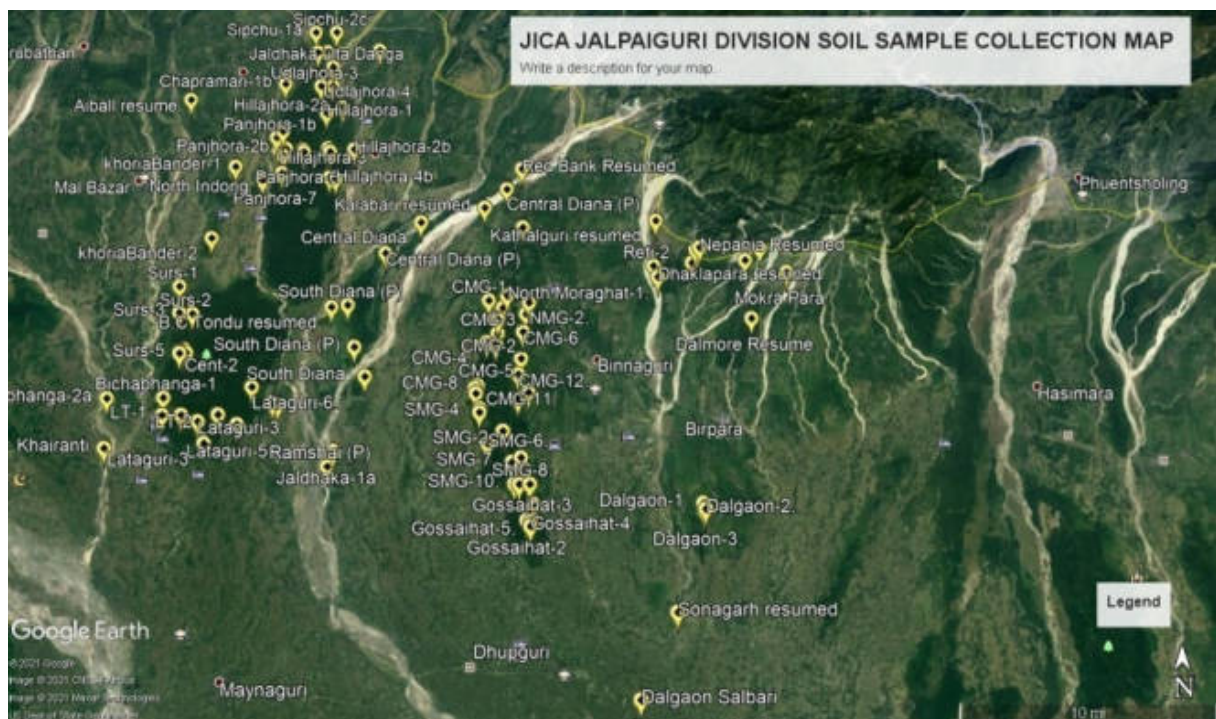
7. Coochbehar Division

| SI No | | SI No | | SI No | | SI No | |
|-------|-------------|-------|---------------------|-------|-----------------------|-------|---------------------|
| 1 | Khagribari | 9 | ChotoSalbari | 17 | Baroibari-II | 25 | ChhatBholka |
| 2 | Takoamari | 10 | PutimariBaxirbas | 18 | Baroibari | 26 | Bas dahaNatibari |
| 3 | Paglirkuthi | 11 | SingimariPachnirpur | 19 | Sorbeswarjoydhar | 27 | KharimalaKhagribari |
| 4 | Atiamochar | 12 | ChhatSingimari | 20 | ChotoSalbari | 28 | SajherparGhoramara |
| 5 | Rashikbill | 13 | Mekhliganj | 21 | Mohismuri | 29 | Salmara (P-I-III) |
| 6 | Chengtimari | 14 | Daibangi | 22 | Uchalpohri | 30 | SajherparKathalbari |
| 7 | Dorko | 15 | Mohimerkuthi | 23 | Dwarikamari | | |
| 8 | Barasalbari | 16 | Bhojanerchara | 24 | CharakerkuthiDewanbas | | |

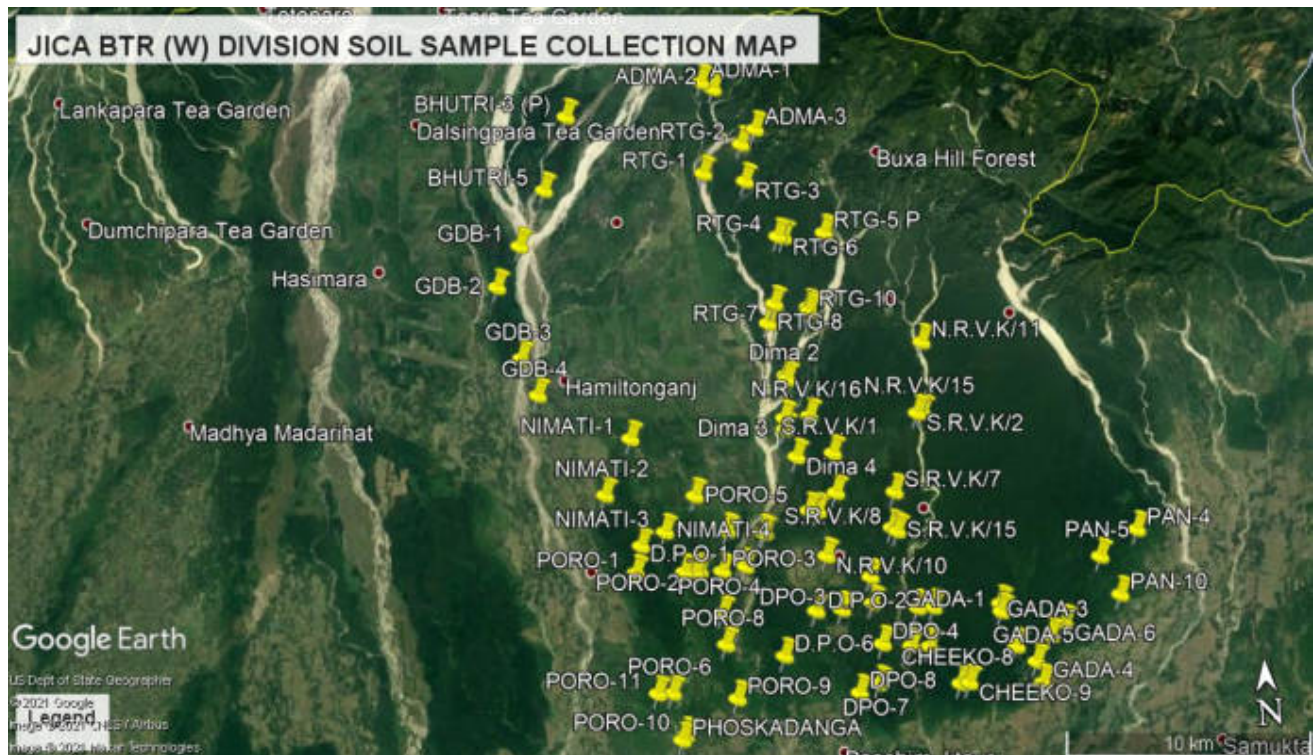
Map no.1: Location map of soil samples collected from various forest compartments of Baikunthapur Division



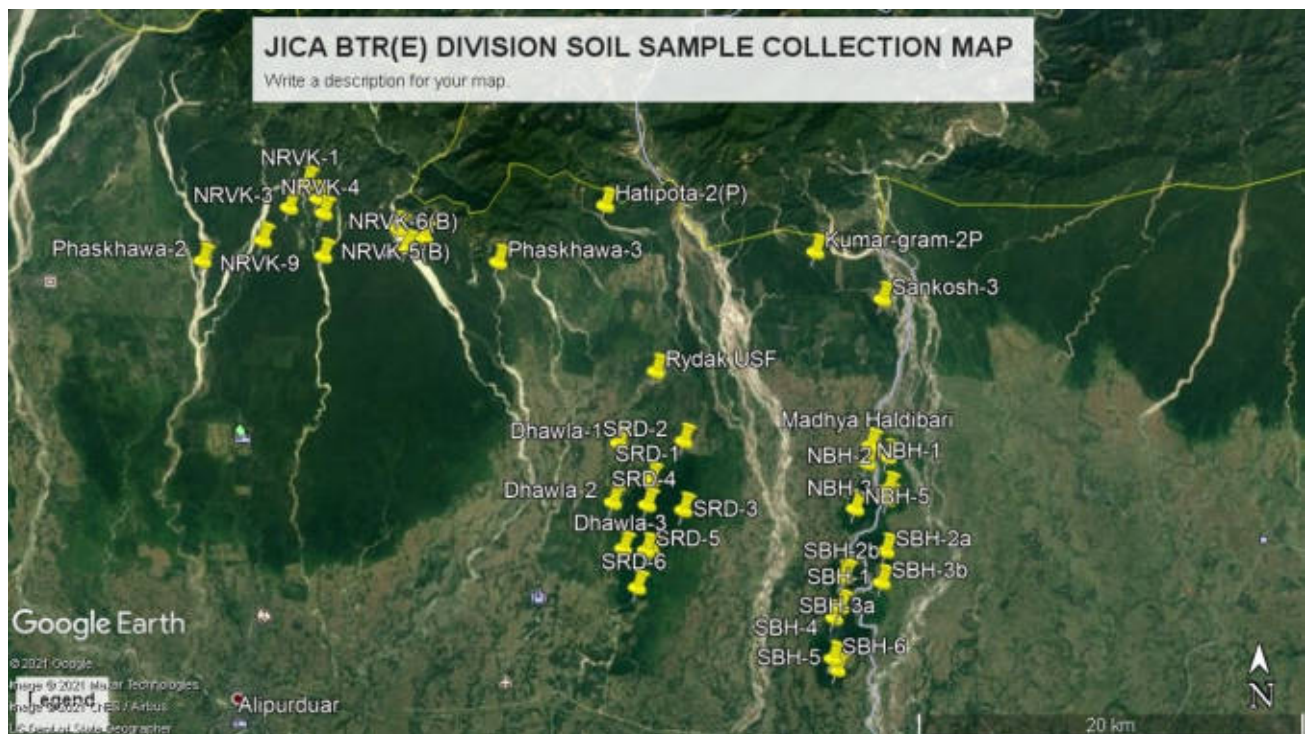
Map no.2: Location map of soil samples collected from various forest compartments of Jalpaiguri Division



Map no.3: Location map of soil samples collected from various forest compartments of BTR (W) Division



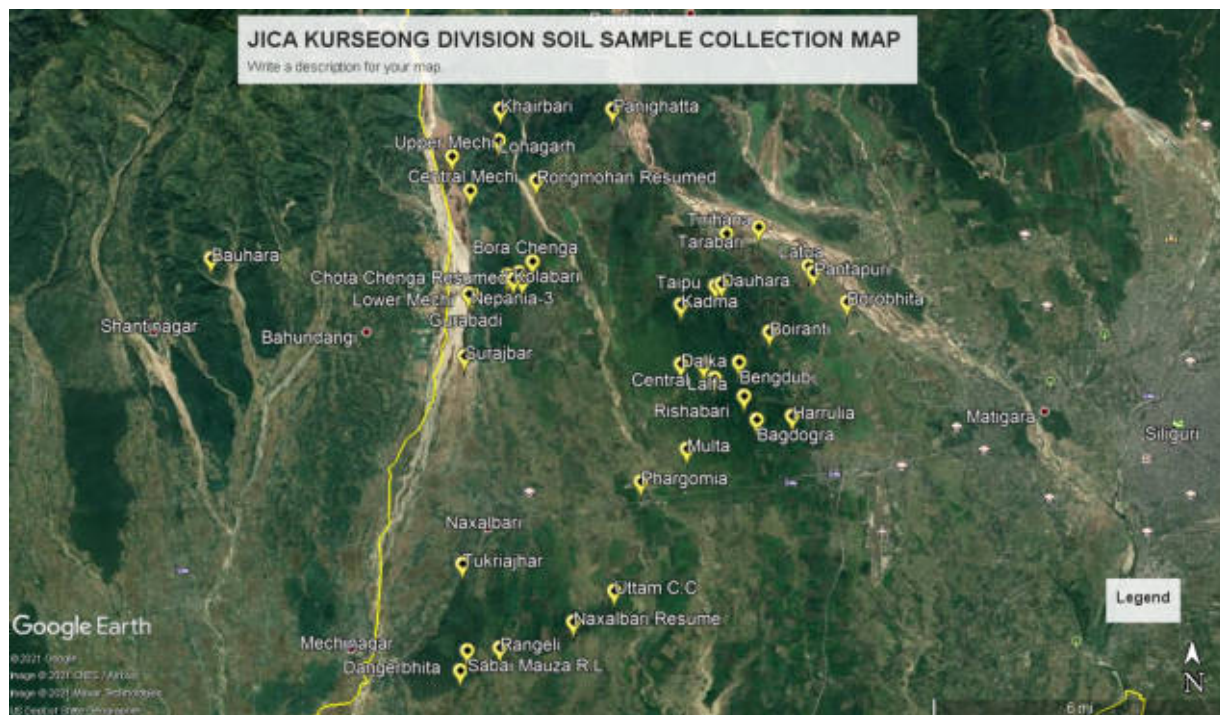
Map no.4: Location map of soil samples collected from various forest compartments of BTR (E) Division



Map no.5: Location map of soil samples collected from various forest compartments of Jaldapara Division



Map no.6: Location map of soil samples collected from various forest compartments of Kurseong Division



Map no.7: Location map of soil samples collected from various forest compartments of Coochbehar Division

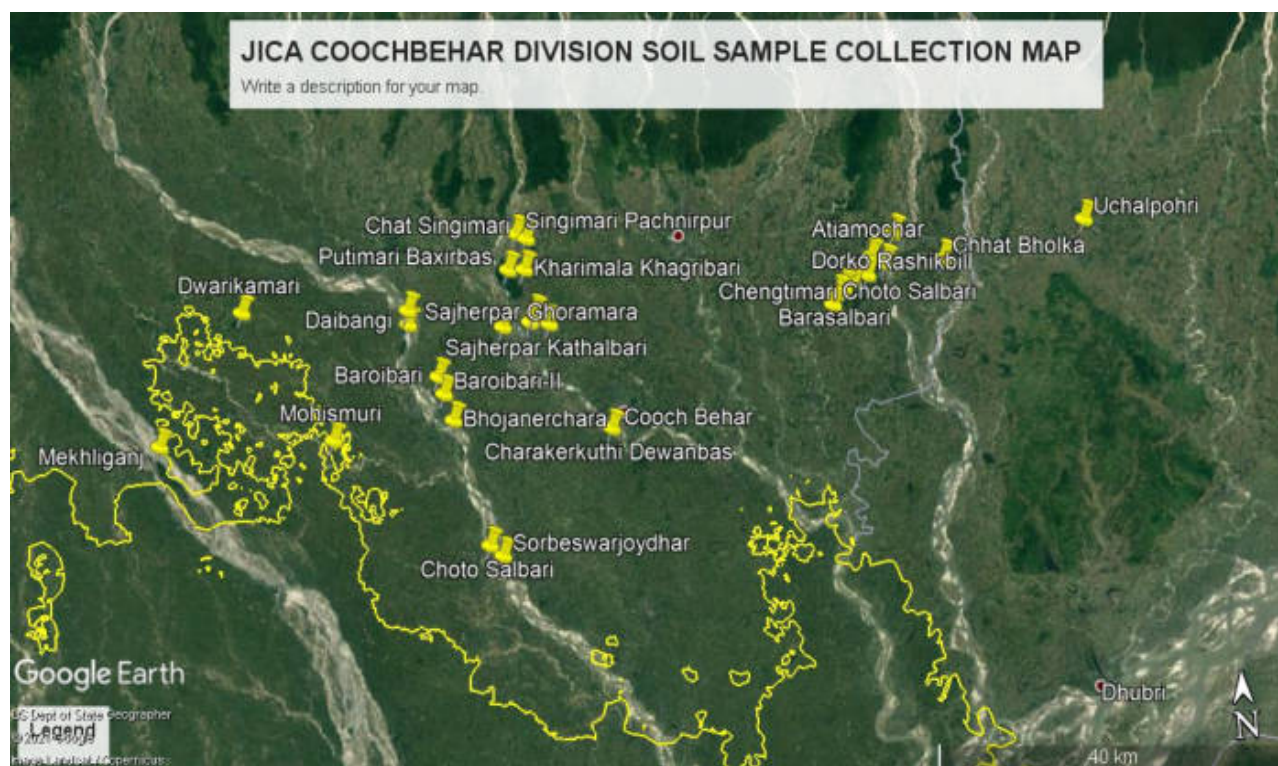


Table no. 1: Details of soil collection and report submission of various forest divisions for the project.

| | Name of Division | No of compartments | Starting date of soil sample collection | Ending date of soil sample collection | No of Soil sample Received | Date of soil report despatch | Memo no.of soil report |
|---|-----------------------|--------------------|---|---------------------------------------|----------------------------|------------------------------|------------------------|
| 1 | Baikunthapur | 88 Nos | 21/09/2018 | 08/01/2019 | 381 Nos | 24/05/2019 | 86/SLR-22 |
| 2 | Jalpaiguri | 101 Nos | 25/06/2019 | 17/02/2020 | 434 Nos | 16/10/2020 | 226/SLR-13 |
| 3 | BTR (W) | 81 Nos | 13/12/2019 | 19/03/2020 | 518 Nos | 16/01/2021 | 16/SLR-13 |
| 4 | Kurseong | 39 Nos | 18/12/2020 | 07/01/2021 | 143 Nos | 18/02/2021 | 42/SLR-13 |
| 5 | BTR (E) | 37 Nos | 12/12/2020 | 30/01/2021 | 227Nos | 03/03/2021 | 70/SLR-13 |
| 6 | Jaldapara WL Division | 27 Nos | 30/01/2021 | 06/02/2021 | 164 Nos | 12/03/2021 | 94/SLR-13 |
| 7 | Coochbehar | 30 Nos | 01/02/2021 | 16/03/2021 | 133Nos | 24/03/2021 | 101/SLR-13 |
| | Total | 403 Nos | | | 2000 No.s | | |

PHOTOS OF SOIL SAMPLE COLLECTION



PHOTO OF SOIL COLLECTION AND TESTING TEAM WITH PCCF, RMD



5. Soil test results, Nutrition Map and Discussion-

Soil testing is an important tool to assess the fertility status as well as suitability of soil to raise a crop. Soil information for forests is based on the results of testing the soil samples in the laboratory and in this project 8 different parameters of the soil related to nutrient availability and have influence on the tree growth were measured. A total of 2000 samples collected from 403 forest compartment were tested and the details results are given in the Annexure 1.

Based on the results, the SLUSI had prepared a soil nutrition sufficiency/deficiency map of seven Forest Division of North Bengal Plains which are given in Annexure 2.

The scale used for measure of nutrient/parameter sufficiency or deficiency are given below -

| Status of soil pH: | Status of available potassium | Status of available phosphate |
|--|--|---|
| <4.5- Strongly acidic | <120 kg/ha- Low | <34 kg/ha- Low |
| 4.5-5.5-Moderately acidic | (120-280) kg/ha- Medium | (34-68) kg/ha- Medium |
| 5.5-6.5- Slightly acidic | >280 kg/ha- High | >68 kg/ha- High |
| Status of available nitrogen: | Status of available organic carbon: | Status of available sulfur: |
| <280 kg/ha- Low | <0.5% - Low (0.5-0.75)%- Medium >0.75%- High | <10 PPM- deficient >10 PPM- sufficient |
| Status of Exchangeable Calcium: | Status of Exchangeable Magnesium: | |
| <1.5 C mol (P ⁺)/kg- deficient | <1.0 C mol (P ⁺)/kg- deficient | |

Based on this scale the status of nutrient availability of each Division were marked and given in the following table.

Baikunthapur Division: As per soil nutrient map the detail status is given below.

| Sl No | Soil Nutrient parameter | Observation |
|-------|-------------------------------|---|
| 1. | Exchangeable Calcium | All compartments are deficient in exchangeable Calcium. |
| 2. | Available Potassium | All compartments are low |
| 3. | Exchangeable Magnesium | All compartments are deficient in exchangeable magnesium |
| 4. | Available Nitrogen | All compartments are low in available nitrogen |
| 5. | Organic Carbon | All compartments are high |
| 6. | Available Phosphorus | Medium:- Targhera, machbasti, Phuljhora, Kathambari, Neem, Farabari, Mantadari, Lalitabari, Shikarpur. Low:- Rest compartments are low |
| 7. | pH | Moderately acidic:- All compartments are moderately acidic in nature |
| 8. | Available Sulfur | All compartments are sufficient |

Jalpaiguri Division : As per soil nutrient map the detail status is given below.

| Sl No | Soil Nutrient parameter | Observation |
|-------|-------------------------------|--|
| 1. | Exchangeable Calcium | Deficient:- Lataguri, Kalamati, Ramsai head quarter , Central, Borodighi, Khariabandar, Sipchu, Nagrakata, Panjhora, Totapara, Khutimari, Gosaighat, Sonakhali. Sufficient:- Rest compartments are sufficient |
| 2. | Available Potassium | Medium:- Kalamati, Khutimari. Low:- Rest compartments are low. |
| 3. | Exchangeable Magnesium | Sufficient:- Carron, Diana, Tollgate, Sulkapara, Khaikata, Nathua Head quarter, Godhearkuthi. |

| | | |
|----|-----------------------------|--|
| | | Deficient:- Rest compartments are deficient. |
| 4. | Available Nitrogen | All compartments are low |
| 5. | Organic Carbon | Medium:- Carron, Sulkapara, Godhearkuthi Low:- Khairkata. High: - Rest compartments are high. |
| 6. | Available Phosphorus | High:- Khariabandar, Borodighi, Sulkapara. Low:- Sipchu, Khairkata, Nathua head quarter, carron, Dina tollgate, Khutimari, lower rethi. Medium:- Rest compartments are medium. |
| 7. | p^H | Moderately acidic:- Sipchu, Nagrakata, Khariabandar, Panjhora, Borodighi, Central, Lataguri, Kalamathi, Ramsai Head quarter. Slightly acidic:- Sulkapara, Khairkata, Nathua head quarter. Strongly acidic:- Totapara, Gosaighat, Sonakhali, Khutimari. Slightly alkaline:- Godhearkhuti. Normal:- Rest compartments are normal. |
| 8. | Available Sulfur | All compartments are sufficient. |

Coochbehar Division : As per soil nutrient map the detail status is given below.

| Sl No | Soil Nutrient parameter | Observation |
|-------|-------------------------------|---|
| 1. | Exchangeable Calcium | Deficient:- Pundibari Head quarter Sufficient:- Mathabhanga, Khagribari, Sitalkuchi, Gosanimari. |
| 2. | Available Potassium | All compartments are low. |
| 3. | Exchangeable Magnesium | Sufficient:- Sitalkuchi, Khagribari. Deficient:- Rest compartments are deficient. |
| 4. | Available Nitrogen | All compartments are low. |
| 5. | Organic Carbon | Medium:- Sitalkuchi, Gosanimari, Mathabhanga, Pundibari |

| | | |
|----|-----------------------------|---|
| | | head quarter. High: - Rest compartments are high. |
| 6. | Available Phosphorus | Medium: -Jamaldha, Pundabari. Low: -Rest compartments are low. |
| 7. | pH | Moderately acidic: -Jamaldha Slightly acidic: -Mathabhanga, Khagribari, pundibari . Slightly alkaline: -Sitalkuchi. Normal: -Gosanimari. |
| 8. | Available Sulfur | All compartments are sufficient. |

BTR West Division - As per soil nutrient map the detail status is given below.

| SI No | Soil Nutrient parameter | Observation |
|-------|-------------------------------|--|
| 1. | Exchangeable Calcium | Sufficient: -Adma, Panbari (North). Deficient: -Rest Compartments are deficient. |
| 2. | Available Potassium | Medium: - Pana, Bhutri, Adma. Low: - Rest compartments are Low. |
| 3. | Exchangeable Magnesium | Sufficient: -Adma, Dima, Panbari (North). Deficient: - Rest compartments are deficient. |
| 4. | Available Nitrogen | All compartments are low. |
| 5. | Organic Carbon | Medium: -Barnabari, Bhutri, Gram west, Gram east, Damunpur, Cheko, Range head quarter beat. Low: Godamdabri, Dima, west rajabhathkhawa. High: - Rest compartments are high. |
| 6. | Available Phosphorus | Low: -Poro west, Poro east, Gram west, Gram east, Damanpur, Cheko, Gadadhar, Panbari (South). High: -South Rajabhathkhawa. Medium: - Rest compartments are medium. |
| 7. | pH | Slightly acidic: -Godamdabri, Panbari (North) . Strongly acidic: -Raimatong, Gongutia, Nimati west, Damanpur, Cheko, South Rajabhathkhawa. |

| | | |
|----|-------------------------|---|
| | | Moderately acidic:- Rest compartments are moderately acidic in nature. |
| 8. | Available Sulfur | All compartments are sufficient. |

BTR East Division: As per soil nutrient map the detail status is given below.

| SI No | Soil Nutrient parameter | Observation |
|-------|-------------------------------|---|
| 1. | Exchangeable Calcium | Deficient:- Chunabhati, Boxaduar, Santrabari, Boxaroad, Sankosh, New land, Kumar gram, Chuniajhora, Mainabari, Narathali, Chipra, Marakhata, South rydak, Changmari, Ghoramara, Barobisa, Sufficient:- Rest Compartments are sufficient. |
| 2. | Available Potassium | Medium:- Balapara, Marakhata, Chunijhora, Hatipota, Mainabari. Low: - Rest compartments are Low. |
| 3. | Exchangeable Magnesium | Sufficient:- Hatipota, Bhutiabasti, Jainti (North), Jainti (south), Chuniajhora, Kartic, Changmari, Balapara. Deficient:- Rest compartments are deficient. |
| 4. | Available Nitrogen | All compartments are low. |
| 5. | Organic Carbon | Medium:- Balapara, Ghoramara. High: - Rest compartments are high. |
| 6. | Available Phosphorus | High:- Chunabhati, Boxaduar, Santrabari, Phashkhawa, Boxaroad. Low:- Bhutiabasti,Chuniajhora, Jainti (South), Kartic, South rydak, marakhata, Teamari, Balapara. Medium:- Rest compartments are medium. |
| 7. | p^H | Slightly acidic:- Bhutiabasti, Kartic, Jainti (North), Changmari, Ghoramara. Strongly acidic:- South Rydak, Boxaroad. |

| | | |
|----|-------------------------|--|
| | | Normal: Jainti (South), Chuniajhora. Moderately acidic:- Rest compartments are moderately acidic in nature. |
| 8. | Available Sulfur | All compartments are sufficient. |

Jaldapara Wildlife Division : As per soil nutrient map the detail status is given below.

| Sl No | Soil Nutrient parameter | Observation |
|-------|-------------------------------|--|
| 1. | Exchangeable Calcium | Deficient:- All compartments are deficient in exchangeable calcium. |
| 2. | Available Potassium | All compartments are low in available potassium. |
| 3. | Exchangeable Magnesium | All compartments are deficient in exchangeable magnesium. |
| 4. | Available Nitrogen | All compartments are low in available nitrogen. |
| 5. | Organic Carbon | All compartments are high in organic carbon. |
| 6. | Available Phosphorus | High:- Lankapara, Dumchi, Nilpara. Low:- North khairbari. Medium:- Rest compartments are medium. |
| 7. | p^H | Strongly acidic:- Dumchi, Mantharam, Kodalbasti, Mendabari, Bania, Lankapara. Moderately acidic:- North khairbari, South Khairbari, Nilpara, Chilapata. |
| 8. | Available Sulfur | All compartments are sufficient. |

Kurseong Division: As per soil nutrient map the detail status is given below.

| SINo | Soil Nutrient parameter | Observation |
|------|-------------------------|-------------|
|------|-------------------------|-------------|

| | | |
|----|-------------------------------|---|
| 1. | Exchangeable Calcium | <p>Deficient:-Uttam CC, .Tukriajhar, Bengdubi, Bagdogara, Taipu, Kolabari, Bamanpokhri, Lamagumba, Mana, Latpanchor, Kalijhora, Berrik.</p> <p>Sufficient:-Lohagarh, Khairbani, Panighata, Singbuli, Dowhill, Shivkhola, Phuguri, Chattakpur, Bagora, Majua.</p> |
| 2. | Available Potassium | <p>Low:-Bagdogara, Bengdubi, Taipu, Bamanpukhri, Panighata, Lamagumba, Shibkhola, Mana, Latpanchor, Kalijhora, Berrik, Kolabari, Tukriajhar, Uttam cc, Lohagarh, .</p> <p>Medium:-Khairbani, Singbuli, Phuguri, Chattakpur, Bagora, Majua, Dowhill.</p> |
| 3. | Exchangeable Magnesium | <p>Sufficient:-Khairbani, Singbuli, Phuguri.</p> <p>Deficient:-Rest compartments are deficient.</p> |
| 4. | Available Nitrogen | All compartments are low in available nitrogen. |
| 5. | Organic Carbon | <p>High:-Tukriajhar, Uttam cc, Bengdubi, Bagdogara, Taipu, Bamanpukhri, Panighata, Khairbani, Lamagumba, Singbuli, Phuguri, Shivkhola, Dowhill, Chattakpur, Bagora, Majua, Mana.</p> <p>Low:-Kalijhora.</p> <p>Medium:-Kolabari, Lohagarh, Berrik, Latpanchor.</p> |
| 6. | Available Phosphorus | <p>High:-Taipu, Panighata, Khairbani, Singbuli, Phuguri, Dowhill, Chattakpur, Majua, Bagora.</p> <p>Low:-Tukriajhar, Uttam cc.</p> <p>Medium:-Bengdubi, Bogdogra, kolabari, Lohagarh, Bamanpukhri, Lamagumba, Shibkhola, Mana, Latpanchar, Kalijhora, Berrik.</p> |
| 7. | pH | <p>Slightly acidic:-Lohaghar, Khairbani.</p> <p>Moderately acidic:- Rest compartments are moderately acidic in nature.</p> |
| 8. | Available Sulfur | All compartments are sufficient. |

As per recommendation, after soil analysis fertility status of the soil to be maintained by manuring in time with proper doses to sustain the soil productivity for a better stand of tree in future.

Status of different parameters given by the soil & land use survey of India in the soil nutrient map prepared in collaboration with the research wing of the forest directorate, Govt. of west Bengal.

CONCLUSION – In summary, this soil nutrition deficiency or sufficiency map will be help to plan reforestation, liming, utilization intensity, tree species selection, and to estimate forest productivity. Soil test report along with the map also guides to prepare the amelioration measue for tree growth and provide information to determine the site quality with in the forest compartments. In most of the area, the content of organic carbon is very high; where as the availability of nitrogen is low. For making a generalized prescription for fertilizer application for growth of chosen species, and enhancing productivity this study to be continued.