

CHAPTER 3: MATERIALS AND METHODS

3.1 Study site

The study was conducted in erstwhile Sonitpur district (presently Biswanath and Sonitpur district) of Assam. Sonitpur is the second largest district of state Assam after Karbi Anglong district, spread over an area of 5324 sq. kms. in the foot hill of Himalaya and on the north bank of Brahmaputra river. The Sonitpur district lies between 26° 40' 25.9860" N and 92° 51' 27.7560" E and is bounded by Arunachal Pradesh in North, river Brahmaputra in South; Lakhimpur in East and Darrang and Udalguri district in the West (Figure 3.1).

There entire district is drained by five major rivers namely, Brahmaputra, Jiabharali, Gabharu, Borgang and Buroi. The total forest area of Sonitpur is 1420 sq. km. There are three protected areas namely, Nameri National Park (NP); Burhachapori and Sonai Rupai Wildlife Sanctuaries (WLS) (Figure 3.2) and 11 Reserve Forests (RF) viz. Behali, Biswanath, Gahpur, Naduar, Singlijan, Balipara, Sengalimora, Charduar, Singri Hills, Bhomraguri and Goroimari distributed in two broad divisions Sonitpur East and West with 4 numbers of forest ranges Viz. Dhekiajuli, Charduar, Central and Sadar (Figure 3.3). Location and surveyed area maps are interpreted from recent satellite images in GIS environment. The Sonitpur district is inhabited by many tribal groups of peoples viz. Boro, Garo, Mishing, Munda, Apatani, Rabha, Mechs, Nyishis, Adis, Lama, etc. The major religions of the populace of Sonitpur district are Hindus, Muslims, Christians and Buddhists.

3.1.1 Vegetation

The major vegetation type of Assam is tropical and sub-tropical type covering areas of wet evergreen, semi-evergreen, deciduous forests, grasslands, littoral and swamp forests [1]. Land use of the district is divided primarily among tropical evergreen, tropical semi-evergreen, moist deciduous, riverine forest, grassland, agricultural land and tea garden [2]. According to Champion and Seth [3], Sonitpur comprises East Himalayan Moist Deciduous forest (I/3/3c/3cb), Assam Valley Semi-Evergreen forest (I/2/2B/ C1), Eastern Alluvial Semi-Evergreen forest (I/2/2B/2S2) and Riverine forest. *Sal (Shorea robusta)* is dominant tree species in tropical moist deciduous forest, while *Mesua ferrea*, *Lagerstroemia* sp., *Artocarpus* sp., *Cinnamomum* sp., *Magnolia hodgsonii*, *Michelia champaca*, *Cassia fistula* are commonly found in Tropical evergreen forests. For better understanding of the habitat structure a recent (2017) forest cover map of the district has been worked out and presented in Figure (3.4). For delineate images of forest cover, Landsat images of 2017 is used in Arc GIS 10.4. The common inbuilt unsupervised classification method is used to demarcate the required feature class (forest cover).

3.1.2 Topography

The slope and relief pattern of Sonitpur Sonitpur is almost even and could be said as plain topography. The elevation varies between 70 and 100 metres above mean sea level, and in some places contour line reaches up to 480 metres. Some small hillocks are situated near the river Brahmaputra in the southern part of the district which are Singri Hill RF and surrounding part of Tezpur town including Bhomoraguri RF. The major soil type of

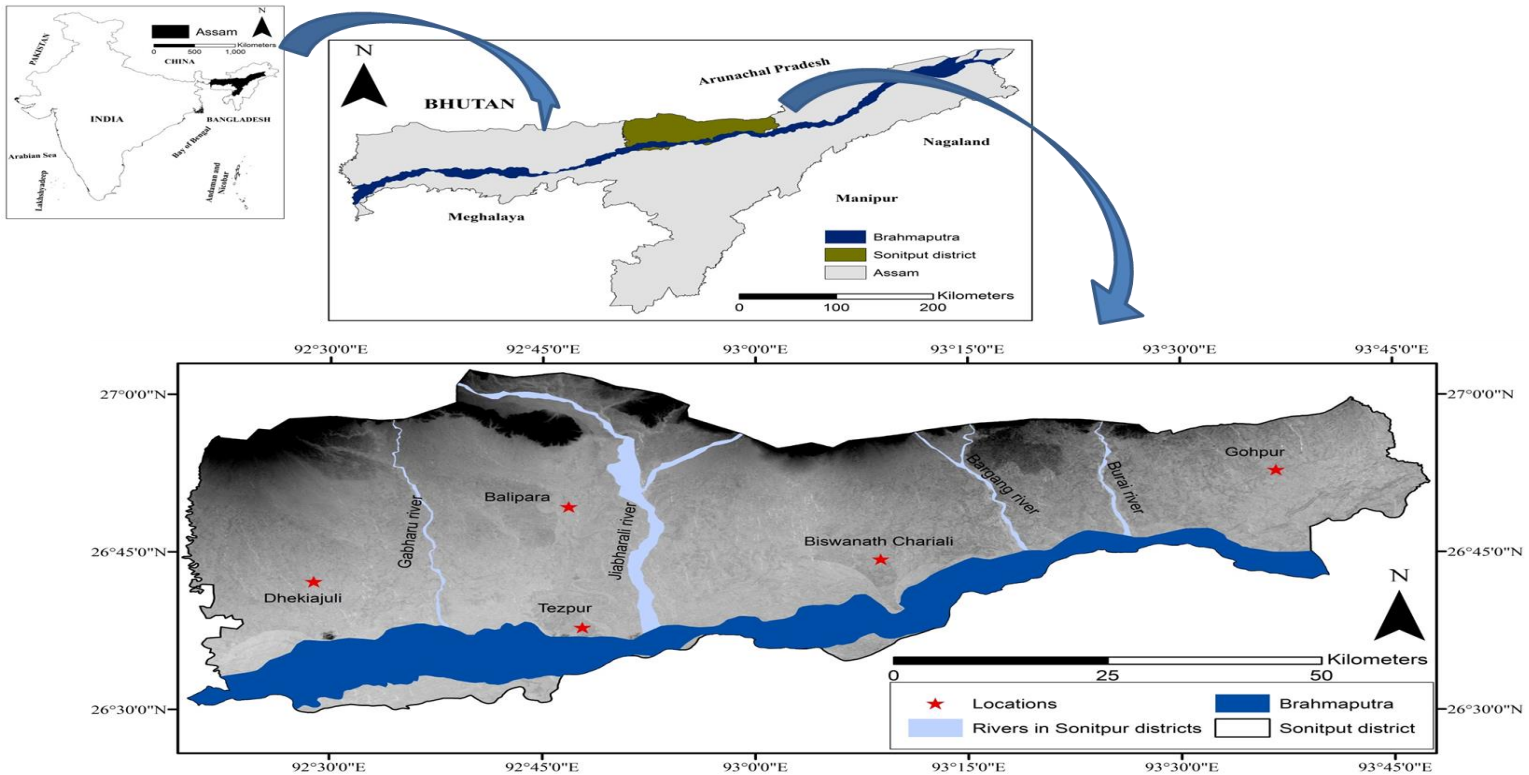


Figure 3.1: Location map of erstwhile Sonitpur district.

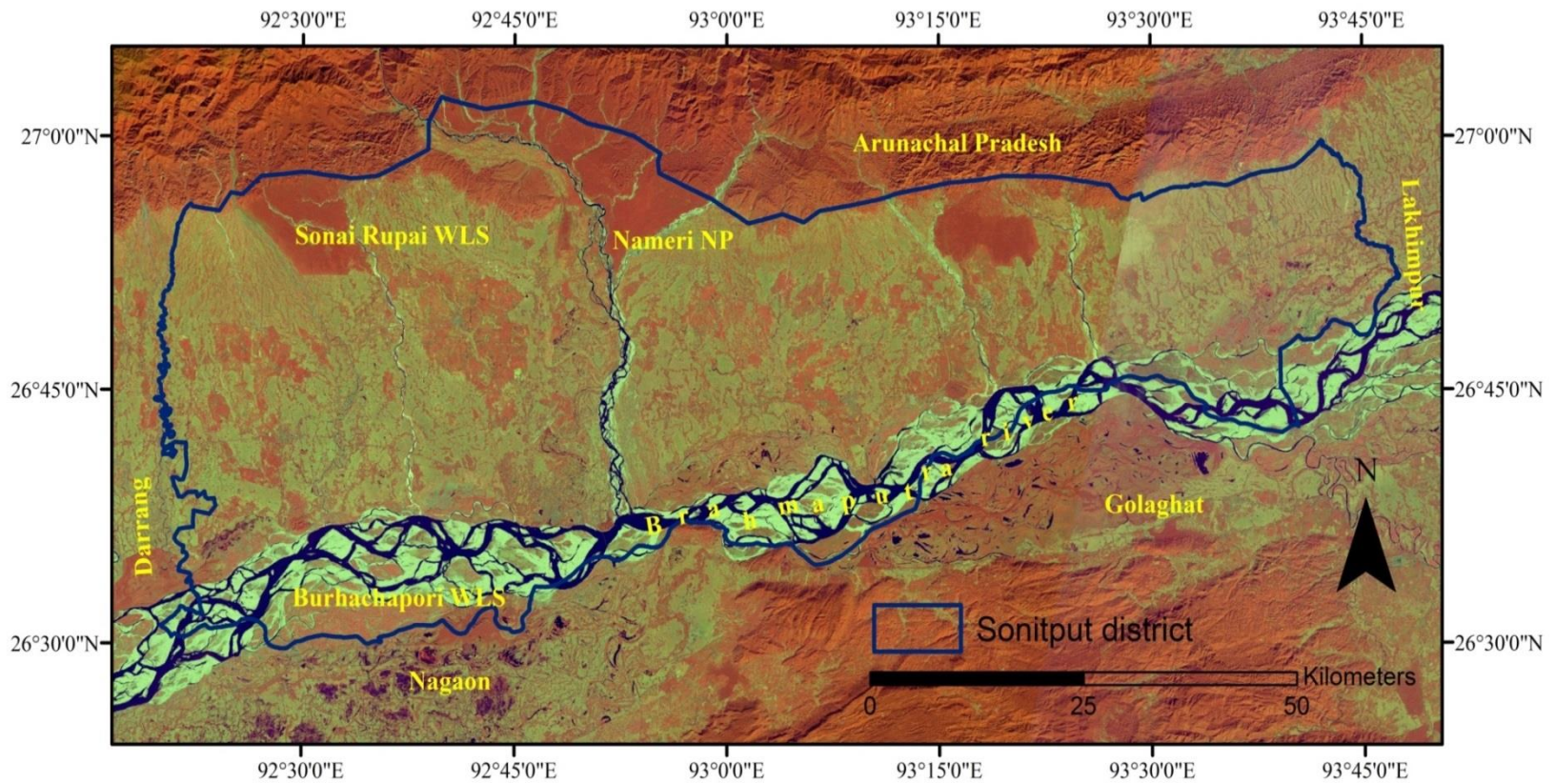


Figure 3.2: Location map of Protected Areas in the study area.

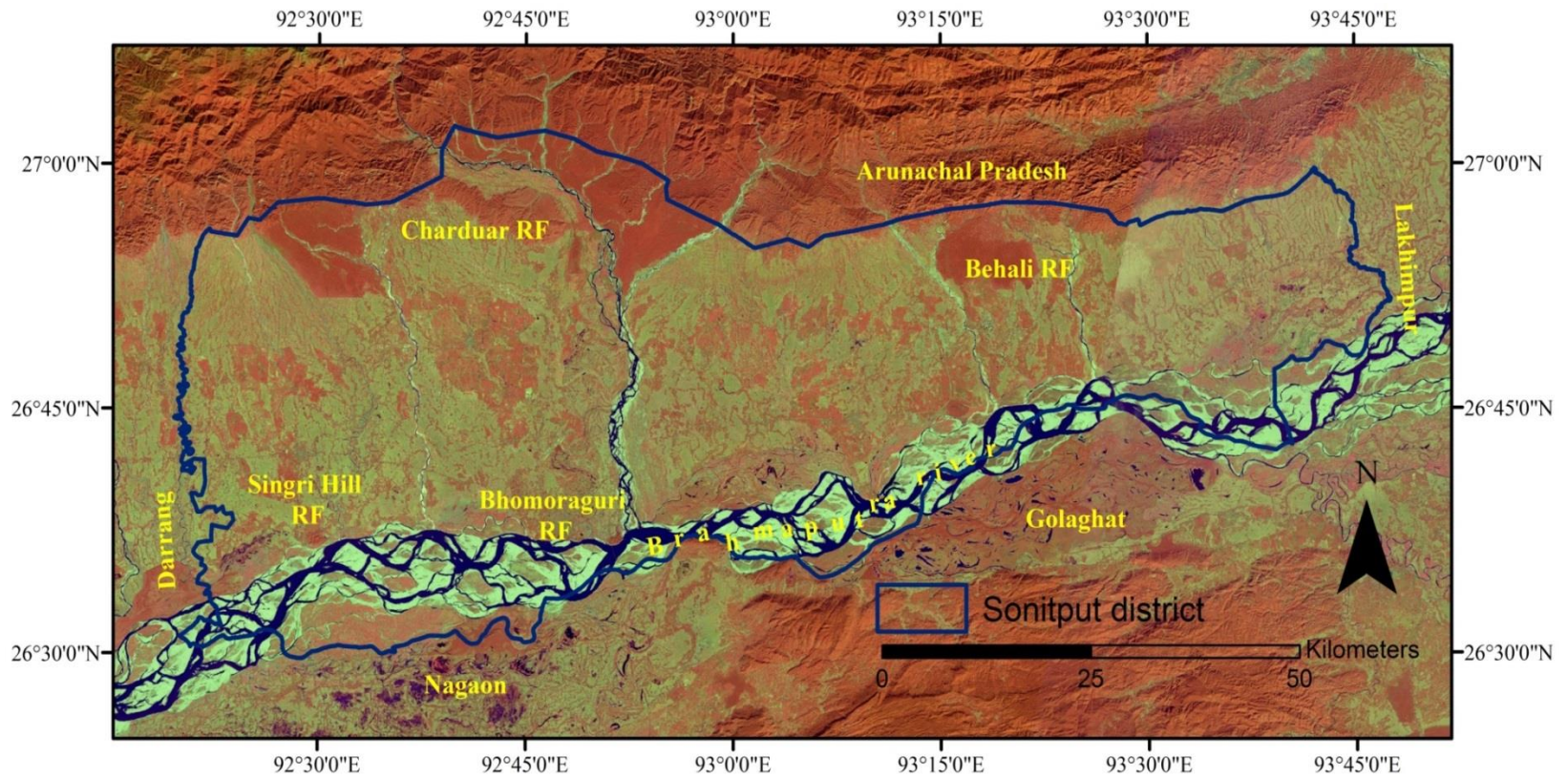


Figure 3.3: Location map of major Reserve Forests of the study area.

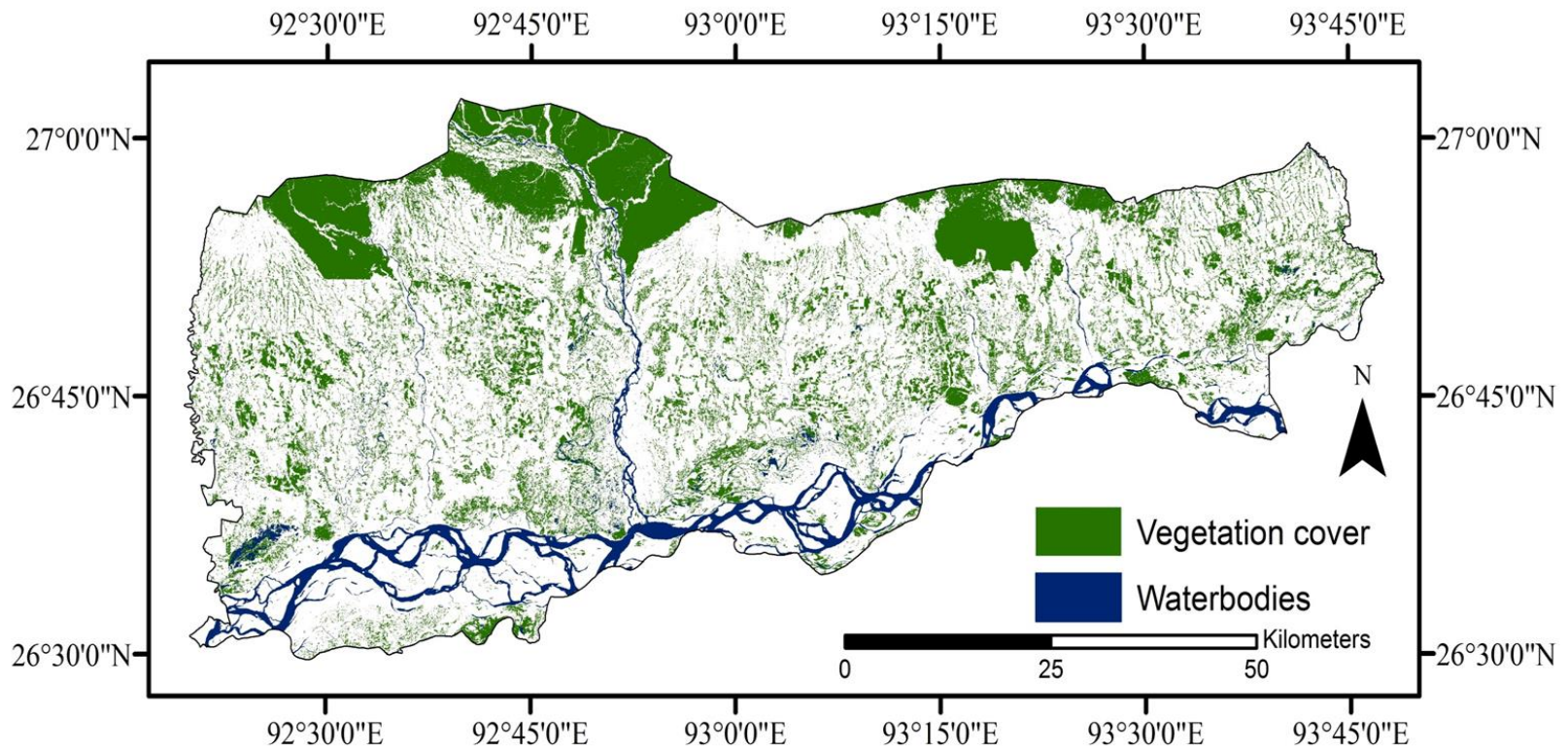


Figure 3.4: Recent (2017) forest cover map of the study area

Sonitpur is red loamy soils, lateritic soil, new alluvial soils and older alluvial soil [4, 5].

3.1.3 Demography

As per 2011 census [6] Sonitpur district has 1,925,975 total populations with a population density of 365 inhabitants per square kilometre. The population growth rate over the decade 2001-2011 was 15.67%. Sonitpur has a sex ratio of 946 females for every 1000 males, and a literacy rate of 69.96%.

3.1.4 Climate

Sonitpur district comes under the Sub-Tropical climatic region, and enjoys Monsoon type of climate. Reviewing the weather data of last 17 years (2000-2016) it was found that Sonitpur experiences summer with an average temperature of 31.3 °C, while the minimum average temperature was recorded in the month of January (8.5 °C). Summer is hot and humid with heavy downpour mainly caused by the moisture-laden South-West Monsoon on striking the Himalayan foothills of the North. In the month of July highest average rainfall was recorded from the district i.e. 368.3 (mm) about 21 rainy days which causes heavy floods in some areas of the district also and at the same time it seems a boon too for the cultivators. Winter experiences cold and dry and temperature ranges between 8 to 23°C and normally December experiences lowest precipitations with about 10mm rainfall [Table 3.1 and Figure 3.1]. Autumns are dry, and warm. Springs are cool and pleasant, occurring in the months of late March and April, when new leaves emerges. During these months

(March-April), flash rains and thunderstorms are at times caused by cyclonic winds, known in local parlance as *Bordoichila*.

Table 3.1: Monthly average of weather parameters for last 17 years (2000-2016) [5]

Month	Average Temperature (°C)		Average RH (%)	Normal rainfall (mm)	Avg. No. of rainy days
	Max.	Min.			
January	23.4	8.5	70	18.8	2.2
February	25.9	12.2	66	30.3	3.1
March	28.6	15.8	64	55.5	6.6
April	28.3	18.9	74	177.9	14.2
May	30.7	22.1	75	248.6	15.6
June	31.3	24.5	80	354.4	19.3
July	31.9	25.5	40.5	368.3	20.3
August	32.4	25	80.5	314	16.6
September	31.6	24	78	244.3	14.6
October	30.3	20.4	71	127	6.5
November	27.6	14.6	69	19.2	1.9
December	24.8	9.5	70	10.5	6.6

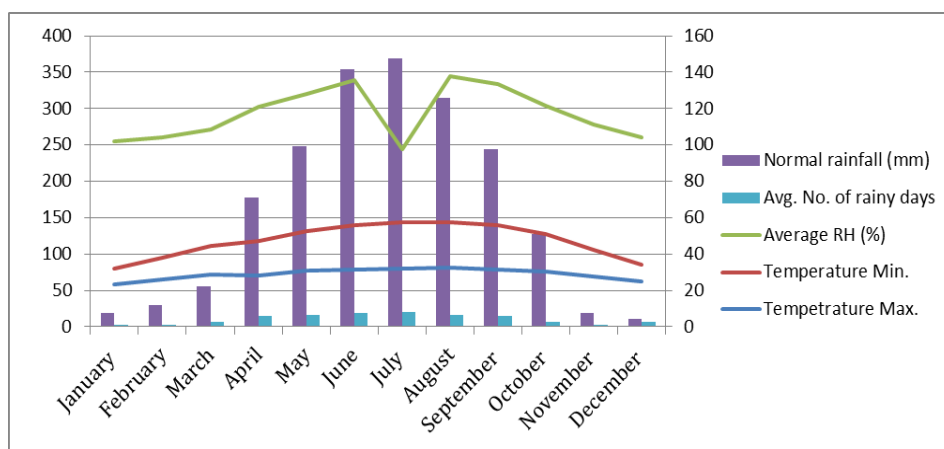


Figure 3.5: Monthly average weather parameters for last 17 years (2000-2016)

3.2 Floristic Study

For the preparation of Dicot Flora of Sonitpur district (erstwhile) a series of extensive floristic explorations was carried out in entire district during 2014-17. A special random sampling chart was prepared for sampling in different locations mainly Nameri National Park, Burhachapori and Sonai Rupai Wild Life Sanctuaries, Behali, Biswanath, Gahpur, Naduar, Singlijan, Balipara, Sengalimora, Charduar, Singri Hills, Bhomraguri, Goroimari reserve forests and other hillocks, ponds, natural depressions, rivers sites etc. depending upon different seasons such as pre-monsoon, monsoon and post monsoon. Accordingly, different field trips were conducted spatially and temporally in dense forests and extended forests for a period of 2 days to maximum 10 days.

All the specimens were collected having reproductive parts such as flowers, fruits and vegetative parts such as roots, tendrils, etc. during the field survey. A standard 'Field Note Book' was prepared consulting BSI and all field information such as habit, habitat, location, morphological characters, flowering and fruiting periods, uses, vernacular names, special note, etc., were recorded in the field books. During collections photographs of the specimens were also collected using a Nikon D5300(18-55/70-300mm lens) camera. The field book was also attached with tags and was fixed with the specimen during the collection with a collection number (Coll. No.). Herbariums were prepared following the techniques given by Jain and Rao [7]. The handmade herbarium sheets were used for mounting the specimens. The fully completed herbariums were deposited in the Ecology and

Biodiversity Laboratory of Dept. of Environmental Science, Tezpur University and some species are deposited in GUBH, Department of Botany, Gauhati University, Guwahati, Assam. The specimens were identified by comparing field observation, description with authentic literatures [8-16], counter checked and confirmed by consulting authenticated herbarium sheets preserved in ASSAM, Herbarium of NBRI, Lucknow and GUBH, G.U. Different digital herbaria were consulted for proper identifications of the specimens viz. Kew (www.apps.kew.org) and FLAS (www.flmnh.ufl.edu), New York Botanic Garden (NYBG) (www.nybg.org), etc. For the accepted nomenclature, library of Botanical Survey of India, Shillong, online authenticate database like The Plant List (www.theplantlist.org), Tropicos (www.tropicos.org) and The International Plant Name Index (www.ipni.org), International Code of Nomenclature for Algae, Fungi and Plants (ICN) were consulted and used[17-19].

3.3 System of Classification

The Bentham and Hookers' system of classification [20] has been followed to arrange the families with slight modifications by later workers, as accepted by the Central National Herbarium (CAL). Botanical keys were created based on morphological characters following indented form. The genera and species were arranged alphabetically. Diagrammatic representations and coloured photographs have been included in the thesis as much as possible and arranged according to familywise. Citation is followed by a brief morphological description in origin and then followed by phenology, flowering and fruiting, status of occurrence, vernacular name (Assamese), uses and a reference to herbarium specimen(s),

collection number and locality. The description of species was made from the herbarium specimens or live specimens during field collection.

3.4 Ethnobotanical study

For the ethnobotanical study three communities namely Munda, Mishing and Garo community have been selected on the basis of extensive literature survey in term of degree of relevant to studies and their existence in the study area. It has been found that these communities have a strong existence in the district and ethnobotanical studies reports on these communities are found to be very meagre. Extensive field survey was conducted during 2014-2017 in different village for the collection of ethnobotanical information's with emphasis on ethnomedicinal plants and uses from Munda, Mishing and Garo communities. A series of informal meetings were conducted with the village heads, family heads of each house and villagers of different age groups. A standard open-ended semi-structured questionnaire was set to conduct the survey, where data associated to ethnomedicinal information like medicinal plant part used, mode of preparation, mode of administration, dose recommended for human care, nature and name of diseases were properly recorded. Prior Informed Consent (PIC) from the respondents was obtained before the informal meeting for field survey as per the CBD guidelines [21] to collect the associated knowledge related to ethnomedicinal wisdom held by these communities. We targeted the knowledgeable persons like medicine-man (*kobirz*) who are capable of providing specific information's on local medicinal plants and their uses. After

collecting the specimen, herbariums were prepared and preserved following the standard method [7].

3.5 Informants' Consensus Factor (FIC) and Fidelity Level (FL) values

The level of similarity among information provided by different informers was calculated by the Informants' Consensus Factor (FIC) given by Trotter and Logan [22] in 1986 using the following formula:

$$FIC = N_{ur} - N_t / (N_{ur} - 1)$$

Where, N_{ur} = number of use reports from informants for a particular plant-use category; N_t = number of taxa or species that are used for that plant use category for all informants. FIC values range between 0 and 1, where '1' indicates the highest level of informant consent.

Fidelity Level (FL) was used to determine the most frequently used medicinal plant species to treat particular disease/ailments. The percentage of informants claiming the use of a certain plant species for the particular disease or ailments can be calculated using Fidelity Level (FL) formula given by Alexiades [23] as follows:

$$FL (\%) = (N_p / N) \times 100$$

Where, N_p = number of informants that claim a use of a plant species to treat a particular disease; N = number of informants that use the plants as a medicine to treat any given disease.

The given formulas of **FIC and FL** are still used as standard by the scientific community [24].

3.6 Evaluation of Non Timber Forest Products (NTFPs)

For this study Mishing community has been selected, as it is the dominant ethnic community of the study area. The Mishing peoples largely depends on forest resources particularly plant products for their livelihood and NTFPs are one of their main source of income. They are very rich in traditional and ethnomedicinal knowledge which needs to be explored and documented. Moreover, no study on NTFPs of this community has been reported so far from this area. In line with floristic survey additional field survey was conducted during 2015-2017 in different Mishing villages and markets of entire Sonitpur district to collect data on Non Timber Forest Products (NTFPs) used by Mishing community. During the field survey Mishing peoples were interviewed using the semi-structured questionnaire to record NTFPs plant species, harvesting and collection, purposes, part used, availability, market price etc. Data on type and parts used for all NTFPs, processing, marketing, source of collection, use, dependency, etc. were recorded separately [25-28].

3.7 Bibliography

- [1] Singh, J.S. The biodiversity crisis: a multifaceted review. *Current Science*, 82(12):638-647, 2002.
- [2] Srivastava, S., Singh, T.P., Singh, H., and Kushwaha, S. Assessment of large-scale deforestation in Sonitpur district of Assam, *Current Science*, 82 (12), 2002.
- [3] Champion, H. G., and Seth, S. K. *A Revised Survey of Forest Types of*

- India*, Govt. of India Press, New Delhi, 1968.
- [4] *Report of Central Ground Water Board*, North Eastern Region, Ministry of Water Resources, Guwahati, September 2013.
- [5] *Krishi Vigyan Kendra*, AAU, Sonitpur Napam, Tezpur 015-16 report.
- [6] *Census report*, Govt. of India, 2011,
- [7] Jain, S.K., and Rao, R.R. *A handbook of field and herbarium methods*, Today and Tomorrow's printers and publishers, Delhi, 1977.
- [8] McNeill, J. and Turland, N.J. Major changes to the Code of Nomenclature-Melbourne. *Taxon* 60(5):1495-1497, 2011.
- [9] Kanjilal, U.N., Kanjilal, P.C. and Das, A. *Flora of Assam*, Vol. 1, Omsons Publications, New Delhi, 1934.
- [10] Kanjilal, U.N., Kanjilal, P.C. and Das, A. *Flora of Assam*, Vol. 2, Omsons Publications, New Delhi, 1938.
- [11] Kanjilal, U.N., Kanjilal, P.C., Das, A. and De, R.N. *Flora of Assam*, Vol. 3, Omsons Publications, New Delhi, 1939.
- [12] Kanjilal, U.N., Kanjilal, P.C. and Das, A. *Flora of Assam*, Vol. 4, Omsons Publications, New Delhi, 1940.
- [13] Hooker, J.D. (1-5 Vol.). *Flora of British India*, L. Reeve and Co., (Under Missouri Botanical Garden), London, 1875-1890.
- [14] Hajra, P.K., and Jain, S.K. *Botany of Kaziranga and Manas Biospheres*, Surya International Publications, Dehradun, 1996.
- [15] Hajra, P.K. *Floristics of Kaziranga National Park and Manas National Park*, Ph.D. thesis, University of Gauhati, Guwhati, 1978.
- [16] Fischer, C. E. C. *The flora of the Lushai hills*, Botanical Survey of India, 1938.
- [17] The Plant List (2013). *Version 1.1. Published on the Internet*;
<http://www.theplantlist.org/>
- [18] Tropicos.org. *Missouri Botanical Garden*. <http://www.tropicos.org>
- [19] *International Plant Names Index*. <http://www.ipni.org/index.html>
- [20] Bentham, G. and Hooker, J.D. *Genera Plantarum*. 3 Vols. Reev and Co. Ltd. Kent. London, 1862-1883.

- [21] UNEP. 2007. *User's Manual on the CBD Guidelines on Biodiversity and Tourism Development*, Accessed [13/12, 2017]. https://www.cbd.int/doc/programmes/tourism_tourism-manual-en.pdf.
- [22] Trotter, R.T. and Logan, M.H. *Informant census: A new approach for identifying potentially effective medicinal plants*. In: Etkin, L.N. (Ed.), *Plants in indigenous medicine and diet*. Redgrave, Bedford Hill, New York, 91-112, 1986
- [23] Alexiades, M.N. *Selected Guidelines for Ethnobotanical Research: A Field Manual*. The New York Botanical Garden, New York, 99-133, 1996.
- [24] Canalesa, M., Hernandez, T., Caballerob, A, J., Romo de Vivarc, A., Avilaa, G., Durana, A. and Liraa, R. Informant consensus factor and antibacterial activity of the medicinal plants used by the people of San Rafael Coxcatlan, Puebla, Mexico. *Journal of Ethnopharmacology* 97: 429–439, 2005.
- [25] Gubbi, S. and Douglas, C. M. Can non-timber forest products solve livelihood problems? A case study from Periyar Tiger Reserve, India, *Fauna and Flora International, Oryx* 42 (2): 222-228, 2008.
- [26] Dattagupta, S., and Gupta, A. Traditional procession of Non timber forest products in Cachar, Assam, India, *International Journal of Traditional Knowledge* 13 (2): 427- 433, 2014.
- [27] Dattagupta, S., et al. Diversity of non-timber forest products in Cachar District, Assam, India, *Journal of Forestry Research* 25 (2): 463-470, 2014.
- [28] Sundriyal, M., and Sundriyal, R.C. Wild edible plants of the Sikkim Himalaya: Marketing, value addition and implications for management, *Economic Botany* 58(2): 300-315, 2004.