

ARCHAEOLOGY OF THE DIGARU – KOLONG RIVER VALLEY WITH SPECIAL EMPHASIS ON THE NEOLITHIC PERIOD

A Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy

by

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DECLARATION

The thesis entitled “**Archaeology of the Digaru – Kolong River Valley with Special Emphasis on the Neolithic Period**” submitted for the degree of Doctor of Philosophy has not been previously submitted for any other degree at this or any other university. It is my original work carried out under the supervision of Prof. Sukanya Sharma, Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, India.

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CERTIFICATE

This is to certify that the work contained in the thesis entitled “Archaeology of the Digaru – Kolong River Valley with Special Emphasis on the Neolithic Period” by Mr. Jitendra Kumar (Roll No. 156141011), a student in the Department of Humanities & Social Sciences, Indian Institute of Technology Guwahati, for the award of the degree of Doctor of Philosophy was carried out under my supervision. The results embodied in the thesis have not been submitted to any other University or institute to award any degree or diploma.

Guwahati

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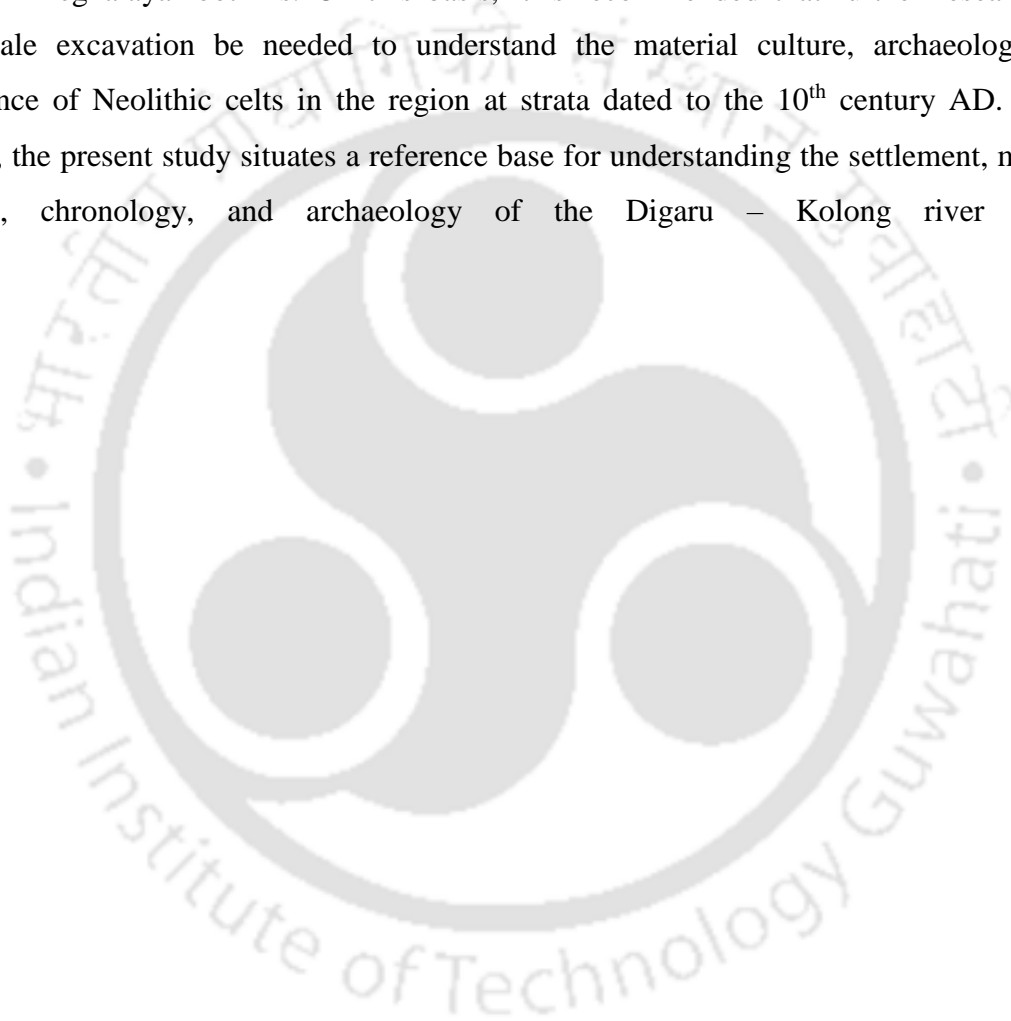
Abstract

Northeast India has long been considered a significant region for archaeological research. The geographical setting, biodiversity, diverse ethnic culture, ancient settlement, and traces of migration play a crucial role in creating a dynamic landscape of Northeast India. Assam and Meghalaya are crucial regions for archaeological research in Northeast India. However, most of the research in the region has been limited to site-specific studies. The present study area of Digaru – Kolong river valley is located in the foothills of the Meghalaya plateau and is surrounded by several archaeologically potential regions, such as North Cachar Hills, Khasi, and Garo Hills. Sarutaru and Marakdola are the only reported and excavated sites in this region. The reports of accidental findings of artifacts are widespread throughout the region, which further indicates the potentiality in terms of archaeological research.

The present study has attempted to understand the past settlement, material culture, and archaeology of the Digaru – Kolong river valley. The research locates the trajectory of settlement, subsistence, and chronology of the communities inhabiting the study area. It traces the research question of any dialogical relationship with the neighboring archaeological sites. This study has used the method of archaeological reconnaissance surveys, test pit excavations, ethnographic surveys (mainly from non-participant observation and unstructured interview methods), and scientific or laboratory analysis methods. It is further anchored in the literature related to the discourse in Northeast India, claiming archaeological, ecological, and ethnographic studies. The artifacts have been analyzed by their morphological features and scientific methods to understand the raw materials, mineralogical compositions, and chronology. The scientific methods utilized are XRD, FTIR, Thin-section petrography, particle size analysis (sieve and hydrometer), Ph. measurement, titration, and AMS dating.

The study has successfully located several findspots, and based on exploration planning and accessibility to the region, it has been divided into five zones. The artifacts recovered from the study area were ceramics, stone celts (axe, adze, shouldered, and tanged celts), charcoal, and megalith monuments. Artifacts have been recovered from the surface as well from the test pits. Evidence from the archaeological reconnaissance indicates that the study area is archaeologically rich and has traces of past settlements. The ethnographic results further enhance the significant role of the socio-cultural memory of the ethnic communities towards

archaeological sites and artifacts. Analysis of the artifacts demonstrated that the raw materials for tools and ceramics were acquired locally. The settlement pattern and subsistence of the region resemble the Neolithic lifestyle. However, the AMS dating results demonstrated that the sites and artifacts are associated with post-Neolithic settlements or historical periods. There is evidence of inscription writing, sculpture making, iron tools, and stone celts parallelly, suggesting human imprints in different forms. Thereby, the study depicts the region as archaeologically rich, and this work helps to build a broad regional sequence in the Assam – Meghalaya foothills. On this basis, it is recommended that further research and large-scale excavation be needed to understand the material culture, archaeology, and occurrence of Neolithic celts in the region at strata dated to the 10th century AD. In this process, the present study situates a reference base for understanding the settlement, material remains, chronology, and archaeology of the Digaru – Kolong river valley.



Contents

DECLARATION	i
CERTIFICATE	ii
Acknowledgments.....	iii
Abstract	vi
Contents	viii
List of Figures	xiii
List of Maps	xiv
List of Tables	xv
List of Plates	xviii
Chapter – 1	1
Introduction and Objective of the Research.....	1
Part I: General Introduction	1
1.1 Introduction	1
1.2 Problem Orientation and Research Objective	6
1.2.1 Statement of Purpose	6
1.2.2 Research Question	7
1.2.3 Aim of the Research	8
1.2.4 Objective of the Research.....	8
1.2.5 Significance of the Study.....	8
1.3 Methodological Considerations.....	9
Part II: Ecological Perspective.....	11
1.4 Geomorphology and Drainage Systems	12
1.5 Climate	16
1.6 Geology	17
1.7 Soil and Vegetation	20
1.8 Ethnic communities.....	21
Part III: Previous Work.....	25
1.9 Understanding the Neolithic Culture in the Indian Subcontinent	25
1.10 The Neolithic Culture of Northeast India: a brief review	26
1.11 Locating Digaru – Kolong river valley: the scope of the research.....	29
1.12 Structure of the Study.....	31

Chapter – 2.....	33
Field Reconnaissance and Findings	33
Part I: Survey Planning and Methods	33
2.1 Field Reconnaissance and Results.....	33
2.2 Plan of Field investigation.....	34
2.3 Field Recording and Sampling.....	36
Part II: Archaeological Sites Descriptions and Observations	37
2.4 Sites Investigated.....	40
2.4.1 Sarutaru and Marakdola.....	40
2.4.2 Bagibari	45
2.4.3 Silchang (Xilchang).....	48
2.4.4 Shankargog	52
2.5 Region or localities surveyed: Reconnaissance and surface collection	54
2.5.1 Jorabat – Sonapur region (Kamrup, Assam)	54
2.5.2 Dimoria – Khetri region (Kamrup, Assam).....	57
2.5.3 Jagiroad – Nelli region (Morigaon, Assam)	58
2.5.4 Umsiang region (Ri-Bhoi, Meghalaya)	60
2.5.5 Umswai region (West Karbi Anglong, Assam).....	63
Part III: Settlement Pattern and Site Formation Process.....	65
2.6 Settlement Patten of the Prehistoric communities in the Digaru – Kolong River Valley.	65
2.6.1 Settlement Pattern Studies in Archaeology	65
2.6.2 Settlement pattern in Northeast India with reference to the present study area	67
2.7 Subsistence Pattern.....	70
2.8 Site Formation Process in Digaru – Kolong river valley	71
2.8.1 Field Observation: Slope Instability and Rearrangement of Sealed Sites	72
2.8.2 Field Observation: Ethnographic Survey	75
2.9 Remote Sensing.....	76
2.9.1 Methodological Consideration for Remote Sensing and Mapping	77
2.9.2 Aerial Mapping and Elevation Model	78
2.9.3 Longitudinal Profile of the Important Rivers within Study Area	84
2.10 Discussion	87
Chapter – 3.....	88
Analysis and Interpretation of Morphological Attributes of Artifacts.....	88

3.1 Artifacts as a Product of Human Workmanship: meaning and importance of analysis	88
Part I: Lithic Analysis	90
3.2 Introduction to Lithic Analysis	90
3.3 Methodological consideration for Lithic Analysis.....	91
3.3.1 Sampling and Nomenclature of Samples.....	92
3.4 Typological Attributes.....	95
3.4.1 Type of the artifacts	95
3.4.2 Shape of the artifacts	96
3.5 Morphological Attributes	97
3.5.1 Dimension of the Artifacts	97
3.5.2 Nature of Working Edge.....	99
3.5.3 Edge Slope of the Working End.....	100
3.5.4 Nature of Butt End.....	100
3.5.5 Cross-Sectional Contour.....	101
3.5.6 Contoural Facet.....	101
3.6 Indices	101
Part II: Ceramic Analysis.....	102
3.7 Introduction to Ceramic analysis.....	102
3.8 Pottery study in Northeast India.....	103
3.9 Methodological Consideration for Ceramic Analysis.....	105
3.9.1 Sampling and Nomenclature	106
3.10 Typological Attributes.....	107
3.10.1 The Anatomy of a Pottery	107
3.11 Impressions and Decorative Motifs.....	111
Part III: Sediment Analysis.....	112
3.12 Introduction to Sediment Analysis	112
3.13 Methodological Consideration for Sediment Analysis	113
3.13.1 Sampling and Nomenclature of Samples.....	113
3.14 Soil Colour	114
3.15 Discussion	115
Chapter – 4.....	118
Scientific Analysis and Interpretation of Archaeological Artifacts.....	118
4.1 Significance and Role of Scientific Methods in Archaeological Research.....	118

Part I: Lithic Analysis	119
4.2 Introduction	119
4.3 Methodological Consideration for Lithic Analysis	119
4.3.1 Sampling and Nomenclature of Samples.....	121
4.4 Raw Materials Analysis	122
4.4.1 Powder XRD Analysis.....	122
4.4.2 Thin-Section Petrography.....	123
Part II: Ceramic Analysis.....	125
4.5 Introduction	125
4.6 Methodological Consideration for Ceramic Analysis.....	125
4.6.1 Sampling and Nomenclature of samples	126
4.7 Mineralogical Characterization of Pottery	127
4.7.1 X-Ray Diffraction analysis of Pottery	127
4.7.2 Fourier Transform Infrared Spectroscopy (FTIR).....	131
4.8 Reconstructing the firing technology	144
Part III: Sediment Analysis.....	146
4.9 Introduction	146
4.10 Methodological Consideration for Sediment Analysis	146
4.10.1 Sampling and Nomenclature of Samples.....	151
4.11 Particle Size Analysis.....	152
4.11.1 Dry Sieving Analysis.....	152
4.11.2 Hydrometer Analysis.....	156
4.12 Mineralogical Analysis	158
4.13 Determining the provenance of potteries based on XRD analysis.....	159
4.14 Analysis of Acidity and Alkaline Nature of Soil	160
4.15 Determination of Calcium Carbonate in Soils	162
4.15.1 Calculation and Result.....	162
Part IV: Dating the Site.....	164
4.16 Introduction to Archaeological Dating.....	164
4.17 Methodological consideration for AMS Dating.....	165
4.17.1 Selected Materials and Sampling	165
4.18 Result and Discussion	166
4.19 Discussion	169

Chapter – 5.....	172
People, Society, and Artifacts: An Ethnoarchaeological Study.....	172
5.1 Introduction.....	172
5.2 Methodological Consideration for Ethnoarchaeological Study.....	174
5.2.1 Desktop Study.....	174
5.2.2 Field Survey.....	174
5.2.3 Ethnographic Approach.....	175
5.3 Ethnicities in the study area: Cultural Configuration.....	176
5.3.1 The Karbis.....	177
5.3.2 The Tiwas.....	179
5.4 Concept and Meaning of Stone Celts: common beliefs and socio-cultural memory ...	182
5.4.1 The Concept of ‘thunder Axe’ and ‘thunderstones’.....	182
5.4.2 Locating the concept of ‘thunderstone’ in the Digaru – Kolong River Valley.....	184
5.5 Megaliths in Digaru – Kolong River Valley: Continuity and Role of Social Memory	186
5.5.1 Megalithism: Socio-cultural belief, memory, and continuity of Tradition.....	187
5.5.2 Ethnographic Observations.....	190
5.6 Concept of Artifact as a man-made object among locals.....	192
5.7 Ethnographic data and Archaeological findings: analysis and interpretation.....	193
5.8 Discussion.....	194
Chapter – 6.....	197
Conclusion.....	197
Bibliography.....	202
Appendices.....	217
List of Publications.....	263

List of Figures

Figure 1. 1: Geological map of Northeast India (after Government of India, 1998).....	19
Figure 1. 2: Assam Population by Religion	22
Figure 1. 3: Meghalaya Population by Religion	23
Figure 2. 1: Hoarding of ‘Department of Horticulture and Farm, Assam’ at 14 th mile, G-S Road.....	42
Figure 2. 2: Menhirs of Marakdola shown in the earlier publication (S.N. Rao, 1973)	42
Figure 2. 3: Menhirs of Marakdola in the present condition	43
Figure 2. 4: Stone celts reported by the locals of Bagibari village	46
Figure 2. 5: Test pit excavation at Bagibari village	48
Figure 2. 6: Menhirs at Silchang village.....	50
Figure 2. 7: Potsherds exposed on hill tracks and test pit at Silchang village	51
Figure 2. 8: Potsherd visible at road cutting section and accumulation of artifacts at Shankargog village	53
Figure 2. 9: Potsherds exposed due to rain and test pit section at Shankargog village	53
Figure 2. 10: Deposition of Sediments	74
Figure 2. 11: Elevation of the rivers within the study area.....	84
Figure 2. 12: Elevation of sites and findspots.....	85
Figure 2. 13: Longitudinal Profile of Digaru River within the study area (Google Earth).....	85
Figure 2. 14: Longitudinal Profile of Kolong River within the study area (Google Earth).....	85
Figure 2. 15: Longitudinal Profile of Killing River within the study area (Google Earth)	86
Figure 2. 16: Longitudinal Profile of Umiam River within the study area (Google Earth).....	86
Figure 2. 17: Longitudinal Profile of Wah Umsiang River within the study area (Google Earth)	86

List of Maps

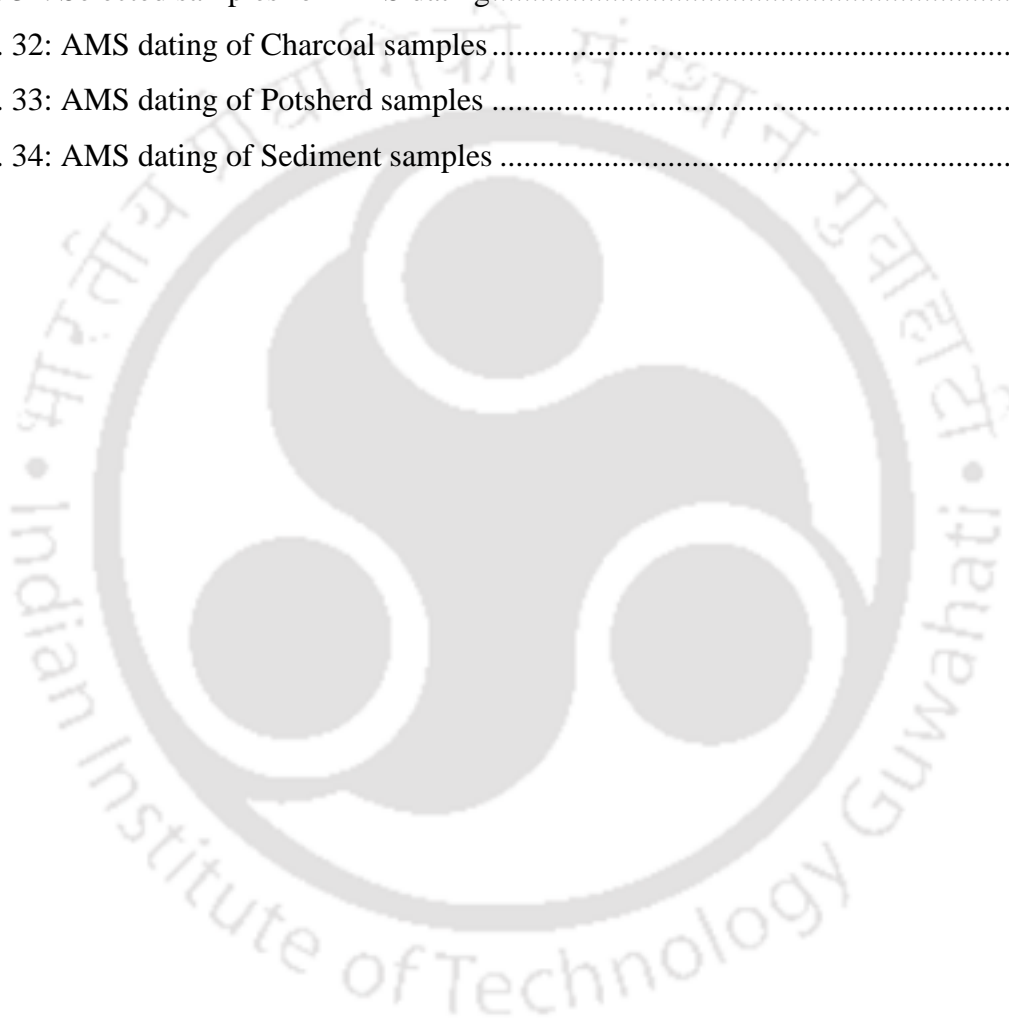
Map 1. 1: Location of the Study Area.....	1
Map 1. 2: Hand-drawn drainage map of the study area (based on Survey of India)	15
Map 1. 3: Major Rivers in the Study Area.....	16
Map 2. 1: Site Distribution Map of the Digaru – Kolong River Valley	34
Map 2. 2: Hand-drawn map of Sarutaru and Marakdola village (based on field survey).....	44
Map 2. 3: Hand-drawn map of Silchang village and locality (based on field survey)	50
Map 2. 4: Google Earth Satellite Image of the Study Area showing important Rivers.....	78
Map 2. 5: (a and b) Elevation Map of the Study Area	79
Map 2. 6: Contour Map of the Study Area	80
Map 2. 7: Hillshade View of the Study Area.....	80
Map 2. 8: Terrain Map of the Study Area (Courtesy Bhuvan, ISRO).....	81
Map 2. 9: Contour Map of the Jorabat – Sonapur Region	81
Map 2. 10: Contour Map of the Dimoria – Khetri Region	82
Map 2. 11: Contour Map of the Jagiroad – Nelli Region	82
Map 2. 12: Contour Map of the Umsiang Region	83
Map 2. 13: Contour Map of the Umswai Region.....	83

List of Tables

Table 1. 1: Population distributions in the study area (source Sub-District Level, Census of India 2011).....	23
Table 1. 2: Major Languages spoken in Assam and Meghalaya (source Language and Mother Tongue, Census of India 2011).....	23
Table 1. 3: Radiometric and Luminescence dates of Neolithic sites from Northeast India.....	29
Table 2. 1: List of Discovered Sites and Findspots during the Field Study.....	38
Table 3. 1: Description of Stone celts collected from the study area, Sh. = shouldered, L= Length, B= Breadth, T= Thickness	93
Table 3. 2: Classification and Distribution of Tool Types from the Study Area.....	96
Table 3. 3: Classification and Distribution of Tools from Study Area	97
Table 3. 4: Frequency and Percentile Distribution of Length of the Tools	97
Table 3. 5: Frequency and Percentile Distribution of Breadth of the Tools	98
Table 3. 6: Frequency and Percentile Distribution of Thickness of the Tools	98
Table 3. 7: Frequency and Percentile Distribution of Weight of the Tools.....	99
Table 3. 8: Frequency distribution of Working Edge	99
Table 3. 9: Nature of the Edge Slope	100
Table 3. 10: Frequency Distribution of Nature of Butt End	100
Table 3. 11: Cross-Sectional Contour of the Stone Tools	101
Table 3. 12: Nature of Facet	101
Table 3. 13: Classification of Artifacts based on Length, Breadth, Thickness, and Weight indices	102
Table 3. 14: Number of different parts of Pottery collected, TP= Test Pit collection, SF= Surface finds	106
Table 3. 15: Thickness of rims of the pottery sample and percentile distribution.....	108
Table 3. 16: Thickness of Body of the pottery sample and percentile distribution	110
Table 4. 1: Description of Stone celt samples.....	122
Table 4. 2: Identified Minerals and phase obtained by XRD of stone celt samples, +++ = very abundant, ++ = abundant, + = present, - = absent	123
Table 4. 3: Raw material of the analyzed tool samples	124
Table 4. 4: Identified Minerals and phase obtained by XRD of pottery reported from Test pits, +++ = very abundant, ++ = abundant, + = present, - = absent	129

Table 4. 5: Identified Minerals and phase obtained by XRD of pottery (Surface collection), +++ = very abundant, ++ = abundant, + = present, - = absent	130
Table 4. 6: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (MRK).....	132
Table 4. 7: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (BGI).....	133
Table 4. 8: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (SLG)	135
Table 4. 9: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (SKG).....	136
Table 4. 10: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (AKG)	137
Table 4. 11: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (KJM).....	138
Table 4. 12: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (MNG)	139
Table 4. 13: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (SBR)	140
Table 4. 14: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (CHR I)	141
Table 4. 15: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (MSK)	142
Table 4. 16: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (LPD)	142
Table 4. 17: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (SDM)	143
Table 4. 18: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (KLB).....	144
Table 4. 19: Sediment samples	151
Table 4. 20: Dry Sieve Analysis (BGI).....	152
Table 4. 21: Dry Sieve Analysis (MRK)	154
Table 4. 22: Dry Sieve analysis showing the percentage of Gravel and Sand in the soil.....	156
Table 4. 23: Percentage of Silt and Clay calculated using the hydrometer analysis.	157
Table 4. 24: Table showing the Gravel, Sand, Silt, and Clay fraction in soil samples.....	157

Table 4. 25: Identified Minerals and phase obtained by XRD of Soil samples, +++ = very abundant, ++ = abundant, + = present, - = absent	159
Table 4. 26: pH value of soil samples (MRK)	160
Table 4. 27: pH value of soil samples (BGI)	160
Table 4. 28: pH value of soil samples (SLG).....	161
Table 4. 29: pH value of soil samples (SKG)	161
Table 4. 30: Percentage of Calcium Carbonate in soil samples.....	163
Table 4. 31. Selected samples for AMS dating.....	166
Table 4. 32: AMS dating of Charcoal samples.....	167
Table 4. 33: AMS dating of Potsherd samples	167
Table 4. 34: AMS dating of Sediment samples	168



List of Plates

Plate 1. 1: Dense deposit of potsherd and sporadic occurrences of celts in Marakdola	218
Plate 1. 2: Massive sediment deposit in Bagibari village	219
Plate 1. 3 Agricultural land created by removing the upper layer of the terrace at the foothill of Silchang village	220
Plate 1. 4: Archaeological records reported from the agricultural land at Silchang	220
Plate 1. 5: District Resource Map of Kamrup district, Assam (source Geological Survey of India).....	221
Plate 1. 6: District Resource Map of Marigaon district, Assam (source Geological Survey of India).....	222
Plate 1. 7: District Resource Map of Karbi Anglong district, Assam (source Geological Survey of India)	223
Plate 1. 8: District Resource Map of Ri-Bhoi district, Meghalaya (source Geological Survey of India)	224
Plate 2. 1: Test pit at Marakdola village	225
Plate 2. 2: Charcoal sample at Marakdola test pit.....	225
Plate 2. 3: Megalith monuments at Chenimur village L1 (left) and Teteliguri village (right)	226
Plate 2. 4: Megalith monuments at Sukuripara village (left) and Barkuchi village (right) ...	226
Plate 2. 5: Dolmen (left) and menhirs (right) at Batakuchi village.....	227
Plate 2. 6: Megalith monuments at Taloni village (left) and Khamar village (right)	227
Plate 2. 7: Megalith monuments at Bogpur (left) and Tegheria (right)	228
Plate 2. 8: Megalith monuments at Dakhin Topatoli (left) and Diksak (right).....	228
Plate 2. 9: Scattered megalith monuments at Lymphuid village	229
Plate 2. 10: Megalith monuments at Kraikijam village	230
Plate 2. 11: Megaliths and potsherds reported from the Umswai region.....	231
Plate 3. 1: Illustration of stone celts from Bagibari (BGI) and Amkhang (AKG).....	232
Plate 3. 2: Illustration of stone celts from Marakdola (MRK) and Kraikijam (KJM)	233
Plate 3. 3: Illustration of stone celts from Shankargog (SKG), Shikdamakha (SDM), Kalbari (KLB), and Lymphuid (LPD)	234
Plate 3. 4: Illustration of stone celts from Silchang (SLG).....	235
Plate 3. 5: Stone celts reported from MRK, BGI, SDM, KJM, AKG, KLB, and LPD	236
Plate 3. 6: Stone celts reported from SLG and SKG.....	237

Plate 3. 7: Potsherd shape reconstruction from rim sherds	238
Plate 3. 8: Rim Stances type – Plain (A – sloping, B – vertical); Articulated (C – thickened internally, D – thickened externally, E – symmetrical thickening, F – inverted plain, G – everted plain); Everted (H); T-shaped (I); Horizontal rim stance (J); Horizontally and vertically flattened rim (K); and Incurving rim (L)	239
Plate 3. 9: Potsherd reported from Marakdola (MRK)	240
Plate 3. 10: Potsherd reported from Bagibari (BGI)	240
Plate 3. 11: Potsherd reported from Shankargog (SKG).....	241
Plate 3. 12: Potsherd reported from Silchang (SLG)	241
Plate 3. 13: Bolia, a tool made of clay to give shape to the pots and also used to make the surface smooth	242
Plate 3. 14: Miscellaneous Ceramics Objects	242
Plate 3. 15: Impressions on the potsherds	243
Plate 4. 1: XRD pattern of Stone Celt samples	244
Plate 4. 2: XRD pattern of MRKc1, 2, 3, 4, 5, and 6.....	245
Plate 4. 3: XRD pattern of BGlc1 to BGlc6	246
Plate 4. 4: XRD pattern of SLGc1 to SLGc6.....	247
Plate 4. 5: XRD pattern of SKGc1 to SKGc6.....	248
Plate 4. 6: XRD pattern of AKGc1 to AKGc3 and KJMc1 to KJMc3	249
Plate 4. 7: XRD pattern of MNGc1 to MNGc3 and SBRC1 to SBRC3.....	250
Plate 4. 8: XRD pattern of CHRlc1 to CHRlc3 and CHRllc1 to CHRllc3.....	251
Plate 4. 9: XRD pattern of MSKc1 to MSKc3 and LPDc1 to LPDc3.....	252
Plate 4. 10: XRD pattern of SDMc1 to SDMc3 and KLbc1 to KLbc3	253
Plate 4. 11: FTIR spectra of BGlc1 – BGlc6.....	254
Plate 4. 12: FTIR spectra of MRKc1 – MRKc6	255
Plate 4. 13: FTIR spectra of SLGc1 – SLGc6	256
Plate 4. 14: FTIR spectra of SKGc1 – SKGc6.....	257
Plate 4. 15: FTIR spectra of CHRlc1 – CHRlc3 and AKGc1 – AKGc3.....	258
Plate 4. 16: FTIR spectra of SBRC1 – SBRC3 and KJMc1 – KJMc3.....	259
Plate 4. 17: FTIR spectra of MNGc1 – MNGc3 and MSKc1 – MSKc3	260
Plate 4. 18: Grain size distribution curve of BGIs1 to BGIs3	261
Plate 4. 19: Grain size distribution curve of MRKs1 to MRKs4.....	262

Chapter – 1

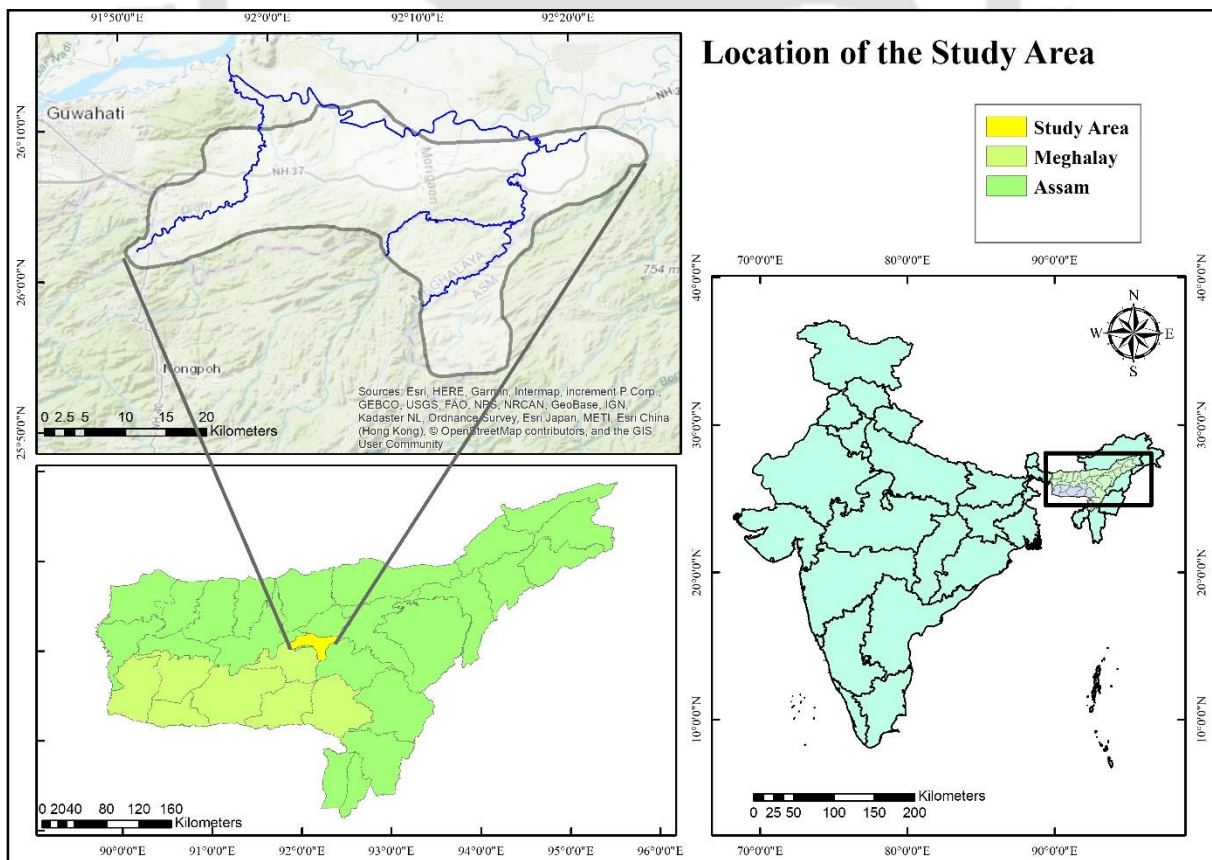
Introduction and Objective of the Research

This chapter introduces the present study by discussing the background and context, followed by the research aims, objectives, questions, and significance. The chapter is divided into three parts: the first part is the general introduction, which comprises the statement of purpose, research aim, objective, and methodology. The second part introduces the region and briefly provides background information about the river system, environmental setting, geology, geomorphology, flora, and fauna of the region. In contrast, the third part discusses previous research and locates the present study area in prehistoric archaeological study. Finally, the structure of the present study is highlighted.

Part I: General Introduction

1.1 Introduction

Map 1. 1: Location of the Study Area



The archaeological record of Digaru – Kolong river valley consists of stone tools, pottery, and standing or buried megaliths. Ground and polished celts, edge grounded, and chipped stone celts have been reported in large numbers from the study area. The sporadic occurrence or accidental discovery of stone celts among locals is common during cultivation, soil quarrying, and house construction. Celts have been reported from the rain gullies, eroded river terraces, hill slopes, cultivated land, and test pits. Similarly, potsherds have been reported widely from village roads, eroded surfaces, rain gullies, test pits, river terraces, and mounds. Megaliths have been reported in buried as well as standing conditions. These structures have been found both in abandoned conditions and as a living tradition.

The study area is a valley which lies between the North Cachar Hills in the Dima Hasao District of Assam and the Khasi Hills of Meghalaya. The first excavated Neolithic site of Northeast India, Daojali Hading, is in the Dima Hasao district. The eastern Asiatic Neolithic assemblage of Cord marked pottery and double-shouldered celt was reported from the site, besides other evidences like querns, tools made of jadeite, and fossil wood (Goswami & Sharma, 1963; Sharma T., 1967). In subsequent year a number of scholars have reported findings of the Neolithic tools and pottery from the area (Bora, 2012-13). The stone jar sites were also reported by J. P. Mills and J. H. Hutton in 1932 from the Dima Hasao district. Recent exploration and excavations in the area have led to the recovery of more sites and material evidence from the district (Thakuria T., 2019). The stone jar sites have also been reported from the east Jaintia Hills of Meghalaya. These stone jar sites are very close to the study area and have dated to 413-229 cal BC and 1442-1631 cal AD (Mitri, et al., 2022). From the sites of Khasi Hills, too similar evidences have been reported. The sites of Lawlongthroh and Myrkhan in Meghalaya have been dated to 2960 ± BP and 3500 ± 30 BP, respectively (Mitri, Kharmawphlang, & Syiemlieh, 2015). Finished and broken stone celts, flakes, potteries, iron fish hooks, and domesticated varieties of cereals have been reported from these sites. The study area is a valley situated between these two regions.

Digaru and Kolong are the two major rivers in the study area. They are tributaries of the Brahmaputra river. The region is between 26°0' N to 26°15' N latitudes and 91°50' E to 92°30' E longitudes, which comprises the part of Kamrup, Morigaon, Karbi Anglong districts of Assam, and Ri-Bhoi district of Meghalaya state (Map 1. 1). The study area is bordered by the North Cachar Hills and Khasi Hills from the east to south-east, the Shillong plateau and Jaintia Hills to the south, and the urban center of Guwahati and Brahmaputra River in the

north and north-west. A considerable part of the study area is flat with sporadic hills except for the southern boundary outlined by the Shillong plateau. Several rivers and water channels (seasonal and perennial) play a significant role in agriculture and livelihood. The flood plain has a massive amount of deposits resulting in the formation of river terraces, making it a potential area for human habitation. These river terraces have been the most attractive spots chosen by people for habitation as frequent finds of stray tools are reported from these terraces.

The archaeological reconnaissance survey and test pit excavation were conducted to collect the archaeological records from the study area. The present study has divided the study area into five regions: Jorabat – Sonapur, Dimoria – Khetri, Nelli – Jagiroad, Umswai in Assam, and Umsiang in Meghalaya. In this reconnaissance survey, we have identified and located nine sites and explored the other parts of the study area. This study is the first to report the archaeological sites of Bagibari, Shankargog, Silchang, Umswai, and Umsiang regions. Marakdola was reported earlier by S.N. Rao in 1973, and Bagibari was reported in the local press¹ after locals accidentally found stone celts.

Marakdola (26°4'3.52''N latitudes and 91°53'33.92''E longitudes) is located 28 km southwest of Guwahati city on the northern bank of the Digaru river. The Marakdola village is located on a mound at an elevation of 62 m above mean sea level. There are several seasonal water channels that cross the mound. Marakdola and Sarutaru are located one kilometer from each other (Rao, 1973); however, the excavated site of Sarutaru is untraceable today. A very dense deposit of potsherds has been reported from the cross-section at Marakdola village (Plate 1. 1). The thickness of the cross-section with potsherds varies from 1 to 1.5 meters. Potsherds have also been reported from the eroded surfaces, village roads, and slope of the mound. Stone celts have been reported from the cross-section by seasonal water channels, eroded surfaces, and river terraces in the area. The megaliths reported by Rao (1973) are in standing condition, and some are in buried condition. The village still erects megaliths in memory of the dead. The charcoal, sediment, and potsherd sample collected from the test pit have been dated using the AMS method. The earliest date of the charcoal sample collected at a depth of 60 cm from the test pit is 895-1021 CE (Sample ID IUACD#19C2849), whereas the sediment sample collected at a depth of 105 cm dated to 132-322 CE (Sample ID IUACD#21C3669),

¹ see Assam Tribune, 31st August 2015, Titled “*Tools belonging to New Stone Age discovered*”

and potsherd sample from the depth of 65 cm dated to 1031-1159 CE (Sample ID IUACD#21C3662).

Bagibari (26°11'24.23''N latitudes and 92°3'33.18''E longitudes) is located 10 km from Tetelia at NH37, and around 50 km from Guwahati city at an elevation of 60 m above mean sea level. The village is situated on a river terrace. The Kolong River flows from the northern side of the village. Water channels regularly cut the sporadic river terraces or mounds around the Bagibari region. The frequent floodwater annually deposit sediments (Plate 1. 2). Stone celts and potsherds are occasionally found by the villagers when they dig. The charcoal samples collected from 10 and 15 cm depth are dated to 976-1152 CE (Sample ID IUACD#19C2852) and 1031-1202 CE (Sample ID IUACD#19C2853), respectively, using the AMS dating method. The potsherd sample collected from the test pit at a 10 and 15 cm depth is dated to 1051-1249 CE (Sample ID IUACD#21C3660) and 777-980 CE (Sample ID IUACD#21C3661), respectively. The sediment sample from the depth of 25 and 30 cm are dated to 170-38 CE (Sample ID IUACD#21C3665) and 130-323 CE (Sample ID IUACD#21C3666), respectively.

Shankargog (26°7'12.92''N latitude and 92°4'40.06''E longitude) is located around 50 km east of Guwahati city near Dimoria College at an elevation of 57.08 m above mean sea level. The village is also located on a river terrace, and present settlements are on the mound. There are dense deposits of potsherds in a mound section in Shankargog village which does not look like an unconscious discard. According to the villagers, these deposits are because of the pot burial tradition practiced by the ancient or previous settlers of the village, who were Santhals. They had abandoned the village due to an epidemic. The potsherd sample at a depth of 45 cm from the test pit is dated to 1213-1273 CE (Sample ID IUACD#21C3663), and the sediment sample at a depth of 50 cm is dated to 1264-1388 CE (Sample ID IUACD#21C3667) using AMS dating method.

Silchang (26°7'19.12''N latitude and 92°21'1.90''E longitude) is situated 75 km eastward from Guwahati city in the Morigaon district of Assam at an elevation of 70 m above the mean sea level. The region is located at the foothill, and water channels cut through it and recycle the sediments annually. Artifacts move from their primary context or are exposed due to erosions. People have removed the upper layer of these terraces or mounds for various purposes, mainly for cultivation (Plate 1. 3). Archaeological records such as stone tools and potsherds are reported from the region. Stone celts have been reported from the cultivated

land, rain gullies at the slopes, and cross-sections on the river terraces (Plate 1. 4). Potsherds have been sporadically found on the slopes, terraces, and water channels. Megaliths have been found at the village entrance, and these structures were relocated from their original space and arranged in the present location. The potsherd sample at a depth of 15 cm from the test pit is dated to 1412-1449 CE (Sample ID IUACD#21C3664), and the sediment sample at a depth of 40 cm is dated to 560-649 CE (Sample ID IUACD#21C3668).

The Umsiang (Ri-bhoi) and Umswai (Karbi Anglong) region is located at a higher elevation than the rest of the study area. The maximum elevation of these regions goes 700 to 800 m above mean sea level. This region has abundant rock sources and seasonal and perennial water channels. Artifacts are mostly reported scattered around the slopes and rain gullies. However, we also report potshards sporadically. The temporary structures for cultivation and safeguarding the field from wild animals are constructed near the agricultural field. After some time, these structures are abandoned and recreated again in the different field seasons. Utilized or broken stone celts are principal findings in the agricultural field and slopes of this region.

Megalith monuments are scattered in different conditions and widespread all around the study area. The first type is the in situ structures such as the megalith site of Lymphuid, Kraikijam, and Diksak. These structures are in abandoned condition and covered with dense vegetation. Investigation suggests that these sites were once a place of cultural importance and then abandoned due to the migration of the inhabitants. The second type is the megalith sites in use and maintained. Present communities utilize these places and structures and still practice the megalith tradition. Megalith sites at Chenimur, Teteliguri, Batakuchi, Barkuchi, Taolni, Khamar, Bhogpur, Tegheria, Dakhin Topatoli, Bormorjong, Umsetri, Amsai, and Shikdamakha are now modified by the locals and rearranged in different shapes and styles.

Erecting memorial stones or Megaliths is still in continuity among Karbis of the study area with some changes and modifications. However, megaliths have also been reported from the Tiwa villages; but they do not associate these structures with their tradition. Due to the continuity of the megalith tradition, new structures are erected along with the ancient structures. The entire megalith at the Sukuripara site are recently erected monuments. The modified or rearranged megaliths are installed in the Silchang, Shikdamakha, and Bormorjong villages. Some of these sites are located at a higher elevation, whereas some are on slopes and river terraces. Potsherds are the common finds around the megalith sites.

The present study area of Digaru – Kolong river valley has never been a remote or untouched region. During the late prehistoric and early historical times, the study area was occupied by several sedentary village farming societies, and they were well exposed to the other neighboring region. The ethnoarchaeological result of this research enhances the geographical context and parallel existence of modern art, culture, and the Neolithic way of life. Local beliefs suggest that stone celts (commonly known as 'thunderstone') are recovered deep down from the earth. This further suggests that stone celts from these regions are not a product of recent phenomena. The occurrence of celts from depth indicates the geological context of these artifacts as a product associated with past societies. Several inscriptions and temple ruins within the study area are dated to the period of archaeological records of the present study, such as the temple and sculpture ruins of Nazirakhat at Sonapur (1100 CE), Hatisila rock inscription (10th century CE), and Rock inscription of Burha Mayong (12th century CE). Guwahati, around 40 km west of the study area, has evidence of urban settlement and life patterns, whereas people in the study area still lived using ground and polished tools.

1.2 Problem Orientation and Research Objective

1.2.1 Statement of Purpose

The potentiality of the area in "prehistoric archaeological remains"² is justified by the accidental finding of artifacts in and around the area, which is often reported in the local press. The present study area is between the two potential areas of archaeological research, North Cachar Hills and Khasi Hills. The Digaru – Kolong river valley region is adjacent to these areas and might be a continuous settlement zone during the same period.

Archaeological sites have been reported from the area before, but no proper documentation, exploration, or analysis of the archaeological records has been done. Locating buried archaeological sites in a tropical region with high rainfall is challenging. The landscape is dynamic, and the thick humus layer created by the dense vegetation further reduces surface visibility. Artifacts may be exposed after the rain in rain gullies (Butzer, 1982, p. 119) or in river terrains but in a secondary context. As a result, most of the sites in Northeast India are reported as surface sites with no information on stratigraphy and chronology. This situation

² Prehistoric archaeological remains in this context refer to archaeological artifacts like potshards, tools and other humanly made or modified objects.

had a prolonged effect on the archaeology of Northeast India. Due to heavy rainfall and slope instability, erosion and re-deposition of sediments are widespread in this area. Due to the erosion and deposition of the sedimentary matrix, artifacts move continuously, and mounds, almost replicating habitation mounds, form at regular intervals on the landscape, building a secondary context. This movement of geological deposits and unstable slopes further creates difficulty in tracing the site in the primary context. The present study is undertaken to identify the buried sites with the ground and polished stone tools and pottery in the Digaru – Kolong river valley.

1.2.2 Research Question

In the present study area, two sites (Sarutaru and Marakdola) were excavated earlier by S.N. Rao (1973); however, those studies were site-specific. A regional archaeological structure³ can provide a specific answer to the man-land relationship⁴ in the area (Sharma, 2007), which is the specific objective of this study.

The development of human society constantly changes the contents of the man-land relationship (Zhengdu, 2002). The man-land relationship helps us construct the past environment of the region and the nature of the landscape. This also reconstructs the life way of people and hints about their settlement and subsistence pattern and technology applied for the same. In general, we can say that it examines how people were using, transforming, or changing the landscape and resources for their living; and how landscape affects people's lifestyles.

The main research questions which were looked at during this work are as follow:

- Was the Digaru – Kolong river valley a continuous settlement zone between North Cachar Hills and Khasi Hills during the Neolithic period?

³ An individual site is not considered an independent entity but as part of whole larger complex, which is the region. Area-approach or regional approach is useful to provide the important data for interpreting the demography, social organization and land-use patterns. See Sharer and Ashmore 1979: 76; Paddayya 1985: 60; Binford 1982.

⁴ Man-land relationship in this study means how the land has been shaped, organized or used for various purposes such as settlement, subsistence, acquiring raw materials for tools and others, and agriculture by the prehistoric people or community in any region.

- Was the adaptability condition different in the area, as the sites in the Meghalaya plateau and Dima Hasao district are at a higher elevation, and the present area of study is a river valley?

1.2.3 Aim of the Research

Given the lack of systematic research regarding the archaeology of Digaru - Kolong river valley, this study will aim to identify and evaluate buried archaeological sites with the ground and polished stone tools and pottery in the region. Further, it will aim to understand the region's material culture, utilizing archaeological and ethnographical approaches.

1.2.4 Objective of the Research

The present work was undertaken in the specified study area with the following objectives:

1. The main objective of the present research was to find out the potentiality of the Digaru – Kolong river valley region in terms of archaeological research. The present study attempts to relocate the previously known sites in the region that are untraceable today.
2. Conducting an archaeological reconnaissance around the Digaru – Kolong river valley to understand the regional archaeological picture, geomorphology, geo-archaeology, and occurrences of typo-technological assemblages. With trial-trench excavation, the present study attempts to understand the stratigraphy, settlement pattern, and material culture of the Digaru – Kolong river valley.
3. The artifacts collected from different sites were analyzed through various methods to determine the nature of material culture. These artifacts were compared with the finding of earlier studies from the neighboring archaeological sites in order to trace their dialogical relation.
4. To understand the socio-cultural memory associated with the archaeological artifacts among locals.

1.2.5 Significance of the Study

The present study will contribute to the archaeology of Assam in particular and Northeast India in general. It will evaluate the dynamic landscape of the Digaru – Kolong river valley

and try to identify new archaeological sites and relocate the earlier known sites. The study of analytical and typological attributes of artifacts can enhance the technological, provenance, and chemical properties of the physical remains. The findings of this study will redound to understand the geomorphology and typo-technology of the archaeological records of the region. Settlement and subsistence patterns, period, and material culture during the past are the other significant highlights of the study.

This will help address the current hindrance of research in the area and lifestyle, socio-cultural, religious, and memory of the present communities inhabiting the region. As only two sites have been systematically excavated in the study area, our knowledge of the archaeology of the study area is based only on stray or accidental findings. Thus, the present study investigates and contributes to the existing knowledge on the archaeology, ethnography, and material culture of the Digaru – Kolong river valley.

1.3 Methodological Considerations

"... if theory covers the 'why' questions, method or methodology covers the 'how' questions. So, theory covers why we selected this site to dig, method how we dig it (Johnson, 2002, p. 2)."

The outline of the present study makes it abundantly clear that it focuses on both qualitative and quantitative data. Hence, the methodology employed in this work is based on primary and secondary data collection sources. In brief, this study followed multiple data-collection methods, systematic surface reconnaissance, scientific analysis of artifacts, content analysis of secondary literature, and relevant earlier works.

The methodology depends on the field or data type, as every field or region has unique and specific kinds of challenges. The primary method followed for the study was to carry out an Archaeological reconnaissance survey and collection of information from multiple sources for cross-verification of the data. A reconnaissance or surface survey is a non-destructive visual survey at ground level and encompasses field walking. Campton (1985, p. 4) has described the two primary purposes for the reconnaissance method, first, to make sure the area is suitable for the topic selected, and second to plan the fieldwork in light of time and funds available. He further said that geological maps should be taken to the field for more effective work. Before reconnaissance, data should be collected and organized from maps like topographical and physical.

Reconnaissance techniques are helpful to map out the evidence of human activity in the landscape and help find significant evidence needed to answer questions arising from the sites. It is a systematic method that attempts to locate, identify, and record the distribution of sites. It is primarily concerned with finding traces of unrecorded sites. It involves a systematic collection of artifacts from the soil that might indicate human settlement (Grant *et al.*, 2005, p. 5). A reconnaissance survey of the Digaru – Kolong river valley was made with the help of Open Series Maps (OSM)⁵ prepared by Survey of India and Google earth. The region bounded by and around both rivers was chosen for study. A drainage map of the study area was prepared with the help of the OSM map, and a systematic survey involving walking across the landscape and localities was identified. For the primary source of information, ethnographic methods were employed by several approaches, such as observation and informal interviews. The ethnographic approach offered significant data regarding the socio-cultural aspects of the ethnic communities inhabiting the study area.

Literature review and study includes massive employment of secondary sources, which have been collected in the form of books, articles in journals, and various other published and unpublished works (reports and thesis) relevant to the study. Geological and geomorphological reports of Assam and Meghalaya states were consulted through the official website of the Geological Survey of India. News articles about archaeological findings related to the present area were investigated. Several maps such as topographical, drainage, physical, and geological available in offline and online formats of the study region were studied. The State Museum of Guwahati and other local museums around the area were visited during the field survey, which helped to understand the regional variation and classification of artifacts.

Other than archaeological reconnaissance and ethnography as a primary source of data collection and literature work for secondary sources, various other methods or techniques were employed in this work to achieve the goal and objective of the present research work. Laboratory work or scientific analysis was employed, such as geophysical and geochemical analysis, to understand the properties of soil, sediments, artifacts, and human activity inland. Quantitative analysis helps to understand the pattern in technology or material culture. Various artifacts have been recovered from the ground reconnaissance and test pit

⁵ These are prepared on 1:250,000; 1: 50,000 and 1: 25,000 scales for the use of general public/civilians for supporting development activities in the country. Technically maps of this series are based on WGS-84 Datum (The World Geodetic System 1984 (WGS84) is a datum featuring coordinates that change with time) and UTM Projection (Universal Transverse Mercator).

excavations. Different methodological tools for scientific analysis have been applied to various materials such as lithic, ceramics, and sediments.

The analysis of morphological attributes of the artifacts involves several typo-technological trends such as artifacts' measurements, colour, shape, texture, and decoration. Laboratory investigation or scientific analysis involves the artifacts' chronology, mineralogical, and chemical properties. The Powder XRD, FTIR, and Thin Section Petrography have been used to determine the mineralogical composition of the artifacts. The FTIR and XRD data further help to determine the firing technology and temperature range of the potteries. The particle size of sediment samples was determined by Dry Sieving and Hydrometer techniques. Sediment samples were analyzed for acidity or alkaline nature and amount of Calcium Carbonate present by Universal Indicator paper and Rapid Titration method, respectively.

Accelerator Mass Spectrometry (AMS) method has been employed to determine the chronology or date of the region by potsherd, sediment, and charcoal samples. Further, detailed descriptions of these methods are mentioned in the respective chapters.

Part II: Ecological Perspective

Environmental factors such as landscape pattern, climate, vegetation, and lithology⁶ of any region play a crucial role in understanding the development of any past settlement. It directly or indirectly affects the settlement pattern, subsistence pattern, and technology. The landscape features (such as a hill, foothill, flood plains, and valley), drainage patterns or rivers, and geomorphology help understand past settlements. Therefore, it is crucial to study the regional, geographical, and physical features while dealing prehistory of any region (Subba Rao, 1958, p. 8). Entire Northeast India is geographically divided into three regions – the plateau, the hills and mountains, and the alluvial plains (Taher, 2004). The mainland of India is connected with the Northeastern part of India through a 21-kilometer-long narrow corridor (known as Chicken's Neck) in West Bengal.

Taher and Ahmed (2010) have described the basic physiographic units of Northeast India into the stable crystalline massif of the Meghalaya-Karbi Plateau, the folded Tertiary hills and mountains of Sikkim, the Arunachal Himalaya, and Tripura, and a part of the Indo-Gangetic-Brahmaputra Plain (Taher and Ahmed, 2010, p. 15). The plateau region of Northeast India is

⁶ Study of physical characteristics of rocks

a geological extension of the Deccan Plateau. The hills and mountains are about sixty percent of Northeast India's total area. The plain region of the Northeast region is divided into four main parts, the Brahmaputra Plain, the Barak Plain, the Manipur Plain, and the Tripura Plain (Deka, 2015, pp. 24-28).

Steep, elongated hills occupy a significant portion of the present study area, and the rest is either a cultivable, alluvial or low-lying, marshy area. National Highway number 37 runs through the middle of the study area and divides the region roughly into two parts. The Northern side of the study area (North of NH 37) is part of the Brahmaputra Plain, and the southern part is the Meghalaya Plateau.

1.4 Geomorphology and Drainage Systems

The drainage system is an essential geological process in shaping surficial features on the landmass. The physical changes in landscape produced by streams and running water are known as fluvial processes (Agrawal, 1994, p. 132). Saikia (2021, p. 1) described the fluvial system as an amalgamation of the physical environment, such as hill slopes, stream networks, biological environments, and river channels.

"As the water flows through the stream channels, the dynamics of processes between water and sediment and geology and hydrology of the landscape develops a complex network of processes. Therefore, the drainage basin is a fundamental unit because of its functional significance of fluvial processes and analysis of form-form and form-process relationship (Saikia, 2021, p. 1)".

There are six river basins in Northeast India: Brahmaputra River, Barak River, Manipur River, Kaladyne River, Karnafuli River, and Tizu river basin. Brahmaputra river basin in Arunachal Pradesh, Assam, Nagaland, and Meghalaya covers an area of about 1,89,000 sq. Km. (Saikia, 2021, p. 1-9). The study area has different undulating terrain and small streams and rivulets. The study region is covered by two main rivers, Digaru and Kolong, which are the main tributaries of the Brahmaputra River within the study area. The drainage system of the Digaru – Kolong river valley is dendritic in nature (**Map 1. 2**). The Brahmaputra is the main river that flows along the extensive northern boundary of the present study area. All the drainage of important rivers or streams of the area finds its way into the Brahmaputra River. Several other rivers and streams join or flow around this region, including Kopili, Umsiang, Killing, and Umiam.

The Brahmaputra is the most significant river of Assam and one of the world's longest rivers, traversing a total length of about 2880 km. The river flows through three countries, Tibet (China) and India, entering Bangladesh as Jamuna and ending as Meghna before entering the Bay of Bengal. In North-East India, it flows through Arunachal Pradesh and Assam. The catchment area of the Brahmaputra has a significant impact on the region's lifestyle. It has several tributaries within the study area. Some of the essential rivers which drain the region are discussed below:

The Digaru River originates in the Khasi Hills (Meghalaya), bordering Assam. It flows towards the Northeast from its original source before meeting the Kolong River in the Kamrup Metropolitan district of Assam. It is called Umtru in Meghalaya, but it takes the name of Digaru when it enters Assam. B.C. Allen (1905) traced the course of the Digaru River in Assam District Gazetteers, Kamrup in the following words:

"The Digaru enters the district [Kamrup] at Barnihat, where the Shillong – Gauhati road crosses it on a large bridge, flows a north-easterly course to Sonapur, and then turns north to fall into the Kalang, a short distance below the confluence of that river with the Brahmaputra. It is navigable by a boat of four tons burthen as far as Barnihat at all seasons of the year and affords an outlet of the cotton grown in the lower hills (Allen, 1905, p. 8)".

Dighalpani stream Umtrew in Meghalaya is the primary source of the Digaru River. Many streams and streams-lets flow through the valleys, between the hills ranges. Most streamlets are ephemeral or seasonal and remain dry during the winter season. During the monsoonal rain, these streams become overflowed. Three significant dams are constructed across the river: Umtru Dam, Nongkhylllem Dam, and Kyrdemkulai Dam in the Ri Bhoi District of Meghalaya.

The Kolong River is an important river in the study area and plays an essential role in the region's drainage system. The Kolong River is a tributary of the Brahmaputra River, is about 250km long, and flows through the districts of Nagaon, Morigaon, and Kamrup. It rises in the Karbi Anglong due to the Brahmaputra River's southward migration and becomes a by-channel. Before meeting the Brahmaputra, it merges with several smaller streams, including Digaru. The Kolong river grows as it receives water from the numerous rivulets and approaches the Morigaon district area. The Kolong River takes off from the Brahmaputra in the Hatimura region of Jagibhakatgaon and flows towards the southwest to meet the river Kopili near Chaparmukh Gaon. The main tributaries joining Kolong river before meeting

with Kopili are Misa, Dizu, and Haria. The combined channel of Kolong and Kopili re-join the Brahmaputra parent river at Kajalimukh, about 24 km from Guwahati (Sarma, 2007).

Before meeting with the Brahmaputra, the combined river channel of Kolong and Kopili meets the Digaru River near the Chandrapur of Kamrup (Metro) district. This river is navigable throughout its course in the region.

The Kopili River is another important river entering the study area after meeting with the Kolong River. The Kolong River is a south-bank tributary of the Brahmaputra River and originates from the Barail Range Mountains near the sherpai peak in North Cachar Hills. Kopili River meets the Kolong River at almost the middle of its course and empties into the Brahmaputra River. The river's upper course defines the district boundary of the Jayantia and North Cachar Hills districts of Meghalaya and Assam, respectively, and covers a distance of 290 kilometers from its source. After that, it meets the Kolong River at Hatiamukh or Hatimura near Jagibhakatgaon. Saikia (2021) describes the combined channel of the Kolong and Kopili rivers in the following words:

"Although the outfall reach of the Kopili River is named as Kolong, geomorphologically, the Kopili River beyond the confluence with Kolong at Hathiamukh is Kopili River (Saikia, 2021, p. 21)".

The combined channel of Kopilli and Kolong River receives the water from the Killing River near Dharmatul (Noabill) within the study area. The Kopili River is fed by several major tributaries, such as at the left bank, Myntang, Kharkar, Wah Umium, and Barapani, and right bank tributaries Diyung and Jamiuna. Besides the Diyung River, which emerges from the tertiary hill ranges of North Cachar Hills, most of the other tributaries of the Kopili river originate from the Shillong plateau and are regulated by the underlying rock structures (Sharma, 2019, pp. 186-88; Saikia, 2021, pp. 20-24).

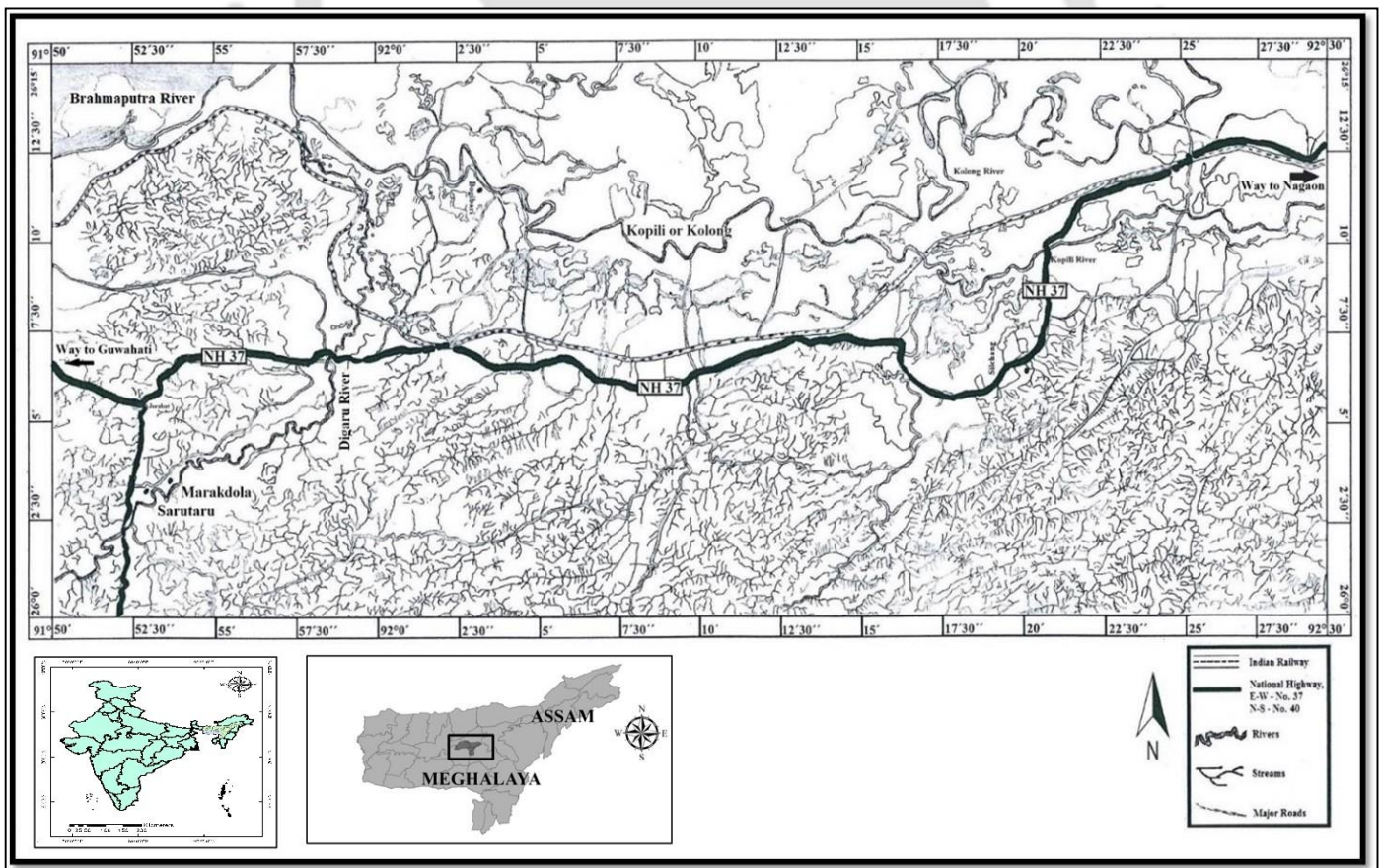
The Wah Umium or Umsiang River rises from the Shillong plateau and is one of the study area's significant rivers flowing south to eastward. The Umsiang River passes over several deep gorges, rapids, waterfalls, hills, and valleys. Umsiang River then reaches the plains (near the boundary between Meghalaya and Karbi Anglong District boundary) before joining the Umiam River. The Umsiang River meets the Umiam near Amjong village in the Ri-Bhoi district of Meghalaya. **The Umaim River** is another significant river that emerges from Umiam Lake. It travels through a long hilly tract, rises a little to the north of Maoflang, and

flows in a deep gorge and the plateau of Shillong. There are several tributaries of Umiam, such as: Um Shiprah, Um Lator, Um Sader, Um Swat, Um Bi, Um Siang, and Um Rangaw. It takes an eastward course after crossing the Guwahati road near Barapani (Allen, 1906, pp. 5-6). It joins the Umsiang at its final point of the basin (Agarwal, 1994, p. 9).

Before entering the plains of Assam as the Killing River, both the river travels the hilly tract and slopes of the Khasi hill range. **The Killing River** is the combined channel of the Umiam and Umsiang rivers and one of the major tributaries of the Kolong-Kopili River. The combined channel of both rivers (Umiam and Umsiang) joins the Kopili and Kolong rivers' combined channel in the Morigaon district of Assam.

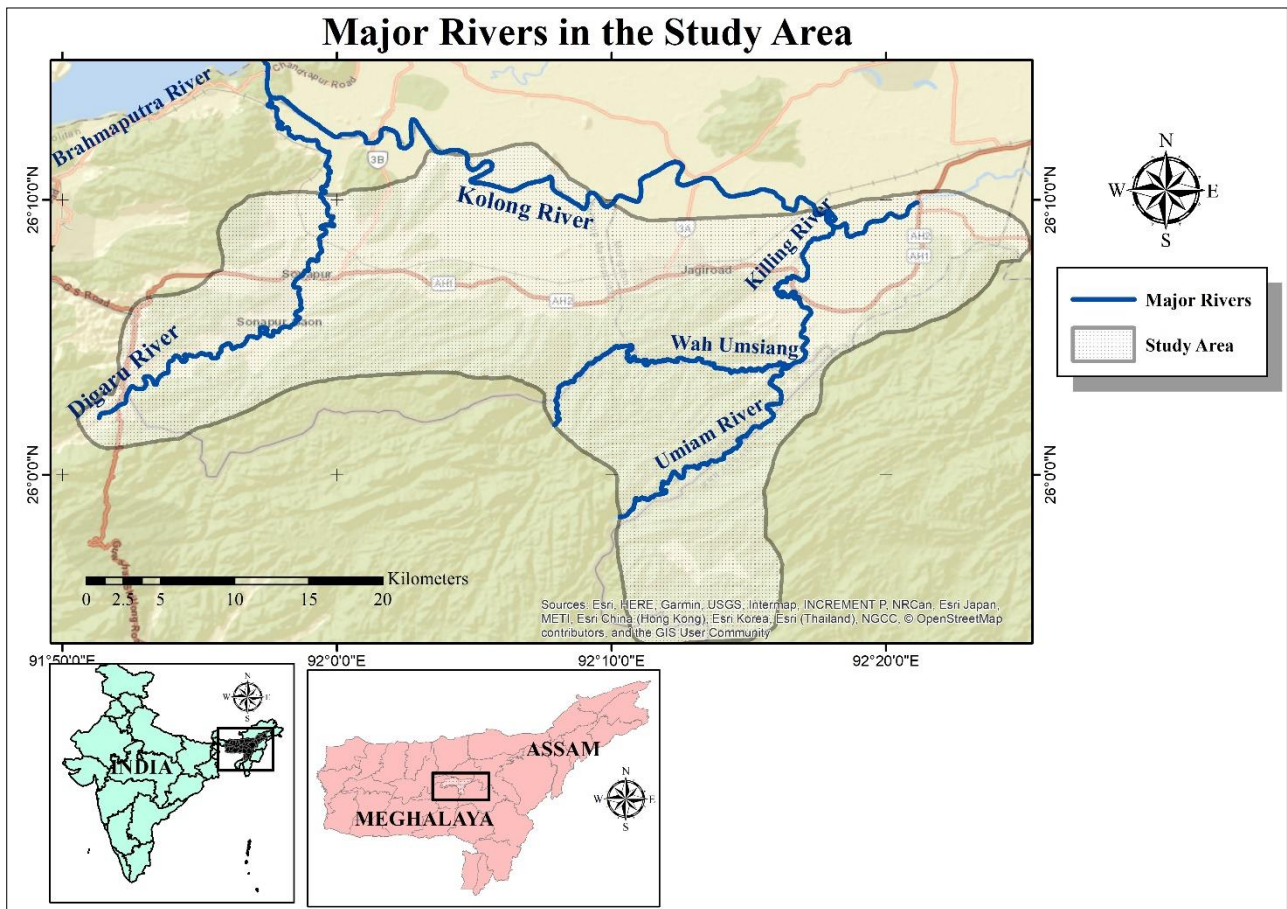
In addition to the Kolong, Kopili, and Digaru, there are several other essential tributaries, channels, and streams locally known as '*jans*' and '*juries*.' The Kolong, Kopili, Umiam, Umsiang, Killing, and Digaru are perennial rivers; besides, several beels⁷, streams, and marshy land are scattered throughout the region, which is seasonal.

Map 1. 2: Hand-drawn drainage map of the study area (based on Survey of India)



⁷ A beel is a lake-like wetland with static water. It formed by the inundation of low-lying lands during flooding, where some water gets trapped even after flood waters recede back from the floodplains.

Map 1. 3: Major Rivers in the Study Area



1.5 Climate

The present study area consists of part of the Assam and Meghalaya states. It is located under the tropical monsoon. The southwest tropical monsoon, active from April to October, significantly influences Assam and the entire study area. Kamrup district has foggy and cold winter, a temperate and humid summer, and a moderately cool spring, similar to central Assam. Average annual rainfall in the study area (Kamrup, Morigaon, and Karbi Anglong) ranges between 1500 mm to 2600 mm, with an average humidity of 76%. The average temperature of the region varies from 4°C to 19°C during winters and 26°C to 39°C with high humidity during summers. The air is humid throughout the year (Government of Assam, official website).

The Meghalaya state has a temperate climate, and the South-west Monsoon influences it with the northeast winter wind. Between April and May, the arrival of the monsoon is frequently indicated by high wind, gloomy skies, thundershowers, occasional hailstorms, and, on rare

occasions, cyclones. Although the study area's climate is similar throughout the region, some variations are noticed due to the uneven landscape or topography with hills and low-lying regions. The bordering part of Ri Bhoi with Assam has a tropical climate, and the climate of the region adjoining the East Khasi Hills is temperate. The average annual temperature in the Ri Bhoi district is around 22°C, and the average rainfall of about 3200 mm. The temperature of the warmest month, that is, August, is 25°C to 26°C. January is the coldest, with an average temperature of 15°C (Bezaruah, 2003; GSI, 2009; Duarah, 2014; Deka, 2015).

1.6 Geology

Northeast India's geology is characterized by a diverse range of rock formations dating from the Archaean to the recent. The area under study forms the northern part of the Meghalaya Plateau, comprising a series of steeply rising hills with narrow valleys and Brahmaputra plains of the southern part of Assam with isolated hillocks and terraces.

There are three geological structure units of Assam. Karbi Anglong plateau is the structural core of the region that is the extension of the Shillong plateau. The tertiary depositional zone is the second structural unit, the folded hills of the North Cachar Hills district with Barail Range. The alluvium depositional plains of the Brahmaputra valley and Barak Valley are the third structural unit (GSI, 2009; Directorate of Geology & Mining, Govt. of Assam). The area under study is a part of the northern extension of the 'Shillong Plateau' that falls in the state of Meghalaya. Shillong Plateau is a north-eastern continuation of the Indian Peninsula. Precambrian gneiss and granite constitute a substantial portion of the Shillong Plateau, and in the Brahmaputra valley, these rocks are covered by alluvium (Maswood, 1973, pp. 12-13).

"The Kamrup district of Assam and adjacent areas of Khasi Hills district of Meghalaya form part of the Archean Gneissic complex and the Precambrian Shillong group, which possibly extends towards north under the north a vast stretch of alluvium of Brahmaputra river. The Archean gneisses include quartz, biotite gneiss, and migmatites with bands of amphibolites, hornblende gneiss, banded magnetite quartzite, mica schist that are traversed by granitic intrusives and younger basic dykes, and quartz Pegmatites veins. The general foliation in gneisses shows North Easterly strike and North-Westerly dips (GSI Field Report 1984-85)".

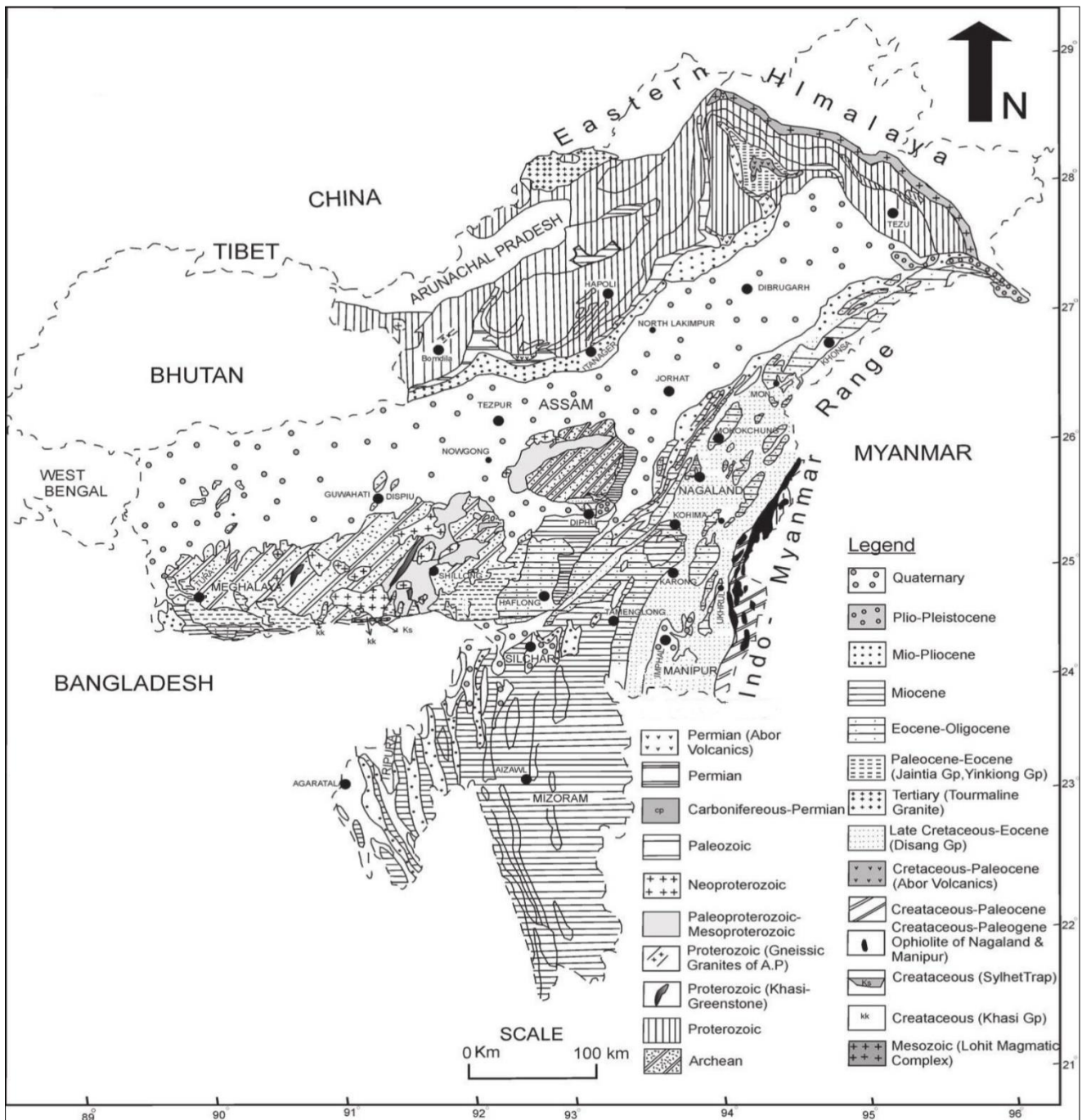
Dutta (2002) reviewed several previous works and summarised the geology of Kamrup and the nearby Plateau region in the following words:

"The Plateau [Kamrup and northern part of Meghalaya plateau] is constituted dominantly by gneisses and schist which acts as the basement and overlain by metasedimentary and metavolcanic cover rocks of Shillong Group of Mesoproterozoic age dominantly confined within Meghalaya and partly exposed in Karbi Anglong district of Assam. Both basement and cover rocks are intruded by a large number of Neoproterozoic porphyritic granite plutons. Hence the basement gneisses and schist either may represent Paleoproterozoic or Archaean in age, but not a single radiometric data is available from the basement of the Plateau. The present area is exclusively confined within the gneissic basement complex". (Dutta, 2002, pp. 12-14)

The northern part of the Morigaon district is mainly covered by recent alluvium formed by the Brahmaputra and its tributaries. The Pre-Cambrian rocks consisting of gneisses and granites are primarily exposed in the elevated regions to the west, south-west, and southern part of the Morigaon district, which are the continuation of the Shillong Plateau. The Kamrup district of Assam and the adjacent area of Meghalaya hills form a part of the Archaean Gneissic complex and the Precambrian Shillong Group. The Regional Geological set described in the field report Geological Survey of India (1984-85) is as follows:

<i>Quaternary</i>		<i>Newer Alluvium</i> <i>Older Alluvium</i>
		-----Unconformity-----
		<i>Tertiary</i> <i>Sediments</i>
		-----Unconformity-----
<i>Jurassic (p)</i>	<i>Sylhet</i>	<i>Trap</i>
		-----Unconformity-----
<i>Pre-Cambrian</i>		<i>Intrusives (Acid and Basic)</i> <i>Micaceous Quartzites with minor</i> <i>phyllite bands</i>
		-----Unconformity-----
<i>Archaean</i>		<i>Gneissic Complex Comprising Biotite Gneiss</i> <i>Biotite hornblende, Gneiss, Granite Gneiss</i> <i>Migmatite Mica Schist, Sillimanite-quartz</i> <i>Schist, Biotite Granulite-Amphibolite,</i> <i>Pyroxene-Granulite etc.</i>

Figure 1. 1: Geological map of Northeast India (after Government of India, 1998)



The striking element in the physical landscape of Digaru – Kolong river valley is the dichotomy between the plains and the hills. It includes alluvial plains as well as the foothills, which extend up to the Meghalaya plateau. The vast alluvial plains of Brahmaputra valley are the eastern continuity of the Indo-Gangetic plain of North India, while the foothills of the Meghalaya Plateau represent the peninsular rock masses in the study area (GSI Assam, 2009; Gupta and Biswas, 2000). The plains are spread extensively over Kamrup, Morigaon, and

Nagaon districts in Assam. In contrast, the hilly or foothill regions broadly fall within the Ri-Bhoi district of Meghalaya and overlap with a few areas in Morigaon and Nagaon as well.

1.7 Soil and Vegetation

Soil has a crucial place in archaeological studies. It helps to reconstruct the past vegetation and nature of the soil that helps to understand the drainage, land use pattern, and fertility of the region. Soil comprises natural minerals and organic materials that have evolved from parent materials via physical and chemical weathering and decayed organic materials (Saikia, 2021). Hazarika (2017, p. 32) has characterized the nature of the soil in Northeast India as averagely acidic. Various rock formations in the study area and nearby region have been subjected to soil-forming processes via weathering and transportation over geological time. The soil of Northeast India is mainly grouped into Alluvial soil, Red soil, Laterite Soil, and Mountain soil (Deka, 2015, p. 34). Alluvial soils include both transported and residual soils that have been modified by water.

The new alluvial soil is significantly found in the flood-affected areas along the Brahmaputra and its tributaries. These soils are deposited by the river Brahmaputra and its tributaries. The area of study consists of the southern part of the Brahmaputra plains. The texture of the upper layer of the new alluvial deposit is generally sandy loam and sandy to loamy sand in the lowermost layers. The old alluvial soil type varies from sandy loam, loam-silty clay to silty clay and is mainly found in the Dibrugarh, Sibsagar, Jorhat, and Nagaon. The mountain or hilly soil is compact and derived from the transported alluvial materials in the hill slopes. This soil contains pebbles, cobbles, and boulders along with sand and silt. It is confined to higher altitude regions such as Kamrup, Morigaon, Ri Bhoi, Karbi Anglong, and North Cachar regions. Red soil is mainly found on the hill slopes and higher elevated regions adjoining foothills such as in Jorhat, Golaghat, Karbi-Anglong, and the North Cachar Hill district of Assam. In Meghalaya, red soils are widespread, except in the low-lying region. Red soils are considered suitable for crops due to humus and nitrogenous materials. The Laterite soil is found on the hilltops of North Cachar Hills and the Karbi Anglong district of Assam. It has extensive patches over the sandstone deposited in the Cherrapunji region of Meghalaya. It becomes sticky, hard, and red in dried conditions (Duarah, 2014; Deka, 2015).

The physical environment influences the natural vegetation and soil, interconnected dynamic complexes (Saikia, 2021). Northeast India is rich in natural resources in forests, minerals, and

several species of birds, mammals, amphibians, and birds. Forests are a precious part of the daily living of locals in the region, and a large amount of food and other household resources are procured from them. The natural vegetation of Northeast India can be divided into the following major groups: Evergreen and Semi-evergreen Forest, Mixed Deciduous Forest, Sal Forests, and Bamboo Forests. The region's unique landscape includes a range of thick forests with several tree varieties, bamboos, cane groves, grasses, and herbaceous, shrubby vegetation.

"In the region, different varieties of deciduous and evergreen timber producing trees flourish like Sal (Shorea robusta), Makai (Shorea assamica), Nageshwara (Mesut ferrea), Tiachapa (Micheelia champaka), Sonaru (Classia fistula), Gunsarai (Chinamonum glanduliferum), Ajhar (Lager straemiaflos regina), Agar (Aquilaria agalocha), Hollock (Terminalia bicolorata), Hollong (Diptercarpus bondii), Simul (Bombak malabaricum), Khair (Accacia cateshu), etc. The forests also shelter various types of parasites, epiphytes, and orchids (GSI, 2009, p. 2)".

The entire foothill and hill of the study area are covered with dense forests. Jhum cultivation in the hills and slopes is very predominant by the local inhabitants. The jhum cultivation is mainly used to cultivate chili, beans, gourd, different types of roots, and tubes. Individual occupations mainly cultivate betel nuts, pineapples, bananas, and oranges. Two types of forest are covered in the southern foothill of the study area, i.e., reserved and unclassified (Duarah, 2014, p. 50). The woods and entire foothills of the region shelter varieties of fauna such as wild pigs, deer, rabbits, mongooses, squirrels, porcupines, monkeys, and various reptiles. Wild elephants are very predominant in the hilly terrain of the study area. The reports of the devastation caused by elephants in the hilly regions are often in Silchang village, the southern part of Kamrup district, and the Umswai and Umsiang region.

1.8 Ethnic communities

Northeast India is an abode of multiple ethnicities consisting of different tribal groups, several religions, diverse languages, and customs and practices. The Northeastern region of India is a heterogeneous cultural tapestry that represents a multi-ethnic culture, rich heritage, and tradition of multiple linguistic, racial and religious streams. There are hundreds of tribal groups inhabiting the region with diverse languages, rituals, religious beliefs, and cultural practices. However, the region witnessed immigration from different parts of the country at several intervals of times and even in recent days.

The present study area is inhabited by several aboriginal ethnic communities such as Assamese, Hindu and Muslims, Karbis, Tiwas, Bodos, Bengalis, and Rabhas. Among several communities and tribal populations, Assamese, Karbi, and Tiwa are the predominant in the region. According to the Census of 2011, the total population of Assam is 31,205,576, of which 15,939,443 are male and 15,266,133 are female. The Hindu population accounts for 61.5 percent, Muslims 34.22 percent, the Christian community 3.7 percent, and the rest belong to other faith or communities. The total population of the Meghalaya state as per Census 2011 is 2,966,889, of which 1,491,832 are male and 1,475,057 are female. The Hindu population accounts for 11.53 percent, Muslims 4.40 percent, the Christian community 74.59 percent, and the rest belong to other faith or communities (Census of India, www.censusindia.gov.in).

Figure 1. 2: Assam Population by Religion

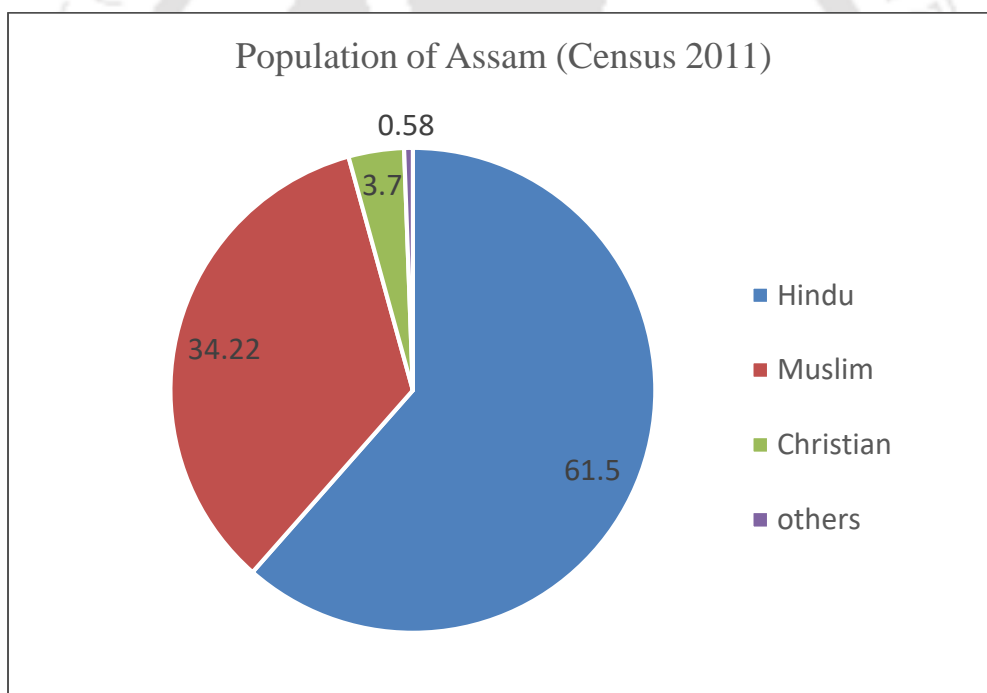


Figure 1. 3: Meghalaya Population by Religion

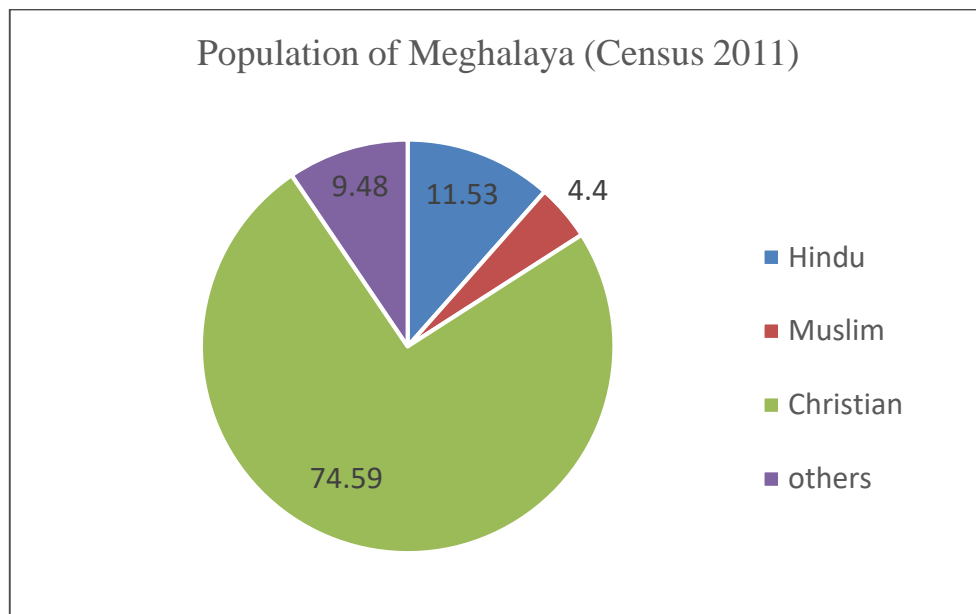


Table 1. 1: Population distributions in the study area (source Sub-District Level, Census of India 2011)

S.No.	District	Total Population
1	Kamrup Metropolitan	1,253,938
2	Morigaon	957,423
3	Karbi Anglong	956,313
4	Ri Bhoi	258,840

Table 1. 2: Major Languages spoken in Assam and Meghalaya (source Language and Mother Tongue, Census of India 2011)

Assam		Meghalaya	
Languages	Numbers	Languages	Numbers
Assamese	15,095,797	Khasi	1,382,278
Bengali	9,024,324	Garo	936,496
Hindi	2,101,435	Bengali	232,525
Mising	619,197	Hindi	62,905
Nepali	596,210	Nepali	54,716
Karbi	511,732	Assamese	39,628
Odia	218,552	Koch	23,199
Santali	213,139	Rabha	21,671
Garo	172,520	Marathi	20,751
Manipuri	168,133	Karbi	14,380
Dimasa	131,474	Punjabi	4,540
Rabha	101,752	Mizo	4,455
Kurrukh/Oraon	73,437	Manipuri	4,451

The Karbi tribe is an important ethnic group of Assam and displays a cultural dichotomy of different nature. They are primarily distributed in plain and hills and called 'Mikirs' by their neighbors. In the hills, they primarily inhabit Karbi Anglong district (Assam) and Meghalaya, and others in the plains on the southern bank of Brahmaputra in Golaghat, Nagaon, Morigaon, and Kamrup districts of Assam. The Karbis did not have their own script, and hence they have no written record of their origin and migration. However, compared to Tiwas, much plain Karbi speak the Karbi language (Bezaruah, 2003; Choudhury, 2004; Ramirez, 2014).

Tiwas are another important ethnic group of this region and are called 'Lalungs' by their neighbors. Tiwa tribe constitutes the dominant population in the Assam – Meghalaya borderland, speaking a Tibeto-Burman dialect (Tiwa) of the *Bodo-Garo* group. In the native language of Tiwas, 'Ti' means 'water' and 'Wa' means 'great.' The history of their origin is a mystery, with several different theories. Among several theories, it is believed that they followed the course of the Brahmaputra river and settled in the plains and hills. The Karbis called them 'Lalungs' ('La' means water and 'lung' means rescued). They are primarily inhabited in the Nagaon, Morigaon, and Karbi Anglong districts. Besides these, few are settled in the Sonitpur, Dhemaji, Jorhat, and Kamrup districts of Assam and the northern side of the Ri Bhoi district of Meghalaya. Tiwas are settled in the plains as well on hills. The majority of hill Tiwas have become Christian, while the rest follow indigenous religion. The Tiwas from the plains do not speak the Tiwa language. They mostly follow Assamese Hinduism. The Tiwas from the plains claim to have come from the hills, but most are unsure of the exact place. There is a tremendous cultural dichotomy between the hill Tiwas and Plain Tiwas in acculturation to the Assamese-dominated culture. Further, the detailed ethnographical observation of the Karbis and Tiwas has been mentioned in Chapters II and V.

Part III: Previous Work

1.9 Understanding the Neolithic Culture in the Indian Subcontinent

John Lubbock coined the term 'Neolithic' in his book titled *Prehistoric Times* in 1865, and it is the youngest period of the Stone Age. The Neolithic period is considered significant in human history in which humans became sedentary and changed the economy caused by a man getting land tilled (Bhattacharya, 1991, pp. 181-182). It represents the transformation from a food gathering or hunting-gathering economy to an agro-pastoral economy. The rise and development of agricultural work did not result from a growing transitory deficit. People suffering from the horrors of famine and living in the dark shadow of deprivation would not have had the means and time to do slow experiments and tests like agricultural work. This must have been done by people living well above the limits of essential needs. Neolithic celts evolved during this period to meet the new subsistence strategies. This period can be understood as a self-sustaining economy, a permanent settlement with a material culture from which pottery is available with a set of polished stone tools or stone celts without pottery. Since the first report of Neolith by Le Mesurier in the Tons valley in the Allahabad region, various neoliths have been collected from all parts of India. Afterward, Neoliths have been reported from various parts of Bundelkhand, Southern and Eastern India. Robert Bruce Foote indicated the association of the Ash-mounds of South India with Neolithic culture. Several works have been conducted in different parts of India, resulting in the discovery of many Neolithic sites.

V. D. Krishnaswami (1962) has divided the Indian Neolithic culture into four geographical zones: (a) The Northern zone comprises the only known sites from Kashmir, then called Burzahom, (b) The Eastern zone was classified based on surface collection from Bihar, West Bengal, Orissa, and Assam, (c) Central and Western zone consist of the Malwa region and northern Maharashtra, and (d) Southern zone comprising the Brahmagiri, Sangankallu, Pilkihal and other known sites in this zone. In 1964, B.K Thapar divided the Neolithic culture of India into three areas based on the available evidence, viz., Northern, Southern, and Eastern. Allchin (1968) studied the available Neolithic pieces of evidence from India and divided them into five zones or groups, viz., (a) Northern group: Kashmir valley; (b) Southern group: the area south of Godawari; (c) Eastern group: area of Assam; (d) Central group: plateau area lying south of Ganga; and (e) Mid-eastern group: Bihar, Orissa and hilly areas of Chotanagpur region. Later in 1978, Thaper revised the cultural division by Allchin

and included one more group as the North-Western group comprising the Indo-Pak subcontinent covering Baluchistan, Swat, and Sindh areas in Pakistan

Ramchandran (1980) classified the Indian Neolithic into three zones and stated that:

"The primary trait of the Neolithic culture is the practice of agriculture and stock raising. Other concomitant traits are the use of polished and smoothed stone tools and the manufacture of pottery; the last is not an essential feature yet forms a contributing factor. Absence of metal in an archaeological context is a prerequisite. In India, three Neolithic culture-zones viz, the north-western, southern, and the eastern have been recognized."

The North-Western zone comprises the site in Kashmir (Burzahom); the Eastern zone has been divided into two subgroups: Bengal, Bihar, Orissa, and Assam are the second group. The Southern zone encompasses the Deccan, Karnatak, and part of the neighboring region (Ramchandra, 1980, pp. 1-16). The earliest carbon date for the Neolithic period from the Indian subcontinent goes back to 10000 B.C. from the Aq Kupruk-II in northern Afghanistan. However, Neolithic culture in the Indian mainland was considered 7000-5000 B.C, near the Indus. Initially, it was thought that Neolithic culture did not evolve before 4000 B.C. in other parts of the subcontinent until the dates from the Lahuradewa site (Uttar Pradesh) came to light. The rice grains from the Lahuradewa sites date back to 6409 B.C., making it one of the earliest sites of rice domestication (Tewari *et al.*, 2006). The aceramic culture in Burzahom in the Kashmir valley presents the earliest sign of Neolithic settlement in the northernmost part of India at around 2800-2500 B.C.

1.10 The Neolithic Culture of Northeast India: a brief review

Northeast India is a potential region for archaeological research due to its physical and ecological location and gateway to Eastern Asia. Systematic archaeological research and excavations were started in the region long after the post-independence time. As mentioned above, it was studied or looked at under a large region among several archaeological zones. Due to this, the knowledge of the regional material culture has been minimal for a long time. T. C. Sharma (1999) describes the negligence of archaeological research in the region in the following words⁸:

⁸ Presidential Address at XXXIII Annual Conference of Indian Archaeological Society at Pune in 1999

"... the Archaeology of Assam and the other Northeastern States remained peripheral in the sub-continental context, and in the Historical Atlas of India as well as in the Archaeological maps of India, Northeast India remains completely blank accepting plotting of medieval kingdoms, Kamrupa which later on became Assam during the British period, and of course the name of the river Brahmaputra included in the maps."

Northeast India was considered archaeologically terra incognita (even now by several scholars) despite the evidence of domestication of plants and traces of ancient settlements in the region. Significant findings or archaeological artifacts have been reported since the mid-19th century from the region, and several scholars have conducted research basis on the surface findings in the region. However, it took years to pinpoint the region on the archaeological map of India. It started with systematic exploration, excavation, and archaeological research on the regional structure. Sharma (1966) described the involvement of British scholars in the foundation or starting of the archaeological research of the region in the following words:

"As in many other fields, we owe a great deal to the British Scholars, administrators, and explorers who were the first to discover the relics of the prehistoric period and to initiate research in the prehistoric Archaeology of Assam."

The earliest reported prehistoric stone artifact was come to the notice by Sir John Lubbock in 1867, a polished axe of bluish jadeite. Several Britishers such as E.H. Steel (1870), John Anderson (1871), H.B. Medlicott (1875), H.H. Godwin Austen (1875), J. Cockburn (1879), H.C. Dasgupta (1913), Coggin Brown (1917), and several others investigated the region. They reported various stone implements that were published in various periodicals in India and abroad (Sharma, 1966, p.3). J.H. Hutton and J.P. Mills played a significant role and started a new era of archaeological research in Northeast India. They reported several archaeological discoveries. The valuable contribution of Hutton and Mills put Northeast India at the forefront of ethnographic and archaeological research that received worldwide popularity. The systematic study of the prehistoric artifacts in Northeast India was first conducted by Hutton. Later, several scholars conducted a regional synthesis of the artifacts collected from Northeast India and compared them with other neighboring regions. Among these, the significant works have been done by K.L. Baruah (1939), P.C. Choudhury (1944), E.C. Worman (1949), A.H. Dani (1960), V.D. Krishnaswami (1962), B.K. Thapar (1978), and T.C. Sharma (1966).

Dani (1960), in his book *Prehistory and Protohistory of Eastern India*, divides the Neolithic culture of Northeast India into six zones, viz., Cachar Hills, Garo Hills, Sadiya Frontier Zone, Khasi Hills, Naga Hills, and Brahmaputra valley zones. He identified two predominant tool types in all zones: the faceted tool and the shouldered tool. Further, Dani classified the tool types into seven categories: shouldered tools, faceted tools, rounded butt axe, splayed axe, axe with broad cutting edge, Tanged axe and wedge blades, and grooved hammerstones. Several scholars from Gauhati University played a tremendous role in understanding the region's archaeology, such as T.C. Sharma, H.C. Sharma, D.K. Medhi, M.C. Goswami, and others. T.C. Sharma was one of the prominent archaeologists and anthropologists of Northeast India. His contribution to archaeological research in Northeast India was outstanding, which emerged as a new paradigm for the region. He started his archaeological research from his doctoral dissertation (1966) and later continued to work in the region. T.C. Sharma and M.C. Goswami conducted the first systematic archaeological excavation in Daojali Hading. T.C. Sharma played a significant role in understanding the ethnicity, archaeology, and material culture of Northeast India. He further argued that the Neolithic culture of East and Southeast Asia had a strong influence on the Neolithic tradition of Northeast India.

The landscape of Northeast India is dynamic, and it has several challenges for archaeological research. Medi (1990) describes this in the following words:

"Archaeologists undertaking new research face a variety of problems, both political and environmental. Natural hazards include frequent flooding by the rivers that abound locally, the processes of siltation associated with flooding, and related human-induced erosion. The plains are the most troublesome, yet the hills have their own problems. Swidden cultivators have for years had an impact on archaeological sites, by the chance excavation of ground celts, which are then used as "thunderstones" in religious rites."

However, the last few decades witnessed a handful of archaeological research in different parts of Northeast India. Several universities, the State and Central department of Archaeology, discovered various sites and attempted to understand the region's archaeology. Most of the earlier research was based on the artifacts' surface collections and morphological attributes. However, several scholars from different parts of Northeast India started studying the region's material culture in contrast with scientific techniques. Several new sites have been discovered in the last decade by various archaeologists such as Ashraf (1990, 2011),

Sharma (2001), Mitri (2009), and others. Analytical methods have been applied to understand the manufacturing techniques and provenance of the artifacts (Singh and Sharma, 2016; Singh, 2017; Tzudir *et al.*, 2019). The material culture associated with the Neolithic period is cord-marked, and basket/mat impressed or plain pottery with shouldered celts.

The archaeological chronology of the Northeast India or the Neolithic dates from sites have been mentioned further in the Chapter 4. The important dates from the reported sites of Northeast India has been mentioned in Table 1. 3.

Table 1. 3: Radiometric and Luminescence dates of Neolithic sites from Northeast India

S.N.	State	Site	¹⁴ C Dates	Reference
1	Assam	Daojali Hading	2.7 ± 0.3 ka BP	Sharma and Singh, 2017
2		Gawak Abri	2.3 ± 0.2 ka BP	Sharma and Singh, 2017
3		Kanai Gaon	1440 ± 80 BP	IAR 1992
4		Bambooti	2700 ± .05 BP	IAR 2012-13
5	Meghalaya	Lawnongthrough	2960 ± 30 BP	Mitri <i>et al.</i> , 2015
6		Myrkhan	3500 ± 30 BP	Mitri <i>et al.</i> , 2015
7	Tripura	Haora and Khowai	3450 ± 110 BP	Ramesh and Rajagopalan, 1999
8	Manipur	Nongpok Keithelmanbi	4460 ± 120 BP	Singh, 1993
9		Napachik	1450 BC	Singh, 1993

1.11 Locating Digaru – Kolong river valley: the scope of the research

Evidence from the adjoining region of the Digaru – Kolong river valley includes the study of Goswami and Sharma (1963) and Sharma (1966) in Daojali Hading, Dima Hasao District. M.C. Goswami and T.C. Sharma excavated the Daojali Hading site revealing the stratigraphical context of the Neolithic culture of Northeast India. This was the first systematic archaeological excavation in Northeast India in which chord-marked pottery was found with the double-shouldered Celt. The excavation revealed a 45 cm thick occupation deposit with Neolithic celts, fossil wood axes, adzes, chisels, grinding slabs, querns, mullers, cord-marked pottery, and plain pottery. The excavators described four cultural sequences: Hoabinhian, Early Neolithic, Late-Neolithic, and Aneolihtic. The artifacts from the excavation comprised 32 edged tools, 4 querns, 22 grinding stones, 6 mullers, 11 quartzite pebbles, and fossil wood. The raw materials for manufacturing these celts were locally

procured: shale, quartzite, sandstone, and fossil wood. The pottery from Daojali Hading was cord-impressed variety, stamped dull red variety, and brick red variety.

Exploration and excavation by S N Rao (1973) further enhance the potentiality of the study area, which helps us build our argument more cohesively. On the northern bank of Digaru River, S.N. Rao (1973, 1977) carried out an excavation at Sarutaru and Marakdola, which confirmed the existence of the Neolithic site in the region. The cultural horizon from Sarutaru was revealed at a depth of 20 cm from the surface, which continued up to the depth of 56 cm (Rao, 1977, p. 40). Marakdola is assigned a post-Neolithic site having a meter-thick cultural stratum. These sites include stone implements such as shoulder axe, adzes, and pottery. However, the archaeological research in this region was site-specific.

Similarly, Lawnongthroh and Myrkhan were the recently excavated Neolithic sites in the Khasi Hills by Mitri in 2016. These sites (Lawnongthroh and Myrkhan) are in the Ri-Bhoi district of Meghalaya, which is adjacent to the Digaru-Kolong river valley. The Lawnongthroh site has two cultural layers that reveal stone implements: finished and broken celts, small flakes, and pottery. Myrkhan is located around 45 km south of the Lawnongthroh site, revealing many stone implements and pottery. The Radiocarbon date of charcoal samples collected from Lawnongthroh sites ranged from 2960 ± 30 BP at the lowest layer and 1640 ± 30 BP at the upper layer. Around these two sites, the Neolithic sites have been discovered even on the left bank of Wah Umium River and Barapani. Various scholars have conducted several other archaeological research around the present study area, but these are mainly based on surface explorations.

However, besides stray reports of accidental findings of prehistoric implements, only a few systematic archaeological research has been done in the region. Sarutaru and Marakdola is the only site located within or anywhere close to the Digaru – Kolong river valley excavated. The Digaru-Kolong river valley is situated between two archaeologically potential areas. Confirmed evidence of the Neolithic period has come from North Cachar Hills and Khasi Hills, the two adjoining areas. Stone implements are reported from the villages, agricultural land, slopes, and hilltops, often due to chance findings with ploughing or digging up earth for different purposes. The character or the nature of the prehistoric archaeological sites and findings of this area is very significant. The northern part of the study area is flat or plain compared to the southern part. Megalithic monuments are widely distributed throughout this region's length and breadth, indicating the existence of past settlements. In view of the

cultural diversity and archaeological potentiality of the region, the present research work is structured to scrutinize the archaeology and material culture of the region.

1.12 Structure of the Study

This study hopes to present itself in an interdisciplinary fashion and hence attempt to situate itself within a framework of the regional approach to study the archaeology of the foothills of Assam - Meghalaya. The thesis is divided into six chapters, including the introduction and conclusion. Although diverse themes are trying to converse throughout this study, we organized them thematically to avoid complications and potential inconsistency in each chapter.

The first chapter presents a general introduction to the theme and discusses the geographical and ecological setting of the study area. It shows how the geographical setting and natural environment of the region played an essential role in the past settlement in the region. It further discusses the human imprint in a different form in the study region. The research purpose, aim, objective, and questions have been identified, and the value of such research is argued. The existing literature or previous work and methodological consideration for the present study have been further discussed. Further, this chapter discusses the history of Neolithic studies and discoveries in Assam – Meghalaya in particular and Northeast India in general. Thus, this chapter introduces various facets of the thesis and discusses various challenges.

The second chapter corresponds to the first two objectives and research questions of the present study. This chapter provides detailed information on the archaeological reconnaissance survey and findings in the study area. We discuss the survey planning and methods, archaeological site descriptions, and nature of physical remains recovered from the field survey. This chapter also emphasizes the site location, settlement, subsistence, and site formation process. We try to understand the geophysical and topographical situation of the sites using the remote sensing method. Lastly, the chapter brings up the narratives that deal with the material culture of the study area and its relation with the neighboring archaeological sites.

The third chapter under a canvas, corresponding to the third objective of the study, captures the overview of the artifacts recovered from the field survey and test pit excavations. This chapter aims to highlight the significance of artifact analysis in archaeological studies. This

chapter depicts the typological or morphological attributes of the artifacts recovered, viz. lithic, ceramic, and sediments. This chapter argues the different methodological approaches utilized for morphological analysis of the artifacts and their significance. In this chapter, an attempt has been made to explore the nature of data that allows for reconstructing the past settlement of the region.

The fourth chapter again explores the nature of artifacts, but with the lens of scientific tools. This chapter depicts the methodology and significance of each experiment applied to study the findings. An attempt has been made to study the mineralogical, chemical, physical, and other features of the artifacts using different analytical approaches. An attempt is also made to date the archaeological sites using the Radiocarbon dating method (AMS). Potsherds, sediment, and charcoal samples were used for dating the site. Lastly, the chapter discusses the nature of artifacts recovered and compared them with earlier studies from the neighboring archaeological region to trace their dialogical relation.

The fifth chapter corresponds to the fourth research objective of the present study. This chapter provides detailed information on the ethnoarchaeological survey conducted in the study area. An attempt has been made to understand the socio-cultural and lifestyle of ethnic communities inhabiting the study area. This chapter investigates the locals' social and religious memory and beliefs associated with the archaeological sites and artifacts. This chapter depicts the varying cultural associations, practices, and implicit meanings of man and environment relationships.

The sixth and last chapter summarises the findings of the study. This chapter examines the outcome of field reconnaissance, ethnographic data, and socio-cultural behavior of the communities inhabiting the study area. This chapter makes concluding remarks based on the earlier chapters' arguments and findings. The concluding section further highlights the contribution of the research and limitations of the present study and sheds light on the need for further research in the field.

Chapter – 2

Field Reconnaissance and Findings

This chapter provides detailed information on the archaeological reconnaissance survey in the Digaru – Kolong river valley. The chapter is divided into three sections, i.e., Survey Planning and Methods, Archaeological Site Descriptions, and Settlement Pattern and Site formation process. The chapter starts with the survey methods or techniques applied for reconnaissance surveys. Further, a detailed description of the sites and localities surveyed is mentioned. The report of sites consists of a brief account of the field observations, the location, and the contexts of the sites discovered. The chapter further describes the test pit excavation, settlement pattern, subsistence pattern, site formation, and remote sensing in the Digaru – Kolong river valley.

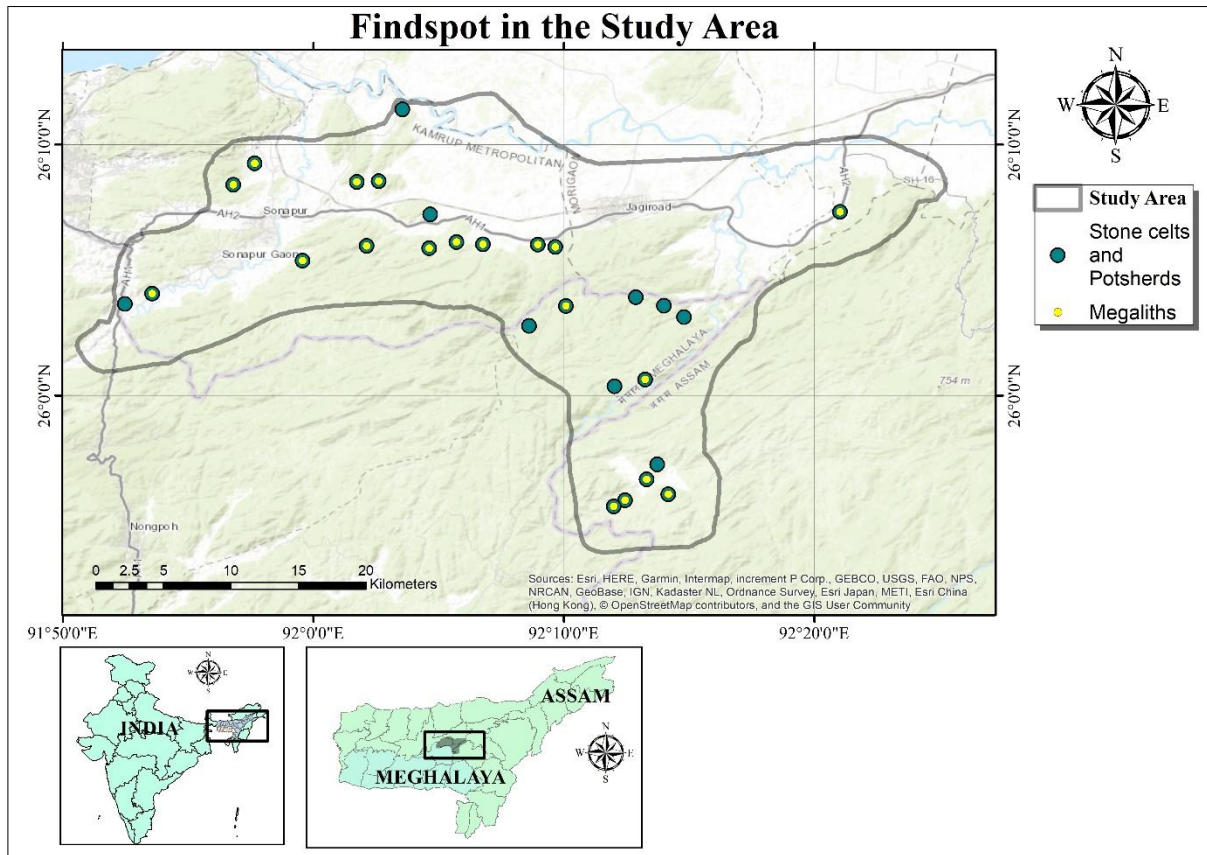
Part I: Survey Planning and Methods

2.1 Field Reconnaissance and Results

The area surveyed for understanding archaeology and geoarchaeology included plains, slopes, and hills of the Digaru – Kolong river valley. The course of the Digaru and Kolong River has been surveyed with their tributaries. The survey was successful as several new archaeological sites were discovered and recorded, along with some earlier known sites with further new findings. The discovery includes investigating nine (9) sites, five localities or regions explored, and several Megalithic sites. These sites were discovered on the Digaru and Kolong river basin, tributaries, and hill slopes. Several sites are reported on the hill slopes, plains, and foothills, consisting of archaeological records of stone celts and potsherds.

On the other hand, Megalithic sites are found at foothills, hilltops, and within dense forests or settlement areas. A specific characteristic of the area is that ground and polished celts and potteries are found in the areas with megaliths. The study area is surrounded by the flood plain of the Kolong river from the northern side, whereas on the southern, the Meghalaya plateau. Sites have been discovered in both the regions, plains as well as hilly terrains. The site distribution map (Map 2. 1) of the study area was prepared to understand the site distribution pattern within the study area. A list of explored and discovered sites followed by a brief description of each occurrence is mentioned below in Table 2. 1.

Map 2. 1: Site Distribution Map of the Digaru – Kolong River Valley



2.2 Plan of Field investigation

The study area was intensively surveyed in three field sessions. An archaeological reconnaissance survey was undertaken in the present study area to investigate the archaeological potentiality in the Digaru – Kolong river valley. Further, the reconnaissance survey aims to understand the settlement pattern and material culture of the region. An ‘area approach study has been conducted to understand the model for an archaeological site structure, geomorphic situations, locations, and site formation processes in the Digaru – Kolong river valley. The ‘area approach study is helpful in providing crucial data for interpreting demography, social organization, and land-use patterns (Paddayya, 1985, p. 60).

The exploration primarily focuses on the following areas or sites: 1) Earlier reported sites for further exploration around the region, 2) Megalithic sites which shows or indicates past settlement in the region, and 3) Information gathered by public or local interaction about the areas from where archaeological objects were reported accidentally. The entire study area was surveyed by walking across the landscape. The riverbanks, basins, tributaries, hillslopes,

mounds, agricultural land, and settlement areas were surveyed, covering around 827 km². The public transport and private vehicle of locals were used to reach the remote areas or villages.

The reconnaissance survey in the study area was done with the help of Google Earth and Open Series Maps⁹ prepared by the Survey of India. The Survey of India OSM serial and sheet numbers G46HI6 (78N/16), G46I4 (83B/4), G46I8 (83B/8), G46O1 (83C/1), and G46O5 (83C/5) on the scale of 1: 50,000 used for the survey. The map number G46I4, G46I8, and G46O1 were published in 2009; G46HI6 in 2010, and G46O5 in 2011, respectively. The Google Earth images and other online map resources such as Bhuvan (Indian Geo-Platform of ISRO) and USGS Earth Explorer (United States Geological Survey) were utilized to find the routes and locate the potential localities. These images helped locate the water source, small hillocks, hill ranges, and rock outcrops. The district resource maps (DRM) and Geological reports of Assam and Meghalaya published by The Geological Survey of India were also used to understand the rocks and minerals sources in the study area.

The field season was designed in different time frames as per the weather, accessibility, and other conditions. During the month of June-July to October, most of the study area gets flooded. After the rainy season, the more significant part of the study area still stays inundated due to the leftover rivers. Therefore, it is challenging to survey during this season. The first field visit or exploration (December 2017 – April 2018) was designed to get familiar with the area, roads all along the rivers, tributaries, and contact locals, locating villages and the sections of the rivers. The first fieldwork phase is confined to investigating and discovering the earlier reported sites. Accidental findings of archaeological artifacts were also united with the objective. The initial survey was confined to the Northern part of the study area and at the basin of Digaru and Kolong Rivers.

In the second season, exploration (December 2018 – April 2019) was conducted more intensively in the area identified in the first field season. During the second season of investigation, the southern part of the study area (the hilly terrain of the Meghalaya Plateau) was investigated. The exploration intensively focused on the hill slopes, the tributaries of the Digaru and Kolong rivers, and nearby areas. In this season, we took a trial trench from two

⁹ These are prepared on 1:250,000; 1: 50,000 and 1: 25,000 scales for the use of general public/civilians for supporting development activities in the country. Technically maps of this series are based on WGS-84 Datum (The World Geodetic System 1984 (WGS84) is a datum featuring coordinates that change with time) and UTM Projection (Universal Transverse Mercator).

sites. A systematic survey was conducted, and samples were collected for further analytical analysis. The third season of field investigation (December 2019 – March 2020) was designed to collect ethnographic data on explored regions and localities. During this season, few localities were examined in the northern and eastern part of the study area, and test pits were excavated from the other two sites. Besides the field visits mentioned above, several other visits were made between or during the research period. These visits were made for several purposes, such as attending the locals' cultural or religious activities to understand their socio-cultural life, interviewing locals, etc. Further, the Ph.D. supervisor guided this exploration to get into different aspects of geoarchaeology and the site formation process.

2.3 Field Recording and Sampling

Most of the sites or regions surveyed revealed potsherds and stone celts as artifacts and indicated the prehistoric settlement in this region. Artifacts were collected from the different clusters. The site located within the study area comprises a large part of cultural materials. It was not easy to grid the whole village or the locality and collect the samples from the entire grid. Therefore, artifacts were collected from specific locations as well as from the test pits. The collection of artifacts or samples was based on a typological and technological point of view. The artifacts were acquired from various sites and subjected to further scientific analysis in laboratory and typological analysis.

Test pits were taken to understand the stratigraphy, material cultural in situ, and deposition phases. Sediments were collected from different strata of the test pits. The riverbanks sections of Digaru and Kolong River were surveyed, and the characteristic features of the sediments were studied. Ethnographic data were collected by observation and informal interview methods. The present climatic conditions, land-form systems, land-use maps, water distribution, and raw material sources were studied to reconstruct the settlement pattern.

In addition to the exploration, artifacts sampling, photography (EOS Canon 1300D), and GIS (Garmin 72h GIS) documentation were conducted. The Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model¹⁰ (ASTER GDEM) version 2 was downloaded from Earth Explorer USGS (United States Geological Survey) as

¹⁰ ASTER GDEM has been produced as a joint activity of the Ministry of Economy, Trade, and Industry (METI) of Japan and the United States National Aeronautics and Space Administration (NASA). This covers land surfaces between 83°N and 83°S and is comprised of 22, 702 1° x 1° tiles. Each image represents a 60 x 60 km area. The Data are posted on a 1 arc-second (approximately 30m at the equator) grid and referenced to the 1984 World Geodetic System (WGS84)/1996 Earth Gravitational Model (EGM96) geoid.

raster tiles. The raster tiles were merged (mosaic) for the whole study area and processed using ArcGIS 10.2 software to convert them into elevation, contour, and other maps.

Part II: Archaeological Sites Descriptions and Observations

Several significant aspects have been considered while describing the sites. Every site is recorded along with its geographical coordinates and elevation. The distance from the considerable landmark or the city and directions were recorded. The site location mentioned river, stream, slope, and hills. The measurement of the election and distances are noted in square meters. The name and description of every site recorded from the study area are discussed below in Table 2. 1.

The sites and the localities explored based on the artifacts or cultural material discovered can be divided into two zones. Firstly, the region lying in Assam – the Brahmaputra plains and second, the area of hill ranges of Meghalaya Plateau. The second part also contains the hilly terrains of Kabi Anglong, which lies in Assam. The artifacts, especially the stone celts recovered from regions, show differences and similarities based on several things.

The stone celts recovered from the hilly terrains are crude or rough in textures and found finished and unfinished both. Their sizes are mostly smaller than the plains ones. Mostly they are not polished, or polished celts are less in numbers. The stone celts from Karbi Anglong and the Meghalaya Plateau are very similar or have identical morphological features. The stone celts recovered from the plains of the study area have different characteristics. The dimension of celts from this part is usually more prominent as compared to hilly regions. Most of the tools recovered from this area are polished and finished.

Table 2. 1: List of Discovered Sites and Findspots during the Field Study

S. N.	Site / Findspots	Latitude	Longitude	Location	Findings
1.	Sarutaru	26°3'39.4''N	91°52'28.6''E	Kamrup, Assam	-
2.	Marakdola	26°4'3.52''N	91°53'33.92''E	Kamrup, Assam	Potsherds, celts, and Megaliths
3.	Bagibari	26°11'24.23''N	92°3'33.18''E	Kamrup, Assam	Potsherds, celts
4.	Silchang	26°7'19.12''N	92°21'1.90''E	Morigaon, Assam	Potsherds, celts, and Megaliths
5.	Shankargog	26°7'12.92''N	92°4'40.06''E	Kamrup, Assam	Potsherds, celts
6.	Chenimur	26° 9'15.11''N	91°57'39.33''E	Kamrup, Assam	Potsherds, celts, and Megaliths
7.	Teteliguri	26°8'32.66''N	92°2'36.47''E	Kamrup, Assam	Megaliths and potsherds
8.	Sukuripara	26°8'31''N	92°1'43.90''E	Kamrup, Assam	Megaliths
9.	Batakuchi	26°8'24.06''N	91°56'48.27''E	Kamrup, Assam	Megaliths and potsherds
10.	Barkuchi	26°5'22.85''N	91°59'33.98''E	Kamrup, Assam	Megaliths and potsherds
11.	Taloni	26°6'7.29''N	92°5'43.09''E	Kamrup, Assam	Megaliths
12.	Khamar	26°6'1.35''N	92°6'46.09''E	Kamrup, Assam	Megaliths
13.	Bhogpur	26°5'52.38''N	92°4'37.76''E	Kamrup, Assam	Megaliths
14.	Tegheria	26°5'57.92''N	92°2'7.78''E	Kamrup, Assam	Megaliths
15.	Dakhin Topatoli	26°5'55.3''N	92°9'39.47''E	Kamrup, Assam	Megaliths
16.	Diksak	26°6'1''N	92°8'58''E	Kamrup, Assam	Megaliths
17.	Maiong	26° 2' 46.70" N	92° 8' 36.50" E	Ri-Bhoi, Meghalaya	Potsherds and celts
18.	Maska	26° 3' 34.61" N	92° 13' 59.77" E	Ri-Bhoi, Meghalaya	Potsherds and celts

19.	Makdah	26° 3' 54.98" N	92° 12' 52.74" E	Ri-Bhoi, Meghalaya	Potsherds and celts
20.	Amjong	26° 3' 07.45" N	92° 14' 47.82" E	Ri-Bhoi, Meghalaya	Potsherds and celts
21.	Lymphuid	26° 0' 38.11" N	92° 13' 14.87" E	Ri-Bhoi, Meghalaya	Potsherds, celts, and Megaliths
22.	Amkhang	26° 0' 22.55" N	92° 12' 1.53" E	Ri-Bhoi, Meghalaya	Potsherds and celts
23.	Kraikijam	26° 3' 34.19" N	92° 10' 5.19" E	Ri-Bhoi, Meghalaya	Potsherds, celts, and Megaliths
24.	Bormorjong	25° 55' 49.89" N	92° 12' 27.05" E	West Karbi Anglong, Assam	Potsherds, celts, and Megaliths
25.	Umsetri	25° 55' 35.19" N	92° 11' 59.49" E	West Karbi Anglong, Assam	Megaliths
26.	Amsai	25° 56' 3.96" N	92° 14' 10.77" E	West Karbi Anglong, Assam	Megaliths
27.	Shikdamakha	25° 56' 39.57" N	92° 13' 18.74" E	West Karbi Anglong, Assam	Potsherds, celts, and Megaliths
28.	Kalbari	25° 57' 15.66" N	92° 13' 44.09" E	West Karbi Anglong, Assam	Potsherds and celts



Every site or occupation has its own spatial and temporal characteristics that leave the nature of activities in its place. In the present study, the descriptions of archaeological sites have been categorized into two parts. First, Sites Investigated denotes the area with a high concentration of artifacts. These are considered 'sites,' and test pits were taken and investigated, particularly compared with regional structures. However, an individual site is not considered an independent entity and is studied as a more extensive complex region. The settlements are never confined to a single site or limited to a particular locale. Instead, the resources of the surroundings govern the different modes of adaptation of the inhabitants of an area. Therefore, considering the area or regional approach, the sites are studied as a part of a larger complex.

The second section contains the region or localities surveyed and reconnaissance and surface collection. This section describes the rest area studied and artifacts collected from the surface. An investigation of the relationship between the spatial distribution of artifacts and landscape features will aid us in making inferences about the prior use of landscape (Sharma, 2007, p. 27).

2.4 Sites Investigated

The Archaeological exploration in the present study area was successful in locating potential regions. Several localities or regions were explored within Kamrup (Metro), Morigaon, and West Karbi Anglong district of Assam and Ri-bhoi district of Meghalaya. Several sites or find spots were investigated intensively, and test pits were excavated. Several localities such as Jorabat – Sonapur, Dimoria – Khetri, Nelli – Jagiroad, Umswai in Assam, and Umsiang in Meghalaya were explored artifacts were collected from the surface with no pertinent information on stratigraphy. The sites intensively investigated are mentioned below.

2.4.1 Sarutaru and Marakdola

S.N. Rao from the Department of History, Northeast Hill University, excavated Sarutaru about 28 km southwest of Guwahati city. According to the publication (Rao, 1973), Sarutaru and Marakdola are located one kilometer from each other on the northern bank of the Digaru river. Sarutaru was described as a Neolithic site and Marakdola as a post-Neolithic site. Due to the dense vegetation, tropical climate, and recent settlements, the Sarutaru site is untraceable today. The earlier study of this site was a site-specific study. Hence, to

understand the regional archaeology and further possibilities around the region, a survey was planned by walking across the landscape using the previously published information.

(i) Locating the site:

Google Map and Google Earth applications were used to trace the exact location of the excavated spot at the Sarutaru site. According to the direction shown by Google Map, Sarutaru is on the road that connects Guwahati and Shillong, commonly known as GS Road (Guwahati-Shillong Road) near Byrnihat, around 15 km from Jorabat of Assam, lying on NH37. However, the physical location of the Sarutaru village did not match the Google Map location, and hence, the survey by foot method was continued to locate the site. While returning from the Byrnihat bus stand towards Jorabat on G-S road, our attention was caught by a hoarding with the display written ‘*Sarutari, Department of Horticulture and Farm, Assam*’ at the 14th mile (Figure 2. 1). In conversation with locals, it was confirmed that Sarutaru had been renamed ‘Sarutari,’ but no authentic information was available behind the change in the village's name.

Nevertheless, having been confirmed as Sarutaru, we extended our method to locate the excavated site. After short conversations with the villagers, another village named Marakdola (now known as Morogdula) was confirmed, located around 1 Km away from the Sarutaru. Local informants were further questioned about the place, and photographs of the area available from an earlier publication (Rao, 1977) were shown to the villager, but the excavated site was untraceable. Henceforth, we extended our exploration towards the Marakdola village with some local inhabitants' help and successfully found the Marakdola site. The place was confirmed by the position of the Menhirs (Figure 2. 2 and Figure 2. 3), which were also cited in the earlier articles and publications.

The present Sarutari village and Marakdola village are semi-urban settlements with a well-connected road network. Many new factories have been set up along the Digaru river bank and the village. The new semi-urban structures like cemented roads, multi-storied residential buildings, and factories pose new challenges for undertaking reconnaissance as the physical scenario of the village has changed, and it does not match the earlier descriptions. During the last two decades, new settlements have developed in the village. The Sarutaru and Marakdola villages are located on a low hill mound near the bank of the Digaru river. There are several

seasonal nullahs or water streams. The village is populated by a mixed population, mainly Assamese, Karbis, and Nepalese.

Figure 2. 1: Hoarding of ‘Department of Horticulture and Farm, Assam’ at 14th mile, G-S Road



Figure 2. 2: Menhirs of Marakdola shown in the earlier publication (S.N. Rao, 1973)



Figure 2. 3: Menhirs of Marakdola in the present condition

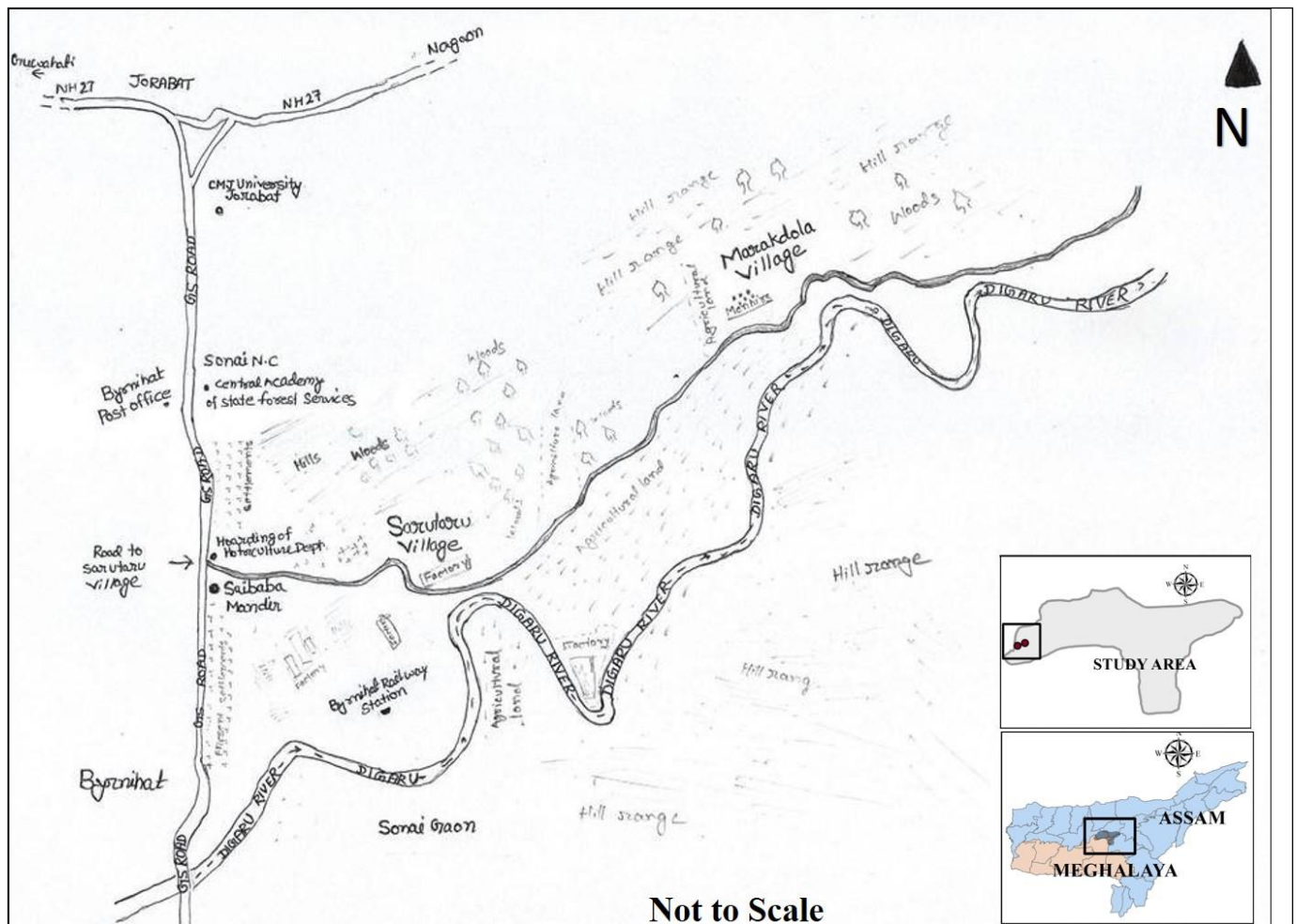


(ii) Exploration:

After locating the Sarutaru and Marakdola village (located on the southern side of the road that connects Guwahati and Shillong near Byrnihat, around 15 km from Jorabat at Assam, lying on National Highway number 37 on the north bank of Digaru river), we started our exploration in both villages, riverbanks, and hill mounds. The survey was intensively conducted for two field seasons. The investigation was undertaken by walking across the landscape. The exploration in the present *Sarutari* (Sarutaru) village did not reveal any information. During the first field visit, an investigation in the Marakdola village ($26^{\circ}4'3.52''N$ latitudes and $91^{\circ}53'33.92''E$ longitudes) was undertaken with an objective to locate sites that revealed the occurrence of ground and polished Neolithic Celts in rain gullies and on eroded surfaces of the area. Few stone Celts have been collected from the sections exposed due to cultivation and hilly terrain, including a stone axe, adze, and shouldered celts. There are several accidental findings of stone tools reported by the locals, and they considered them as 'Thunderstone or Thunder Axe.' Pottery was found in sections exposed to road cutting and nearby the megalithic structures, but tools were seldom found in a buried context. Potsherds recovered from the cross-sections exposed were of different sizes and

shapes. Potsherds were recovered in fragments of different shapes and sizes of rim, body, base, neck, and other unidentified types. These are both plain and basket/mat impressed. The investigation along the bank of Digaru River also reveals a few potsherds.

Map 2. 2: Hand-drawn map of Sarutaru and Marakdola village (based on field survey)



During the second field visit, a trial trenching is done at the Marakdola village ($26^{\circ} 4' 3.52''$ N latitudes and $91^{\circ} 53' 33.92''$ E longitudes) to understand the stratigraphy, nature, and context of the site (Plate 2. 1).

(iii) Test Pit No. 1:

A test pit was dug in at 2 x 1 meter rectangular at an elevation of 62 m above mean sea level following the North-South orientation. The pit was dug to the depth of 130 cm from the surface, and the sterile layer was struck after the depth of 115 cm. The humus layer was found till the dept of 10 cm from the surface, and traces of cultural material was not found. At

a 10 to 40 cm depth, potsherds were recovered in small numbers. From the depth of 60 cm to 110 cm, potsherds of different sizes continuously occurred. The concentration of potsherds decreases at a depth of 90 to 110 cm. The size of potsherds at this depth was minimal. The potsherd sample at a depth of 65 cm dated to 1031-1159 CE. Charcoal samples were collected at a depth of 25, 35, 60, 70, and 75 cms (Plate 2. 2). The median value of radiocarbon dates of charcoal samples at a depth of 25cm, 35cm, 60cm, 70cm, and 75cm are 1347 CE, 1316 CE, 947 CE, 1204 CE, and 1216 CE, respectively. The colour of the layer varies from very pale brown (10YR 7/4) at the surface to dark brown (10YR 3/3) to 115 cm. The bottom layer, or after the depth of 115 cm, is natural brown (10YR 4/3) compact soil and archaeologically sterile. This primary dig provided the required approximation of the site's stratigraphy, which revealed the extent of the single cultural layer to 110 cm. The sediment sample at a depth of 105 cm dated to 132-322 CE. From surface to 10 cm, the layer has not any cultural material evidence.

2.4.2 Bagibari

Bagibari village, also called Bogibari (26°11'24.23''N latitudes and 92°3'33.18''E longitudes), lies in Sonapur Revenue Circle of Kamrup (Metro). Bagibari village is situated 10 km from Tetelia at NH 37 at an elevation of 60 m above mean sea level. The village is on low terrain and is surrounded by agricultural land on the eastern and southern sides. The Kolong River flows on the northern side of the village. The village consists of Assamese, Karbi, Bengali, and Nepali people.

(i) Locating the site:

On August 31, 2015, a newspaper report titled '*Tools belonging to New Stone Age discovered*' was published in Assam Tribune. Based on that report, we intended to explore the area for further possibilities along the Digaru-Kolong River valley. The information in the newspaper was the accidental finding of some stone tools by one resident named Moon Talukdar of Bagibari under the Sonapur Revenue Circle of Kamrup (Metro). His collection of five stone tools of Neolithic celts, including the bar-type shoulder adze and shoulder axe (Figure 2. 4), further confirmed the potentiality of the region. With his help, we reached the findspot from where he collected the tools. The archaeological exploration of the area reveals potshards from nearby villages, eroded sections, and rain gullies. The surface visibility of the reason was very low due to dense vegetation.

(ii) Exploration:

A systematic archaeological exploration was undertaken around the village and the habitation area, foothills, agricultural land, and the Kolong river bank with the help of residents. The village was surveyed during all three field seasons. The settlement near the Kolong river reveals the sedimentation process in the nearby regions. The exploration revealed potsherds exposed on the village road, exposed section cutting, and rain gullies. The report of the accidental finding of the stone tools among the locals was prevalent. Shoulder celts, axe, and adze were reported from several houses. Locals recovered these stone celts from agricultural and during jhum cultivation or quarrying of the hills. Ethnographic data collected from the locals provided various information, including associations and beliefs with archaeological artifacts.

Figure 2. 4: Stone celts reported by the locals of Bagibari village



Two test pits have been excavated to understand the stratigraphy and nature of the site. The test pits were taken on the Northern side of the village.

(iii) Test Pit No. 1:

The first test pit of 2 x 1 meter was taken at an elevation of 58m above mean sea level in the North-South orientation. From the surface to 17 cm, traces of cultural material in the form of potsherds were recovered in high concentrations. After the depth of 17 cm to 13 cm, the concentration of pottery decreases. A shouldered celt has been recovered at a depth of 15 cm. The working edge of the celt is convex and worn out, and it has a straight rectangular butt. The profile of the celt is convex. The soil colour changes from yellow (10YR 8/6) to very pale brown (10YR 7/4) and to pale brown (10YR 6/3) from the surface to the depth of 17 cm. After that, brownish-yellow (10YR 6/6) from upward to downward. Charcoal samples have been collected at a depth of 10 cm and 15cm. The layer below 30 cm is composed of loose brownish-yellow soil and is sterile with no artifacts. This test pit provided the required approximation of the site's stratigraphy, which resulted in the cultural layer's depth.

(iv) Test Pit No. 2:

Another Trial pit designated as Test Pit No. 2, measuring 2 x 1 meter, was taken at an elevation of 61m above mean sea level following the East-West orientation. The trench was dug to the depth of 40 cm, and a fragile kind of rock came out from the eastern end of the pit. The trench was dug to 60 cm at the western end, and a few potsherds were recovered. No other artifacts were found. The layer below 5 cm is composed of gravel and stones. The colour of the layer varies from very pale brown (10YR 7/4) at the surface to pale brown (10YR 6/3) till 19 cm and brownish yellow (10YR 6/6) again further at 18 cm. The layer below 40 cm is sterile and is composed of loose dark greyish brown (10YR 4/2) soil.

The charcoal samples collected from 10 and 15 cm depth at the first test pit are dated to 976-1152 CE and 1031-1202 CE, respectively, using the AMS dating method. The potsherd sample collected from the test pit at a 10 and 15 cm depth is dated to 1051-1249 CE and 777-980 CE, respectively. The sediment sample from the depth of 25 and 30 cm are dated to 170-38 CE and 130-323 CE, respectively.

Figure 2. 5: Test pit excavation at Bagibari village



2.4.3 Silchang (Xilchang)

(i) Locating the site:

There is another locality around 62 km east of Sarutaru, where the locals have reported the Megaliths and stone artifacts. However, no other connection was found except the stray references in the local newspapers. The reconnaissance survey extended to the area to understand the archaeological remains along the course of the Digaru – Kolong River and the region bordering the foothills of Meghalaya from where the river begins.

Silchang village, also called Xilchang ($26^{\circ}7'19.12''N$ latitude and $92^{\circ}21'1.90''E$ longitude), is situated in the Morigaon district of Assam around 75km from Guwahati city on the right side of National Highway 37, on the way to Nagaon at an elevation of 70 m above the mean sea level. There is a long strip of agricultural land between the settlement area and foothills. The present scenario of the agricultural land has become a digging site for several

commercial and construction factories. Jagiroad is the nearest Railway station that connects Silchang village. Tiwa tribe constitutes the dominant population of the village, speaking a Tibeto-Burman dialect of the Bodo-Garo group along with Assamese languages.

The first evidence showing or indicating past settlements in this region is the Megaliths and several stray references of stone celts reported by locals. The locals confirm the above information along with observations made during the survey. The Megalithic (Menhirs) are visible at the village's entrance in a well-arranged manner and have been declared a protected space by the Archaeology Department of the Government of Assam. These Menhirs are placed in such a manner that it looks like a King's court with a throne and seats for nobles (Figure 2. 6). However, the closer observation of these Menhirs suggests that they were relocated there from different places around the village.

(ii) Exploration:

The fieldwalking method or surface survey is applied to explore the region. Attempts have been made to communicate with the locals to understand the settlement and subsistence pattern, tradition and practices, and association with the artifacts. Most of the responses (informal interview and observation method) considered the Megalithic structure as the Kings' court and stone celts as 'Thunderstone or Thunder axe.' We found several accidental findings of stone celts by the locals. Then, we systematically explore the village and habitation area, agricultural land, foot slopes, and forest area over the nearby hill range. The exploration in this region was conducted over two seasons of fieldwork. The region is covered with dense vegetation and a high number of rock boulders. Neolithic celts were collected through hill tracks, rain gullies, and hill slopes exposed by cultivation and erosion.

Potsherds were found at several locations, such as near agricultural lands, forests, slopes, and sections exposed due to water channels. Attempts were made to cover the maximum area of the hill range, which is accessible through the village. Two test pits have been excavated near the foothill and on agricultural land where the concentration of potsherds was high.

Map 2. 3: Hand-drawn map of Silchang village and locality (based on field survey)

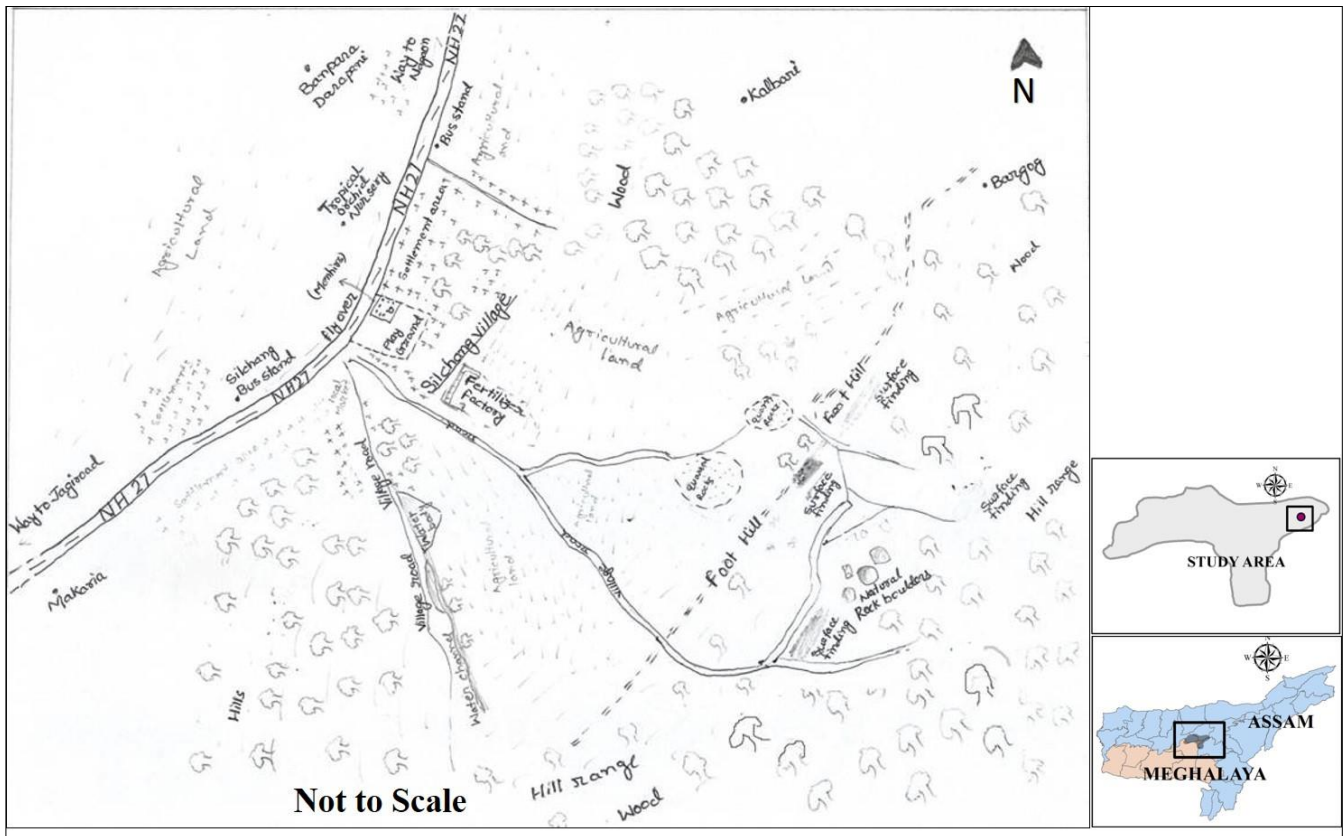


Figure 2. 6: Menhirs at Silchang village



Figure 2. 7: Potsherds exposed on hill tracks and test pit at Silchang village



(iii) Test Pit No. 1

A test pit was dug in at 1 square meters at an elevation of 75 m above mean sea level. The pit was dug to the depth of 70 cm from the surface, and the sterile layer was struck after the depth of 45 cm. From the surface to 10 cm was a humus layer and the traces of cultural material were rare. Few potsherds recovered from the humus layer, which might result from surroundings deposition. At a 10 to 45 cm depth, potsherds were recovered in tiny fragments. The concentration of potsherds decreases at a depth of 35 to 45 cm. The colour of the soil at the surface is yellow (10YR 8/6), which changes to pale brown (10YR 6/3) at a depth of 40 cm and, after that, brownish-yellow (10YR 6/6) from upward to downward. This primary dig provided the required approximation of the site's stratigraphy, which revealed the extent of the single cultural layer to 45 cm.

(iv) Test Pit No. 2

Another Trial pit designated as Test Pit No. 2, measuring 1 X 1 meter, was taken at an elevation of 78 m above mean sea level. The trench was dug to the depth of 65 cm from the surface, and the sterile layer was struck after the depth of 50 cm. From the surface to 12 cm was a humus layer and traces of cultural material were rare. Towards the end of the humus layer, tiny fragments of potsherds were recovered. Potsherds were retrieved in different shapes and sizes at a depth of 12 cm to 50 cm, mainly the body sherds. The occurrence density of potsherds has decreased after the depth of 45 cm. The soil colour at the surface is yellow (10YR 8/6) to very pale brown (10YR 7/4) to pale brown (10YR 6/3) at a depth of 50 cm. After 50 cm soil colour was brownish yellow (10YR 6/6).

The potsherd sample at a depth of 15 cm from test pit one is dated to 1412-1449 CE, and the sediment sample at a depth of 40 cm is dated to 560-649 CE (Sample ID IUACD#21C3668).

2.4.4 Shankargog

(i) Locating the site:

Shankargog village ($26^{\circ}7'12.92''$ N latitude and $92^{\circ}4'40.06''$ E longitude) is situated around 50 km east of Guwahati city in the Kamrup (Metro) district of Assam, on the NH 37 at an elevation of 57.08 m above mean sea level. The village is located around 700 m from NH37 near Dimoria College. During our exploration of the Sonapur region and nearby areas, locals informed us about a village named Shankargog. Hence, our investigation began with the information of finding a stone Celt from the village. Based on such information, we intended to explore the area for further possibilities, and we managed to locate the findspot from which the stone celts were recovered. Further, we plan to explore the village, hill mound, and nearby area to understand the archaeology and nature of the findings.

(ii) Exploration:

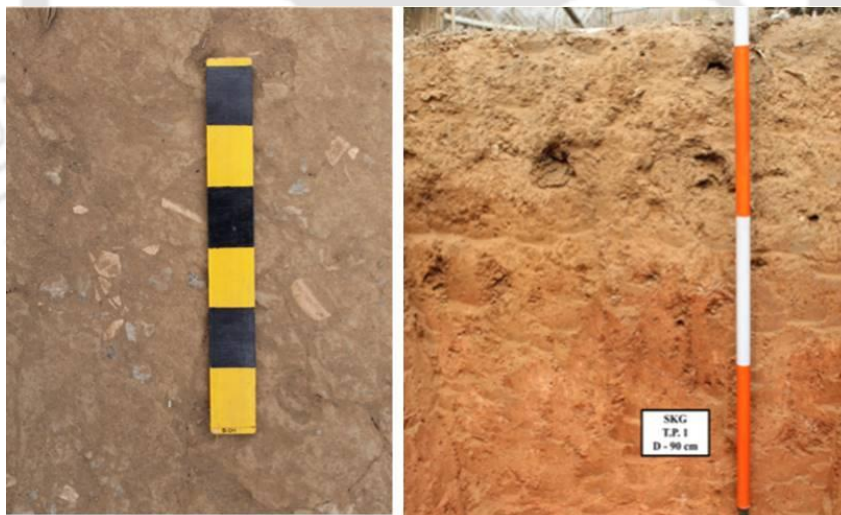
The village is on the slope, and the present settlement is on the hill as well in the plains. Present settlements are constructed by quarrying the hill slopes. Eroded soil from the foothills has accumulated around the different parts of the village, and these contained potsherds (Figure 2. 8 and Figure 2. 9). Potsherds were collected from sections exposed by road cutting, rain gullies, and slopes of the hills. Stone Celts and pottery are reported during the excavation of mounds to build houses. We also reported several accidental findings of stone celts by locals. The Neolithic celts collected by locals were polished, and the length varied from 15 to 17 cm.

Further, a test pit was taken at the Shankargog village to understand the stratigraphy and nature of the site and its context with other nearby areas.

Figure 2. 8: Potsherd visible at road cutting section and accumulation of artifacts at Shankargog village



Figure 2. 9: Potsherds exposed due to rain and test pit section at Shankargog village



(iii) Test Pit No. 1

A test pit of the size 2 x 1 meter was taken at an elevation of 60 m above mean sea level following the North-South orientation. The test pit was excavated at the foot slope from the north-eastern side of Dimoria College. The pit was dug to the depth of 90 cm from the surface, and the sterile layer was stuck after the depth of 63 cm. From the surface to the depth of 12 cm was a humus layer. Potsherds were recovered from a depth of 10 cm to 63 cm. The

potsherds include small and medium fragments, mainly plain and few basket impressions. The concentration of potsherds gets decreases from the depth of 40 cm. The potsherd sample at a depth of 45 cm is dated 1213-1273 CE. The colour of the layer varies from very pale brown (10YR 7/4) at the surface to pale brown (10YR 6/3) till 63 cm, and the layer below 63 cm is sterile without any cultural materials and is composed of loose dark greyish brown (10YR 4/2) soil. The sediment sample at a depth of 50 cm is dated to 1264-1388 CE.

2.5 Region or localities surveyed: Reconnaissance and surface collection

For the convenience of the study, the description of the explored area has been divided into five zones. In this study, these zones are termed 'Region' or 'Localities.' A systematic archaeological reconnaissance was carried out in the present study area by walking across the landscape. The find spots or surface findings during the exploration have been mentioned in this section. Several localities/regions and villages were successfully located with potential for archaeological research. Artifacts have been collected from several sites or regions in a surface context. The descriptions of localities or villages explored are mentioned below:

2.5.1 Jorabat – Sonapur region (Kamrup, Assam)

Jorabat is connected with Sonapur through National Highway No 37 and is around 17 km from Guwahati city. Sonapur is approximately 20 km from Jorabat on NH 34 towards Jagiroad. This region is mainly populated with Assamese, Karbi, and Nepalese people. The region covers the Kamrup Metropolitan and Morigaon district of Assam and the Ri-Bhoi district of Meghalaya. This region is the most extreme eastern part of the study area. East Khasi Hills surround it from the southern side and the plains of the Brahmaputra from the northern side. Digaru River flows diagonally to this region and crosses Guwahati – Shillong road at Byrnihat and NH 37 near Sonapur.

This region was extensively explored along with the banks of the Digaru river, villages, and hill ranges. Sarutaru, Marakdola, and Bagibari sites came under this region and were explicitly investigated, as mentioned above. During our exploration, we located several other find spots and collected artifacts. The investigation reveals various ceramics, stone tools, and megalithic sites. Most of the Megalithic monuments are reused, relocated, and abandoned. The region is considered rich and has potential for archaeological research based on the findings. Several findspots under this region are mentioned below.

Chenimur village ($26^{\circ} 9'15.11''\text{N}$, $91^{\circ}57'39.33''\text{E}$) is located around 10 km north of Sonapur Township at an elevation of 53.95 m above mean sea level. The present settlement is on the plains, followed by the foothills, and populated mainly by the Karbis, Assameses, and a few Bodos.

Megalithic monuments are widespread and prominent in the region. Our exploration extended into the region based on locals' accidental discovery of the potsherds and celts. We located two megalithic sites (Plate 2. 3). In Locality I, there are around 130 menhirs. Among them, the height of four menhirs is 90-110 cm, whereas others vary from 20 to 60 cm. All the menhirs have the associated sitting stone. Around 900m southwest of Locality I, we found another megalithic site. In that place (Locality II), there were about 65 menhirs with their sitting stones. Their height varies from 30 to 60 cm. Potsherds were recovered from both the megalithic sites. Further, the investigation around the village and megalithic sites revealed potsherds in a large quantity. These were mainly collected from the sections exposed due to rain or water channels and gullies.

The potsherds from Locality I were thin and small, whereas the ones in Locality II were thick compared to the previous ones. The rim sherds were very thick and in large numbers. However, typologically those were similar other than thickness. The thickness of the potsherds often indicates the use or function of the pottery. Stone celts were accidentally reported very often by the locals during digging and cultivation.

Teteliguri Village ($26^{\circ}8'32.66''\text{N}$ latitudes and $92^{\circ}2'36.47''\text{E}$ longitudes), also known as Dakhinbam, is located around 5km from Tetelia at National Highway 37 at an elevation of 45.30 m above the mean sea level. The village is situated on the plain and inhabited by the Karbis. There are around 150 menhirs, and approximately 110 are table stone (Plate 2. 3). The height of menhirs varies from 120cm to 250cm, and breadth ranges from 90cm to 120cm. All these menhirs are fenced to the adjacent village road and protected by the Directorate of Archaeology in Assam. The protected area was deserted due to the growth of dense vegetation. According to the locals, these structures have been installed since ancient times and belong to their ancestors. During the concrete road construction, several menhirs were relocated or displaced from their original place. The potsherds were discovered from rain gullies, village roads, cross-sections, and quarried areas. The potsherds were very tiny fragments.

Sukuripara Village ($26^{\circ}8'31''$ N latitudes and $92^{\circ}1'43.90''$ E longitudes) is located around 2.5km from the Teteliguri village and 7km from Tetelia at NH37, at an elevation of 59m above mean sea level. Karbis mostly populate the village. There are around 145 menhirs installed near the village road (Plate 2. 4). These menhirs are newly established and are a perfect example of the living tradition of Megalithism. These menhirs look typologically similar to the ancient megaliths structures. These were probably constructed with similar types of stones used to erect the old menhirs. The newly erected or installed menhirs were painted and displayed the deceased's name and year of death. The depiction of names and dates was mainly done by painting, and sometimes it was engraved over the stone.

Batakuchi village ($26^{\circ}8'24.06''$ N latitudes and $91^{\circ}56'48.27''$ E longitudes) is located around 15 km from Sonapur Township NH37 at an elevation of 74.14 m above mean sea level. This village is situated in a plain area inhabited by the Karbi tribe. The megaliths are installed at two different places in the habitation area.

In Locality I, there are around 30 Dolmens. Three Dolmens were integrated or not disturbed, whereas others were scattered around that area. The dolmens were installed between the habitational areas adjacent to the village road (Plate 2. 5). The site is considered religiously significant among the locals. Around 300 meters away from Locality I, 110 menhirs were located. The height of these menhirs varies from 30-60cm. All menhirs have an associated sitting stone slab. The newly erected or installed menhirs could be seen among the ancient menhirs. The locals further confirmed the present tradition of erecting menhirs in memory of deceased ones. The accidental findings of stone celts are pretty common among the locals. The locals reported shouldered celts, which are primarily adzes and polished. Few potsherd fragments were discovered nearby the Megalithic structures.

Barkuchi village ($26^{\circ}5'22.85''$ N latitudes and $91^{\circ}59'33.98''$ E longitudes) is located around 7 km from the Sonapur township at an elevation of 89.52 m above mean sea level, towards the hill range, which is followed by Meghalaya state. Karbi tribes inhabit the village. There are around 150 menhirs installed and spread around 50 m (Plate 2. 4). The height of menhirs varies from 50-200 cm. One can easily observe the newly installed memorial stone made of cement with the name of the deceased mentioned. There were around 15 newly constructed memorial stones that can be observed. Potsherds were collected from nearby the megalithic site and section cutting due to the erosion and water channels. These were primarily plain body sherds.

2.5.2 Dimoria – Khetri region (Kamrup, Assam)

The Jorabat – Sonapur region is followed further by the Dimoria – Khetri region at National Highway 37. Khetri is located around 45.5 km eastward of Guwahati city and lies on National Highway 37. The area is surrounded by plains of the Brahmaputra River on the northern side and the foothills of the Meghalaya Plateau on the southern side. Dimoria is very famous for its Megalithic monuments. Karbis are the dominant community in the area. Tiwas, Bodos, Assamese, and Nepalese, are the other communities residing in the area. The occurrence of potsherds and stone celts is widespread all around the region. During the exploration, several findspots were located with potsherds, stone celts, and megaliths.

Taloni Village ($26^{\circ}6'7.29''$ N latitudes and $92^{\circ}5'43.09''$ E longitudes), also known as Dharbam, is located around 4 km from Khetri Police Station¹¹ at National Highway 37 at an elevation of 65.01 m above mean sea level. Present settlement is on the plain, followed by a hill range after 400m. The village is inhabited mainly by Karbis, and few of them follow Christianity. There are around 130 megaliths in the village, among which about 60 are menhirs and approximately 70 are table stone (Plate 2. 6). All the menhirs have an associated sitting stone slab and are found in the middle part of the habitation area. The Megalith site is currently covered with shrubs and bushes. We cleaned the area and documented it. The height of these menhirs varies from 100 cm to 250 cm.

Khamar village ($26^{\circ}6'1.35''$ N latitudes and $92^{\circ}6'46.09''$ E longitudes), also known as Khomar, is located around 7 km from Khetri Police station at NH 37 at an elevation of 67.89m above mean sea level. Khamar and Taloni village is situated about 3.5 kilometers from each other. Present settlement is located in the plain area, further surrounded by a hill range. Karbis are the monogamous population in the village. Megalithic structures were installed at two places in the village at a distance of 100 meters.

The Menhirs at Locality I was ancient, whereas Locality II was recently installed or modern. In Locality I, there are 27 menhirs and 20 table stones. The height of menhirs varied from 120 cm to 200 cm. Among the megaliths in Locality I, a few belong to the King of Dimoria Kingdom. There are around 25 menhirs at Locality II, and all menhirs have an associated sitting stone slab. The height varies from 30 to 60 cm. These are recently installed or modern menhirs established by the locals in the memory of their deceased.

¹¹ Khetri Police Station is located on the National Highway 37 on the left side of the road towards Naogaon.

Bhogpur village ($26^{\circ}5'52.38''\text{N}$ latitudes and $92^{\circ}4'37.76''\text{E}$ longitudes) is located around 5 km from the Khetri Police Station on NH 37 at an elevation of 75.34 m above mean sea level. The village is inhabited chiefly by the Karbis, Assamese, Bodos, and Rabhas. The present settlement of the village is near the foothills. The megalithic structure of Bhogpur village is situated at the foothill, which is the habitation area. There are 48 menhirs installed, and all have an associated sitting stone slab (Plate 2. 7). The height of the menhirs varies from 50-70cm. Four recently constructed menhirs made of cement were also installed along with the old ones. Few small and fragile potsherds have been discovered nearby megalithic structures and village roads.

Tegheria village: - Tegheria village ($26^{\circ}5'57.92''\text{N}$ latitudes and $92^{\circ}2'7.78''\text{E}$ longitudes) is located around 8 km eastward of Sonapur Township at an elevation of 67.89 m above mean sea level. The village is approximately three kilometers from the National Highway southward. The village is located on a narrow plain strip surrounded by a hill range of Meghalaya and is famous for its beautiful scenario and tourist spot. The village is inhabited by the Karbi and Tiwa tribes. There are ten (10) menhir and 11 table stones. The height of the menhirs was around 100 cm to 160 cm. According to the locals, several menhirs were displaced or moved from their original place for construction work.

2.5.3 Jagiroad – Nelli region (Morigaon, Assam)

The Dimoria – Khetri region is followed further by Jagiroad – Nelli region at National Highway 37. Jagiroad has located around 57 km, and Nellie is about 71 km east of Guwahati. Nellie region is the westernmost area, and Silchang is the westernmost site of the study area. The foothills of the Meghalaya plateau surround the region and are mainly populated by the Karbi and Tiwa tribes. The region is a multi-linguistic locality with a dominating population of the Tiwas. The other significant people inhabiting the region are the non-tribal Assamese, Muslims, Karbis, Nepalese, and Marwaris. The exploration in this region reveals several findspots consisting of potsherds, stone celts, and megalith structures.

Silchang village ($26^{\circ}7'19.12''\text{N}$ latitudes and $92^{\circ}21'1.90''\text{E}$ longitudes) is situated in the Morigaon district of Assam, around 75km from Guwahati city, the right side of National Highway 37, on the way to Nagaon at an elevation of 69.82m above the sea level. The first evidence which shows or indicates past settlements in this region is the Megaliths. Megaliths

were visible at the village's entrance in a well-arranged manner and have been declared a protected site by the Archaeology Department of the government of Assam.

These Menhirs are placed in such a manner that it looks like a King's court with a throne and seats for nobles. The above information is further confirmed by the locals and field observation method. However, the closer observation of these Menhirs suggests that they are relocated there from different places around the village. The region further reveals high potential for archaeological research. This region is explicitly investigated, as mentioned above. The exploration and test pit excavation reveals potsherds and stone celts.

Dakhin Topatoli village ($26^{\circ}5'55.3''$ N latitudes and $92^{\circ}9'39.47''$ E longitudes) is located around 3 km eastward from the NH 37 towards Jagiroad, an elevation of 55.40 m above mean sea level. The village is populated mainly with Karbis and a few Assamese. The megaliths of Dakhin Topatoli are found in and around the present settlement of the village. The megaliths were installed at two different places at a distance of 150 m from each other (Plate 2. 8). The menhirs of Locality II are mainly recently erected or modern structures.

In Locality I, there were sixty-five menhirs with associated sitting stone slabs arranged in two rows. These were erected or installed during ancient times. The height of these menhirs varied from 35-30 cm. There were 145 menhirs with associated sitting stone slabs installed in 5 different rows in Locality II. The height of these menhirs varied from 60-100 cm. The recently installed memorial stones were wrapped with white clothes; sometimes, offerings such as lamps and betel nuts can be seen there. The erecting of Menhirs is a living tradition among the locals, which the locals further confirm.

Diksak village ($26^{\circ}6'1''$ N latitudes and $92^{\circ}8'58''$ E longitudes) is located around 400 m eastward from the NH 37 towards Jagiroad, around 3 km westward to Dakhin Topatoli village at an elevation of 59 m above the sea level. The Megalithic structures were discovered at the hill mound, and most menhirs were buried. It was observed that the hill was quarried recently. Few menhirs were not visible due to the dense vegetation growth around the structures. Around 115-120 menhirs were installed, whose height varies from 100-200 cm. Most menhirs were covered or half-buried due to the soil coming out from the quarried mound.

2.5.4 Umsiang region (Ri-Bhoi, Meghalaya)

Umsiang is a Block in the Ri-Bhoi district of Meghalaya state and 7 km from Topatoli at NH 37, Assam. Several villages come under Umsiang Block. The whole Block and nearby area are a hilly terrain with dense vegetation. The region is mainly populated by the Tiwa tribe and a few Khasi tribes. Most of the population follows Christianity, whereas only a few follow their indigenous tribal belief. Several villages were surveyed during this course in the Umsiang region. The geographical and socio-cultural aspects of these settlements and demography are somehow similar. Agriculture is the main sustenance of the locals, and Jhum cultivation is common among locals. Rubber plantation and betel nut plantation are done for commercial and personal purposes. The drainage pattern of this area is good with the season and perennial water channels. The Killing river (combined channel of the Umiam and Umsiang rivers in the study area) flows from this region and further meets with the Kolong River in the Morigaon district of Assam.

The locals have several reports of accidental findings of stone celts and potsherds. Our exploration began with the information of these findings. We started a systematic investigation of different villages of the Umsiang Block, which focuses on the settlement area, hill mounds, villages road, slopes, rain gullies, cultivation land, water channels, and bank of rivers. The locals identified the stone celts and Megaliths with the help of photographs shown to them. There are different findspots located in the region mentioned below.

Maiong village (26° 2' 46.70" N latitude and 92° 8' 36.50" E longitude) is located within the Umsiang Block 8 km from the Topatoli, NH37 Assam, at an elevation of 262 m above mean sea level. The reports of accidental findings of stone celts are widespread among the locals. The exploration in Maiong village reveals potsherds on the hill tracks, village roads, and rain gullies. Almost every person from the village identifies the stone celts. The stone celts had been collected by them during the cultivation on the slopes or hills. Some people recognize them as 'Thunder axe or stone.' There is also an association of fear with these artifacts (if they keep these celts in their house, it is likely that thunderstone may be stuck on them). Few locals said they did not find any importance in that piece of stone; therefore, they threw them away.

Maska village (also called Muska, 26° 3' 34.61" N latitude and 92° 13' 59.77" E longitude) is located around 28 km from Topatoli, NH 37 (Assam) and 16 km from Nelli (Assam) in Ri-bhoi district of Meghalaya at an elevation of 103 m above mean sea level. This small village is mainly populated by the Tiwa tribe and covered with dense forests. The present settlement is primarily on the hill and slopes. The report of several accidental findings of stone celts is prevalent among the locals. The concept of 'Thunder axe or stone' is similar to the other neighboring villages. Potsherds have been reported from the hill tracks and rain gullies. The potsherds were in tiny fragments with no decoration or impression over the surface.

A village named **Makdah** (26° 3' 54.98" N latitude and 92° 12' 52.74" E longitude) is located further on the same road of the Maska village on a low slope at an elevation of 70 m above mean sea level. The socio-cultural and ecological setting of the village was similar to earlier. The exploration in the present village reveals several findspots. The ethnography survey reveals similar observations regarding artifacts as mentioned above. The observation and informal interview methods were used to understand the socio-cultural behavior and association or belief to the archaeological artifacts among locals.

Amjong village (26° 3' 07.45" N latitude and 92° 14' 47.82" E longitude) is located around 10 km from Neli (Assam) in the Ri-bhoi district of Meghalaya at an elevation of 92 m above mean sea level. The present village is geographically and demographically similar to the earlier mentioned villages in the Umsiang region. Several celts have been studied, and photographs have been taken from the personal collection of the locals. The accidental finding of celts among the locals during the cultivation and other digging work is widespread.

Lymphuid village (26° 0' 38.11" N latitude and 92° 13' 14.87" E longitude) is located around 3 km southward of the Amjong village at an elevation of 256 m. The village is populated by the Tiwa tribe and surrounded by dense forest. During the exploration of this village, Megalithic structures have been reported on the top of a low hill mound. The location was covered with dense vegetation and partly buried as well scattered. Menhirs were scattered at the top of the hill, and due to their location, luxuriant vegetation, and buried context, it was not easy to measure and numbered them appropriately. However, the place was cleaned as much as possible, and documentation of the Megalith was done (Plate 2. 9). 18 Menhirs were found, which were 20 to 90 cm in length and 25 to 30 cm in width. The condition of the Menhirs suggests that it was discarded or the place was in isolation for an extended period.

The Tiwa people deny any Megalithic tradition associated with their culture or tradition. The Tiwa people called these monuments “*Orlong*,” which means stone in the Tiwa language.

Potsherds have been reported as surface collection near the mounds, hill tracks, rain gullies, village roads, and cross-sectional areas exposed to erosion. The fragments of potsherds were tiny and thin. Due to erosion, a single stone celt has been collected from the hill track. The locals have reported several stone celts; few celts have been studied from the collection of locals. These were most shouldered celts.

Amkhang village (26° 0' 22.55" N latitude and 92° 12' 1.53" E longitude, 378 m AMSL) is located around 5 km southwest of the Lymphid village hilly terrain with dense forest at an elevation of 239 m above mean sea level. Potsherds have been reported from different areas in this village, and most of the findspot resulted from erosion due to water channels and rain. Potsherds were in large number over the hill slopes due to rain wash. The occurrence of stone celts is relatively high in this locality. The locals have collected several stone celts during their agricultural and other works. During exploration, two stone celts were collected from the rain gullies near the slope.

Kraikijam village (26° 3' 34.19" N latitude and 92° 10' 5.19" E longitude) is located around 3 km northward to the Maiong village at an elevation of 194 m above mean sea level. The accidental finding of stone celts is widespread in all these localities. There was plenty of rock source or rock boulders. Potsherds were recovered from different village locations, such as rain gullies, eroded surfaces of the mound, and hill tracks. Two stone celt were collected from the eroded surface on the hill slopes as surface collection during our exploration. Locals identified the celts by the pictures shown to them. We also found stone celts kept in the houses or farms of locals.

Further, the exploration located a megalithic site. The Megalithic monuments at Kraikijam village (26° 3' 50.4792" N latitude and 92° 10' 15.7584" E longitude) were covered with dense vegetation. The locals did not identify or consider these monuments as part of their cultural practice. The site is located at the foot of a hill separated by a narrow strip of agricultural land and was located or discovered due to a sitting stone's long-standing Menhir (250 x 80 cm). The site was covered with dense vegetation like in the Lymphuid village. We cleared the area as much as it was possible. We found around 20 Menhirs with their associated sitting stone other than one long-standing Menhir (Plate 2. 10). The length of these

Menhirs varies from 40 to 120 cm and breadth from 20 to 40 cm. Most of the Menhirs were dislocated from their original positions or scattered.

2.5.5 Umswai region (West Karbi Anglong, Assam)

The present study area of Digaru – Kolong river valley comprises a small part of the West Karbi Anglong district of Assam. Umswai valley in West Karbi Anglong is a transitioned landscape from broad flatland to serpentine curves of the hills. The region is also famous as an emerging ecotourism destination. The area is located remotely on the Karbi – Meghalaya plateau, surrounded by beautiful hills. It comprises a cluster of villages, primarily inhabited by the hill Tiwa tribes, followed by Karbis and a few Khasis. The majority of the population has adopted Christianity. Jhum cultivation and Eco-tourism or rural tourism are the locals' primary subsistence patterns. Jagiroad is the nearest town at a distance of 39 km. The region is less connected to the chaos of the city as the frequencies of public transport are minimal. Villages were scattered over the slopes, and the houses were scattered at a distance.

Including this region in the study area was based on different factors. First, this region is situated adjacent to the Umsiang region (Ri-Bhoi) and is a continuity of the western side of the study area. This region's socio-cultural, demographic, and ecological settings are similar to the neighboring regions mentioned above. The accidental findings and stray references to artifacts were widespread in the area. Mitri (2009) suggests this region along the northern part of the Ri-Bhoi region was the entry point to the Khasi and Jaintia Hills for the Neolithic dwellers. He further claimed this region as a direct offshoot of the outlier Neolithic from the Cachar Hills and Karbi Anglong region. Therefore, to understand the archaeology and material culture of the Digaru – Kolong river valley, it is essential to examine the location and relation with the Karbi Anglong region.

During our present field survey, we explored the region by walking across the landscape. The exploration focused on the agricultural field, hill slopes, hill tracks, and village nearby. Different localities or villages were surveyed with the help of locals in the valley. The exploration reveals several findspots comprising potsherds, stone celts, and megaliths (Plate 2. 11). The potsherds and stone celts were reported as surface findings with no reference to stratigraphy. Due to the dense vegetation, it was challenging to trace the surface. We found several Megalithic sites in the same condition as in the Umsiang region of the Ri-Bhoi district of Meghalaya.

In **Bormorjong** village (25° 55' 49.89" N latitude and 92° 12' 27.0504" E longitude), we located two Megalithic sites at an elevation of 620 meters above mean sea level. First, one long Menhir (250 x 244 cm) is installed at the side of the village road. Around 200 m northwest of the location, the locals protected 12 menhirs with associated sitting stones inside a cemented hall. A close observation of these Menhirs suggests that these were collected from different places in the village and installed there. A few people, primarily the Non-Christian community, considered them part of their ancestors or past cultural practices.

Similarly, several villages such as Umsetri, Shikdamakha, and Amsai village are located in this region. The village road followed the Umswai main market to several villages from its pathways. At an elevation of 632 meters above mean sea level, **Umsetri village** is (25° 55' 35.193" N latitude and 92° 11' 59.496" E longitude) located less than a kilometer from Bormorhong on the same village road. A long-standing menhir (217 x 105 cm) is located near the village road in Umsetri village. At the top of the mound at **Amsai village** (25° 56' 3.96" N latitude and 92° 14' 10.77" E longitude), more than 500 small menhirs are associated with sitting stone at an elevation of 713 m above mean sea level. Due to the dense vegetation, forest, and compact installation of Menhirs, it was not easy to know the exact numbers of Menhirs. The village market of Amsai is situated on the outskirts of the settlement. Four long-standing menhirs are installed in front of the gateway towards the market.

Shikdamakha village (25° 56' 39.57" N latitude and 92° 13' 18.74" E longitude) is located in the center of the Umswai valley and surrounded by the hills at an elevation of 631 m above mean sea level. The village is a popular destination in the West Karbi Anglong district and is known for its panoramic view of the Umswai Valley, rural tourism, and sanitation. The village is inhabited mainly by Christian-dominated Tiwa people. Menhirs have been located at several places around the village. Three menhirs were installed at the village entrance with the statue of Jesus. According to the locals, the figure of Jesus was installed on the occasion of the village day celebration.

Further, the exploration reveals two (2) stone celts from the section exposed erosion. The accidental findings of the stone celts were prevalent among the locals. Another village in the Umswai valley named Kalbari was explored. **Kalbari village** (25° 57' 15.66" N latitude and 92° 13' 44.09" E longitude) is situated at the hill at an elevation of 676 m above mean sea level. The region is geographically and demographically similar to the villages mentioned above in the Umswai valley. A stone celt has been collected from the hill track from the

village. The exploration in the village reveals several find spots comprising potsherds and a report of the local's accidental finding of the stone celt. The region further indicates high potentiality in archaeological research.

Part III: Settlement Pattern and Site Formation Process

2.6 Settlement Patten of the Prehistoric communities in the Digaru – Kolong River Valley.

The study of prehistoric settlements has a significant place in archaeological studies. It has a central position in studying the history of humankind in the context of communities and provides an essential aspect of the interrelationship of men and their environment. It examines the traces of human activity distributed over the landscape through time to shedding insight on the nature of prior human relationships and between humans and the environment (Ashmore and Willey, 1981, pp. 3-4). Settlement pattern research has a vibrant tradition in archaeology ranging from intensive investigations of single sites to systematic regional surveys. It provides crucial information on ecological, demographic, and socio-cultural processes (Pandey, 2015).

2.6.1 Settlement Pattern Studies in Archaeology

G. R. Willey emphasizes the concept of settlement patterns in archaeology. Willey had played an essential role in developing this concept to interpret archaeological data. Willey is one of the essential American archaeologists of the second half of the twentieth century. He pioneered settlement pattern studies based on fieldwork in Peru's Viru Valley during the late 1940s and early 1950s. Archaeological site maps and site locations were mainly concerned by the archaeologists before the 1940s; very little attention was paid to settlement patterns. Willey (1953) addresses the relevance of settlement pattern studies as:

“The term ‘Settlement pattern’ is defined here as the way in which man disposes himself over the landscape on which he lived. It refers to dwellings, their arrangement, and to the nature and disposition of other buildings pertaining to community life. These settlements reflect the natural environment, the level of technology on which the builders operated, and various social interactions and control institutions that the culture maintained. Because settlement patterns are, to a large extent, directly shaped by widely held cultural needs, they offer a strategic starting point for the functional interpretation of archaeological cultures” (Willey, 1953, pp. 1-2).

He applied the settlement pattern approach of looking at archaeological evidence on a regional scale. His publication of *Prehistoric Settlement Patterns in the Viru Valley* represented a revolution in archaeology. He suggests that understanding the site's prehistory required considering the larger regional context instead of just looking at a place in isolation. He argued that settlement reflects a society's natural environment and level of technological sophistication and the influences of various institutions of social interaction and control on which the culture is maintained (1953, p. 1). The study of the settlement pattern at a larger scale reveals the geographical locations of cities of varying sizes. It suggests a hierarchically structured organization that helps the articulation of socio-political processes. He further expanded upon his work and emphasized that:

“Settlements are a more direct reflection of social and economic activities than are most other aspects of material culture available to the archaeologist. Because of this, settlement investigations offer a strategic meeting ground for archaeology and ethnology.” (1956, p. 1).

Concerning the status of settlement pattern study in archaeology, Willey argued that there is no settlement pattern approach to archaeology. He has used the settlement pattern approach to study past societies' structure and functioning. Other scholars have interpreted the settlement pattern approach considerably and contributed to this study.

K. C. Chang distinguishes 'settlement pattern' and 'community pattern.' He describes it in a geographical sense. He explains that settlement pattern is to be studied by considering physiography and the community pattern denotes the distribution of houses, therefore, social structure and communal life within a given ambient (Chang, 1968). B.G. Trigger (1965) said that:

“The settlement pattern is an expression of the societal aspects of ancient culture. The study of change in settlement patterns thus becomes study of the development of social and political organization”.

He observes that the role of ecology is left out of Chang's study of settlement (Trigger, 1965, p. 2; Sikka, 1989). According to S.J. Knudson, the settlement pattern is *“that unit which is created when a group of human beings occupies a particular geographical region to exploit its resources. The resulting distribution of sites is what most archaeologists refer to as a settlement pattern”*. He emphasizes three essential dimensions for studying settlement

patterns, i.e., Household structures, local groups-sites, and cultural – settlement patterns (Knudson, 1978).

The interest in settlement patterns arises in different types of investigations. The regional settlement pattern study is very significant and challenging work. It produces new and unexpected insights and builds a foundation for other studies at different scales. There are many other studies that have been done like Willey (1953) and others mentioned above, such as Winter (1967-69) and Fitting (1969) in North America; Adams (1965) and Wright (1969) in Mesopotamia; Coe and Flannery (1967) and Spores (1969) in Mesoamerica; Flemming (1971) and Jones (1960-61) in Europe; Hester and Hober (1969) and Trigger (1965) in North-East Africa; Kennedy (1969) in East Polynesia; Mughal (1982) in Cholistain region, Rouse (1972); Trigger (1977-78); Bettinger (1980); Parsons (1972); and Binford (1966, 1980).

Several studies on settlement patterns have been conducted in different parts of India. H.D. Sankalia played a brief role in the archaeological settlement pattern in India. The Paleolithic sites of Hunsgi-Baichbal are one of the most famous examples where several studies were conducted during the last four decades (Paddayya, 1979; 1982; 2006). It helps to understand the habitation patterns, seasonal behaviors, migration, food habits, and landscapes inhabited by pre-historic men. Further various significant studies were carried out by different scholars such as N. Akhtar (1972) in Northern India, M.K. Dhavaliker and G.L. Possehl (1974), Y.M. Chitalwala (1977, 1982) in Western India, S. Bhan (1977), M.K. Dhavaliker (1977, 1978, 1983) in Deccan, K.N. Dikshit (1979), M. Lal (1985) in Ganga-Yamuna Doab, V. Shinde (1984, 1990), V.H. Sonewane, and R.N. Mehta (1985) in Gujarat, M.L.K. Murty (1989) in the Lower Godavari, Krishana river basin, D. Raju (1985, 1990) in the Lower Krishana Valley, R. Ray (1987) in Eastern India and Venkatasubbaiah (1992) in the Pennar Basin; V. Pawar (2013) in Hanumangarh District (Rajasthan); R.C. Thakran (2000) in the Sonipat, S. Malik (2006) in Hansi, N. Parmar (2008, 2013) in the Bhiwani and Appu (2009) in Julana Block all in Haryana state.

2.6.2 Settlement pattern in Northeast India with reference to the present study area

The archaeological research in the Northeastern part of India indicates that the Neolithic men inhabited different zones in the region. Neolithic sites have been reported in all the states of Northeast India. Based on the locations of the sites, the settlements were mainly found in the mountainous zones, the plateau areas, and the alluvial tract (Ray, 1983, p. 484). The stone

tools and pottery discovered in these areas indicate the settlement pattern and subsistence of the prehistoric people. The sites reported from the Meghalaya reveal many Neolithic tools and potsherds from Garo and Khasi Hills. The two famous reported sites from Assam, viz., Daojali-Hading and Sarutaru, have yielded a large number of potsherds and stone celts. The communities inhabiting these regions were probably practicing the shifting cultivation. The majority of sites reported in these regions were on the hills. The preference for the settlement on the mountain continues among several tribal communities of the area.

The present study area of Digaru – Kolong river valley comprises the region of the foothills of Assam and Meghalaya states of India. The vast alluvial plains of the Brahmaputra plains surround the study area from the north and the hilly and alluvial terrain of the Meghalaya Plateau from the south. The study area has a vibrant landscape of plains, plateau, rivulets, lakes, and hill slopes. The southern zone of the study area is geologically part of the Shillong Plateau. The landscape has dense vegetation and sub-tropical and wet climates with heavy rainfall. The Neolithic sites and findspots have been located in the Brahmaputra valley's hilly terrain, slopes, and alluvial plains. As mentioned above, the present study area is primarily inhabited by Karbi, Tiwa, and Assamese. The settlements are mainly on the hilltops and the edges of the hills. The settlement pattern or the dwelling structures around the National Highway (such as in the Jorabat, Sonapur, and Khetri region) are mixed, viz, town settlements having cemented dwelling structures and village dwelling structures.

The Karbis inhabit the hilltops and edges of the hills. Medhi (1991) describes Karbis changing their habitational sites with the jhum or shifting cultivation and primarily settled near a stream or a river for water requirement. He further mentioned that the Karbis inhabited sedentary settlements, and the settlement pattern of the Karbis occupying the hills is different from the plain Karbis (Medhi, 1991, p. 9). The village of the Karbis comprises 20 to 30 households of close relations and tight bindings in the day-to-day activities and other ceremonial or festive occasions. The villages of the hill Karbis are mostly scattered across hilltops, whereas in the plains, the villages are compact. The dwelling structures are similar to the Neolithic phase of bamboo and wood with mud. The wattle and daub house construction methods can easily be found in the villages. Bamboo is an integral part of their subsistence and settlement pattern and used for different purposes. The villages are connected with the hilly road, mostly *kaccha* roads. Most houses have attached kitchens, granaries, and animal sheds.

A typical Karbi and the Tiwas house are made from natural materials. They mostly use wood, bamboo, mud, reed, and jute. The Karbi hut is built on a bamboo platform a few feet high above the ground. The walls of the house are made of bamboo and are mud-plastered. The courtyard is an essential characteristic of the housing pattern, generally attached to the house for several activities. Weaving is very common among the locals, mainly among the females, and they can be seen in the house's courtyard. Bamboo, cane, palm leaves, and thatch are used for roofing purposes. Granaries are mostly attached to the house, or a corner of the house is used for storing grains. Granaries are also built on raised platforms separate from the house. The walls are built similar to the house roofing with thatch. The mixture of mud and cow dung is used for plastering the walls made of bamboo with only one opening. The animal shelters are built away from the houses or nearby. These are constructed similarly to homes with separate or different entrances.

The Tiwas are another dominant community in the study area. The settlement pattern of the Tiwas is similar to the Karbi tribes. The Tiwas can be divided into two groups as per their settlements, the Hill Tiwas and the Plain Tiwas. The Hill Tiwa live in the Ri-Bhoi district of Meghalaya and West Karbi Anglong district of Assam, whereas the Plain Tiwa primarily inhabit the Kamrup and Morigaon districts. As the name suggests, a large Tiwa population inhabits the hilltops, like in the Umsiang and Umswai regions. Generally, open hilltops are selected for the settlement for good sunlight. Some Tiwa settlements are located in the plains or at the edges of the hill. The geographical or topography of the territory has a crucial influence on the life of this tribal community. According to the socio-religious memory and beliefs of Plain Tiwas, they migrated from the hills. The household structures of the Tiwas are also very similar to the Neolithic settlements.

The village of Tiwas is scattered, and houses are located at some distance from each other. There are around 30-100 households inhabits in the village. A traditional Tiwa house in the highlands includes a compact kitchen garden and a courtyard surrounded by bamboo stakes on all sides. The bamboo stakes around the house or the fencing called *pera* to protect the home from wild animals and have only one entrance located in front of the house. The houses are built with locally available materials such as bamboo, wood, cane, thatch, and grass for roofs. The prominent structures of the Tiwa settlement are individual houses, animal shelters, and community halls (Raktim, 2018, p. 37). The Tiwa houses are constructed on a raised platform with a rectangular design and slanting roof. An open platform is generally attached

to the house for various activities. The walls are short and mostly lack windows. The granary is connected with the house, mainly among the Hill Tiwas. The animal shelters in the Tiwa houses are built separately in a large rectangular compartment. These shelters are generally for animals like pigs, chickens, and goats. The community hall or the *Shamadi* is another crucial part of Tiwa village and represents a socio-political-judicial and religious institution. Apart from the individual houses, animal shelters, and community hall, other huts or structures are constructed in the field, known as crop watching huts or tree houses. It is used to watch the jhum field from wild animals.

The non-tribal population of the region, such as the Assamese, inhabit mainly modern architecture with concrete houses. However, communities inhabiting the hilly and forest region follow the traditional settlement pattern or are mixed. Nowadays, tin sheets are commonly used for roofing and walls made of concrete.

2.7 Subsistence Pattern

The artifacts recovered from the prehistoric site of Northeast India play a crucial role in understanding the region's subsistence pattern. The tool assemblage from the archaeological site of Daojali Hading comprises grinding stones, querns, and mullers with tanged and shouldered celts (Sharma, 1966). The tool assemblage from Sarutaru consists of shouldered celts and potsherds (Rao, 1977). Similarly, the archaeological sites from the neighboring regions, such as in Khasi and Garo Hills, comprise similar tool assemblages (Sharma, 1967; IAR, 1967). These tools were probably used for food processing or grinding grains during the Neolithic period. The dominant tool types discovered were tanged or shouldered celts, indicating they might be used as hoes. The dominance of hoes indicates an essential tool for agriculture. This further explains that these communities might have lived in semi-permanent settlements whose subsistence was based on food production and shifting cultivation in the hilly and alluvial regions (Ray, 1983, pp. 478-482; Sankalia, 1977).

The shifting cultivation in the Northeastern part of India is ancient, which is still embedded in the culture of people residing in the present study area. Rice is the principal crop, and several others, such as vegetables, betel nuts and leaves, and potatoes. Bamboo is used for several purposes, such as cooking, storing, to construction. Besides shifting-cultivation, gathering, hunting, fishing, and domesticated animals are other food sources. The locals generally collect wood, bamboo, cane, honey, etc., from the forest and hunt pigs, deer, squirrels, and

several other birds. Rao (1977, p. 193) states that hunting and fishing are essential to complete people's livelihood. The consumption of Rice beer is one of the crucial dietary practices among the people in the study area. It is prepared by the fermentation of the cooked rice and served in their day-to-day life, rituals, and festivals.

Roy (1981) studied the modern agricultural pattern of the Garo Hills and investigated the past agrarian system. He studied the archaeological records of the region and tools utilized today for household, agricultural, and hunting-gathering activities. He pointed out the relationship as "Chronologically the culture under study is modern but economically Neolithic" (Roy, 1981, p.193). Similarly, the material culture of archaeological sites from the region indicates the settlement and subsistence pattern, which shows similarities to the present-day tribal population (Rao, 1973, 1977). Chapter V analyses the co-relation of the archaeological data with an ethnographic study of the present communities to understand the socio-cultural beliefs and man-land relationship.

2.8 Site Formation Process in Digaru – Kolong river valley

Archaeological sites are created in a specific environment with human behaviors, material evidence, and leftovers. The formation process refers to the events that created and modified it before, during, and after human habitation. The site formation process investigates and describes human activities, natural and environmental factors, and geochemical processes forming and shaping the archaeological materials after deposition. The site formation process describes the rate of deposition or depositional and post-dispositional history of the site, along with the duration and intensity of human occupation (Ahsan, 1993, 2-3). The site formation continues to alter and change the archaeological material and site settings (Friesem et al., 2016, pp. 2-25). Ahsan (1993) divided the agencies that influence the site formation process into cultural and noncultural formation processes. Studying the site formation process is vital in understanding an area's nature and character.

The site formation studies have been conducted using modern methods in several parts of the globe by scholars, such as Isaac (1967), Gifford (1980), Schiffer (1972, 1987), Butzer (1982), Villa (1983), Waters (1992), and Goldberg and Macphail (2006). Several studies also have been conducted in India to understand the site formation process of sites. Several scholars have studied the formation process in various regional contexts, such as Paddayya (1987), Paddayya and Petraglia (1993), Ahsan (1993), Pappu (1996), and Mishra *et al.* (2009).

2.8.1 Field Observation: Slope Instability and Rearrangement of Sealed Sites

The character or the nature of the prehistoric archaeological sites and findings of this area is significant. The northern part of the study area is flat or plain compared to the southern region. The phenomenon of erosion or slope instability is noticed in the study area's southern part, which comprises the hills and slopes. However, this problem or the slope instability in the northern region, which includes low slopes and sporadic hills or undulating landscapes, is deficient. The southern part comprises the Meghalaya Plateau's hill range, and the northern part is comparatively flat with sporadic hills and more stable than the south. Thus, the terrain is different in both areas. Cultural residues are exposed on the surface in surface sites due to erosion of the top layers and exposure by various disturbance processes.

Slope instability or the rearrangement of sealed sites in a place is a vertical movement of buried sediments, variably affecting particles of different mass, shape, and material, leading to changes in inclination, orientation, and vertical or horizontal position distorting or eliminating the original three-dimensional relationship. Due to the erosion and deposition of the sedimentary matrix, artifacts move continuously, and mounds, almost replicating habitation mounds, form at regular intervals on the landscape, building a secondary context. This movement of geological deposits and unstable slopes further creates difficulty tracing the site in the primary context. Slope instability is the failure of slopes due to external and intrinsic factors or the low balance of shear stress and shear strength (Butzer, 1982). Slope instability causes downward and outward movement of the entire soil mass that participates in the failure. There are several reasons which cause slope instability. These are the actions of gravitational forces, seepage forces within the soil, rainfall, and excavation or undercutting of its foot (Salunkhe *et al.*, 2017). Erosion and deposition are simultaneous processes but do not always happen at the same place. Deposition in some areas creates a sedimentary record. Due to deposition, a single location may acquire a succession of sediment units that record repeated landscape events, however small or brief (Butzer, 1982, pp. 43-44).

During field reconnaissance, erosion and re-deposition of sediments are widespread in the study area due to heavy rainfall and slope instability. The slopes in this area continuously erode the surface and create secondary deposits. The rainwater, seasonal nullahs, and other water streams erode the mounds and wash out the sediments from their primary context. The artifacts from sealed sites are carried out by the water channels or rain gullies in different locations as per the intensity of the water channels. Due to this, the artifacts move

continuously, and mounds, almost replicating habitation mounds, form at regular intervals on the landscape, building a secondary context. In the secondary context, the artifacts are primarily found in rain gullies, quarried hill slopes, or river terraces. This movement of geological deposits and unstable slopes further creates difficulty tracing the site in the primary context. This situation has had a prolonged effect on the prehistoric archaeology of Northeast India. The sporadic finds indicate the potentiality of the area as far as prehistoric archaeological research is concerned.

The Digaru-Kolong river valley consists of plain, crest slopes, mid-slopes, and foot-slopes. The slopes in this area continuously erode the surface due to mass movements of surface water, rain, human intervention in quarries, and road cutting. The quarrying of hills for different construction purposes can easily be noticed around the region. Shallow deposits build up on the mid-slopes and the foot slopes. These deposits consist of the slow accumulation of rock rubble, soil on unstable hillsides, and soil products by the gradual movement of particles called rain wash erosion (Butzer, 1982, pp. 53-54). The accumulation of soil along foot-slopes helps to preserve the archaeological sites. Such accumulation has severe implications on our understanding as up-slopes or upland sites can be eroded and then re-deposited on foot-slopes. Archaeological materials or objects of different sizes and materials get rearranged on the landscape.

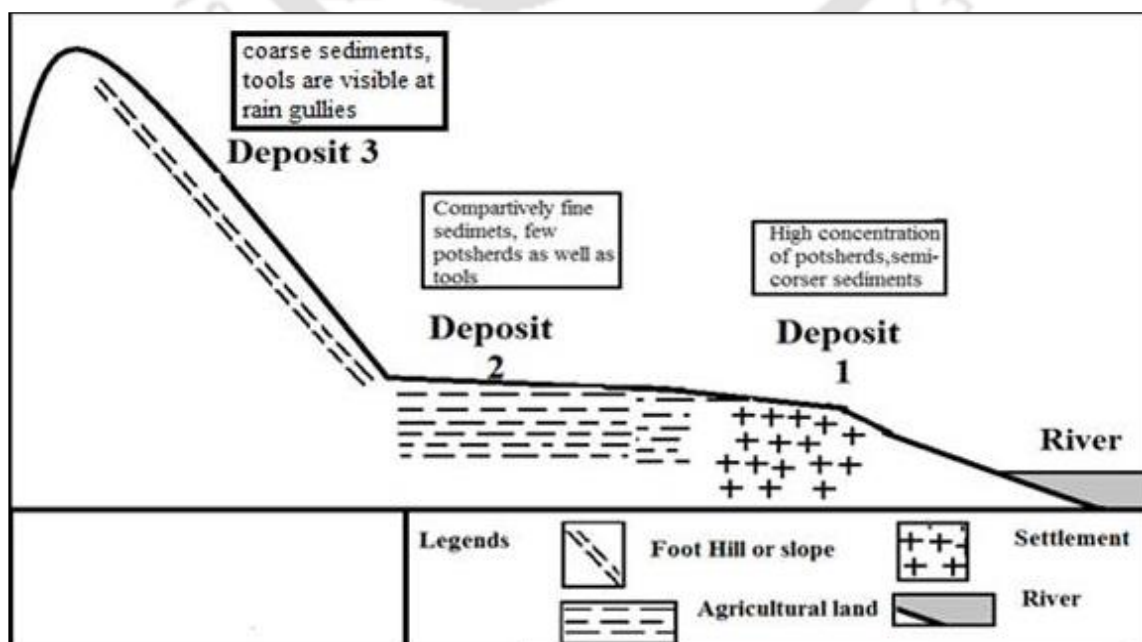
In addition to the Kolong, Kopili, and Digaru, there are several other essential tributaries, numerous channels, and streams in the study area. These river channels or water bodies play an essential role in eroding the soil of the region. The area also comes under the heavy rainfall zone, due to which seasonal rain gullies form on the hill slopes and erode the slopes. The deposition and re-deposition or the movements of the sediments continue depending on the form and elevation of the area and the size and force of water channels or rain gullies. At a certain point in the landscape, sediments of different periods form mounds. Heavier contents like stone tools are deposited in the early phase of the deposition. At the same time, the lighter materials like pottery are carried to the point that the water loses its capacity to carry it. The re-deposited mound surface continues to erode again, and the sediments further spread out and get distributed.

Artifacts recovered during the exploration for the present study area are found in different contexts. Stone tools are exposed in the rain gullies located in the mid-slope and the foot slope during the rainy season. Potsherds were found on foot slopes as well as near the river or

water channels. In the particular spot where the rain gullies land in the plains, a trough or a basin-like depressed zone is formed on the landscape. Here the water sits for a while, depositing and recycling the sediments it carries down from the hills; this is the area used for agriculture. Stone tools and pottery sporadically occur in this area. Drainage below this level has a low intensity. The water from this area seeps out further down to the main river through narrow streams carrying the pottery particularly. Beyond this level, no stone tools have been found, but the density of pottery seen on the bank of the rivers is high. Two specific field observations point towards the role of farmers who might be cleaning their agricultural plot annually of the debris brought down from the hills, thus creating dumps of pottery on the roadside. Also, during the rainy season, low-intensity floods might occur. As a result, both the streams and the main river might deposit this almost weightless pottery and float in the water.

Thus, the re-deposition of sediments in this area can be divided into three zones (Figure 2. 10). Three types of deposits have been mapped in the area during the exploration. (1) On the bank of the rivers along with the road, unsorted semi-coarse sediments with a heavy concentration of pottery, (2) in the middle- a course which is a relatively flat area, used for agriculture today, comparatively fine sediments, few pieces of pottery occurring with grounded and polished stone tools, (3) upper course on the slope of the hill has coarse sediments which are cut-through by the streams but with grounded and polished tools only and pottery.

Figure 2. 10: Deposition of Sediments



The stone tools in the area are in a buried context, and they are only exposed in the rain gullies, section cuttings made by road buildings, quarries (deposit 3), etc. The Neolithic celts from the Silchang and Shankargog villages have been recovered from the foot slope. In deposit 2, in the agricultural field, they are deposited by the streams and nullahs, which lose the capacity to carry them further down. In Marakdola village, potsherds were found near the river and water channels (deposit 1). The water channel or streams from hills lost the intensity to carry the stone tool further and deposited it in 'Deposit 2'. However, potsherds are washed out due to their lightweight and move towards the deposit 1 area. On the slopes, deposit 3, there is a thick layer of humus created by annual tree litter, which is very high in the tropical zone. The rain gullies cut through this humus layer which is almost half a meter thick. The primary sites are buried under this layer, probably on the slope of the hill range, which is part of the Meghalaya plateau. This humus layer makes surface visibility very poor in tropical areas like the study area. This is also true of significant portions of Northeast India. Garo Hills has also reported similar phenomena (Sharma, 2007).

The above observation is evident from the study that the landscape is dynamic. Annually the sediments are recycled and re-deposited. This recycling and re-deposition are dependent on the intensity of the annual rainfall. In the light of this study, we found that the sediments in the area are recycled every year and re-deposited, creating secondary deposits and three different contexts; Deposit 1, Deposit 2, and Deposit 3.

2.8.2 Field Observation: Ethnographic Survey

The archaeological evidence is the product of discarded or leftover by the past societies formed over different conditions. The abandonment process is a significant stage in the formation of archaeological sites. The abandonment of sites and artifacts forms an archaeological pattern that can be understood by combining the ethnoarchaeological, ethnographic, and archaeological data with geography and time period (Cameron, 1993). The reconnaissance survey and ethnographic observation of the study area recorded the activities that resulted in the deposition of materials, and post-deposition influenced the preservation of these materials. The ethnographic data of this study provides important information regarding the use of space and material deposition patterns by the people. The outcome of the study conducted on contemporary sites and settlements recorded how peoples' activity resulted in the deposition of materials and how past deposited materials were exposed in the present context.

As discussed above, houses were built in modern and traditional styles using modern concrete mud and wood. In the study area (mainly in the hilly and forest region or not located near National Highway No 37 and near the city), houses were built from natural materials such as wood, mud, bamboo, and grasses; in some cases, mud bricks also used. A typical Karbi and Tiwa house is set on a flat terrace or elevated platform that removes the soil from the hill slope. Most houses have a roof and outline, creating a covered veranda on the part of the platform. Several activities were carried out in different locations outside and indoors. Sometimes activities change locations according to the immediate social needs or environmental factors. Due to food preparation and consumption, small shards of bones and the leftovers of vegetables, fruits, oils, other liquids, and ceramic utensils were deposited. Hearths generally were inside the house, sometimes secondary ones outside. The hearth outside is ephemeral and often abandoned after a few days of use, and a new fire started in another location. It used small amounts of fuel, mostly wood and cow dung. Metal objects such as steel and tin are used very commonly nowadays. Plastic is an integral part of today's waste as it is used to wrap items purchased in the markets. This resulted in the deposition of small chips of metals and plastics. The most crucial activity on a daily basis in terms of material deposition patterns was the sweeping of the terraces. The waste materials are typically re-deposited over the edge of the terrace by sweeping, resulting from small cumulative middens on the hill slope. This place (midden) was a designated area for repeated material deposition.

The abandoned sites or the homestead are now being covered with dense vegetation. The observable anthropogenic features in these sites were the potsherds, sporadic occurrences of stone celts, and Megaliths. Although the households in the study area still use ceramic utensils in cooking, storage, drinking, and other activities, the utilization is meager. If these houses become piles in sections today, such a thick surface will not be built. The only materials associated with human activity area or surface were small fragments of charcoal and potsherds in the excavation pits.

2.9 Remote Sensing

Remote sensing and Geographic information system (GIS) is an effective technological tool used in archaeological research. It has accounted for several crucial archaeological discoveries and provided significant capabilities in regional surveys. Aerial photography was the earliest tool utilized as a remote sensing study to understand the archaeological site

settings better and detect traces of past settlements. An aerial survey in archaeology has played a significant role in discovering many sites through aerial photographs. Today, remote sensing technique is equipped with a broad range of techniques, from conventional aerial photography to satellite imaginaries and geophysical surveys. Henry Chapman (2006, p. 9) emphasized the importance of remote sensing and GIS in archaeology by stating that:

“There can be no question that Geographical Information System technology has already made a tremendous impact on archaeology and that this impact continues to increase. Its use has both influenced and been influenced by all areas of archaeological research and practice.”

Parcak (2009, p. 3) describes the importance of remote sensing in archaeological research in the following words:

“Remote sensing is a term that refers to the remote viewing of our surrounding world, including all forms of photography, video and other forms of visualization.”

He further incorporates that satellite remote sensing can provide a snapshot of an entire landscape at various resolutions and scales (Parcak, 2009, p. 3). Several satellite images provide scope for aerial archaeological investigation, such as Google Earth, Bhuvan (ISRO), and USGS. The various remote sensing applications help investigate the topography, elevation, palaeo-ecosystem, river system, environment, vegetation cover, and geomorphology.

2.9.1 Methodological Consideration for Remote Sensing and Mapping

Google Earth (Version 7.3) and Google Map (android mobile application) were used for mapping and locating sites during field reconnaissance. The site coordinates and elevation were taken by Garmin 72h GIS device. The coordinates obtained from the GIS device were cross-checked on Google Earth. The sites were traced on Google Earth through geo-coordinates obtained by GIS and plotted on the map. The Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model¹² (ASTER GDEM) version 2 and Shuttle Remote Topography Mission (SRTM) data were obtained from Earth

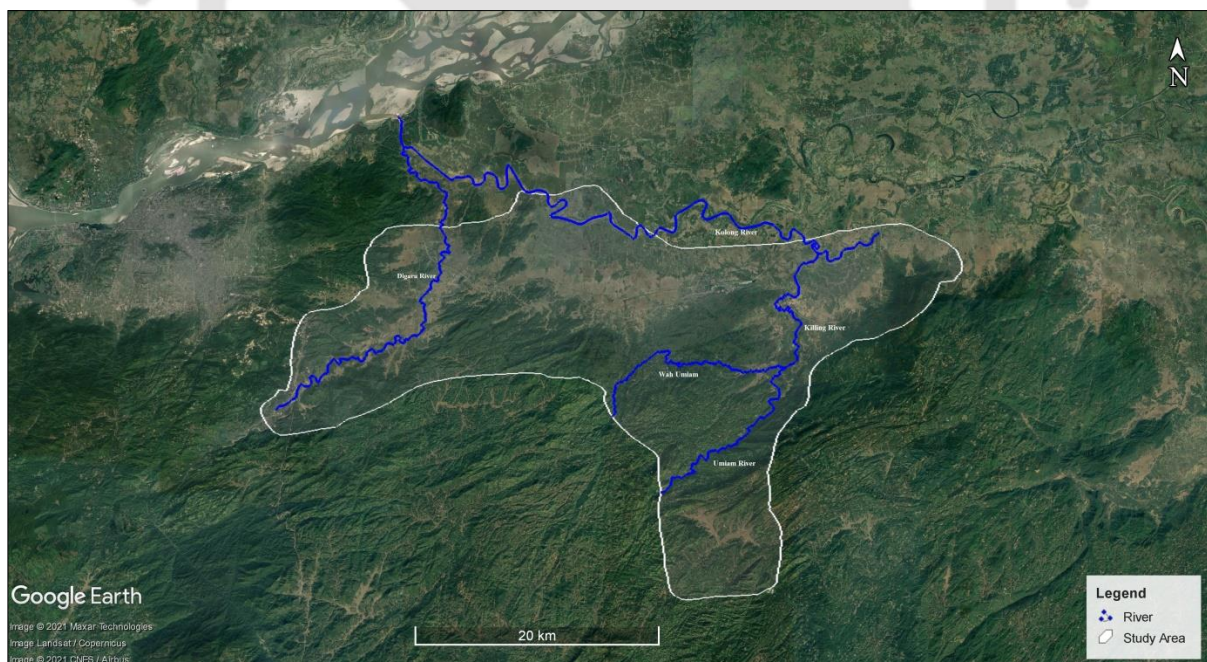
¹² ASTER GDEM has been produced as a joint activity of the Ministry of Economy, Trade, and Industry (METI) of Japan and the United States National Aeronautics and Space Administration (NASA). This covers land surfaces between 83°N and 83°S and is comprised of 22, 702 1° x 1° tiles. Each image represents a 60 x 60 km area. The Data are posted on a 1 arc-second (approximately 30m at the equator) grid and referenced to the 1984 World Geodetic System (WGS84)/1996 Earth Gravitational Model (EGM96) geoid.

Explorer USGS (United States Geological Survey) as raster tiles. The Google Earth Polygons were traced on the SRTM data to view their positions. The raster tiles were merged (mosaic) for the whole study area and processed using ArcGIS 10.2 software to convert them into elevation, contour, and other maps in different shades. All these geo-referenced data universally accept WGS84 as the datum point. The open-source satellite and aerial imageries provided by Google Earth and Bhuvan (Indian Space Research Organisation) were extensively utilized to study the topography and hill system of the study area,

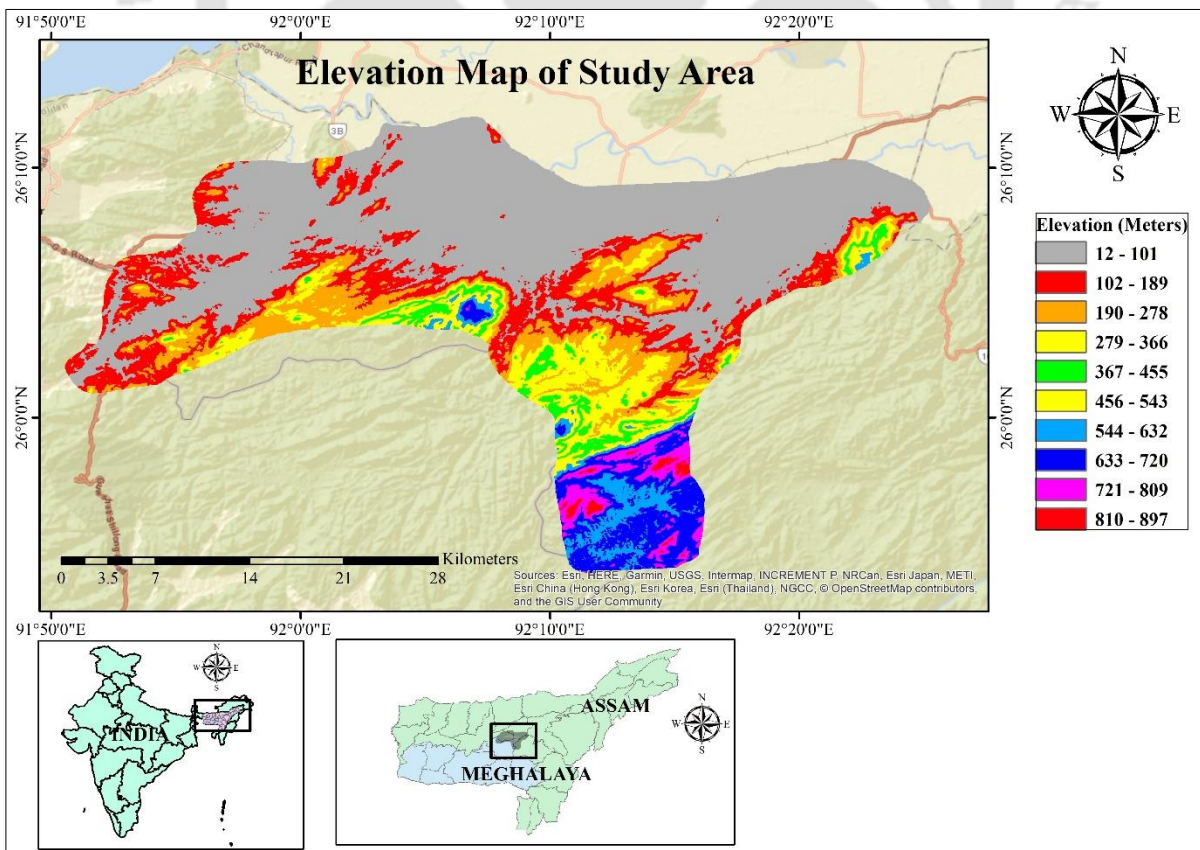
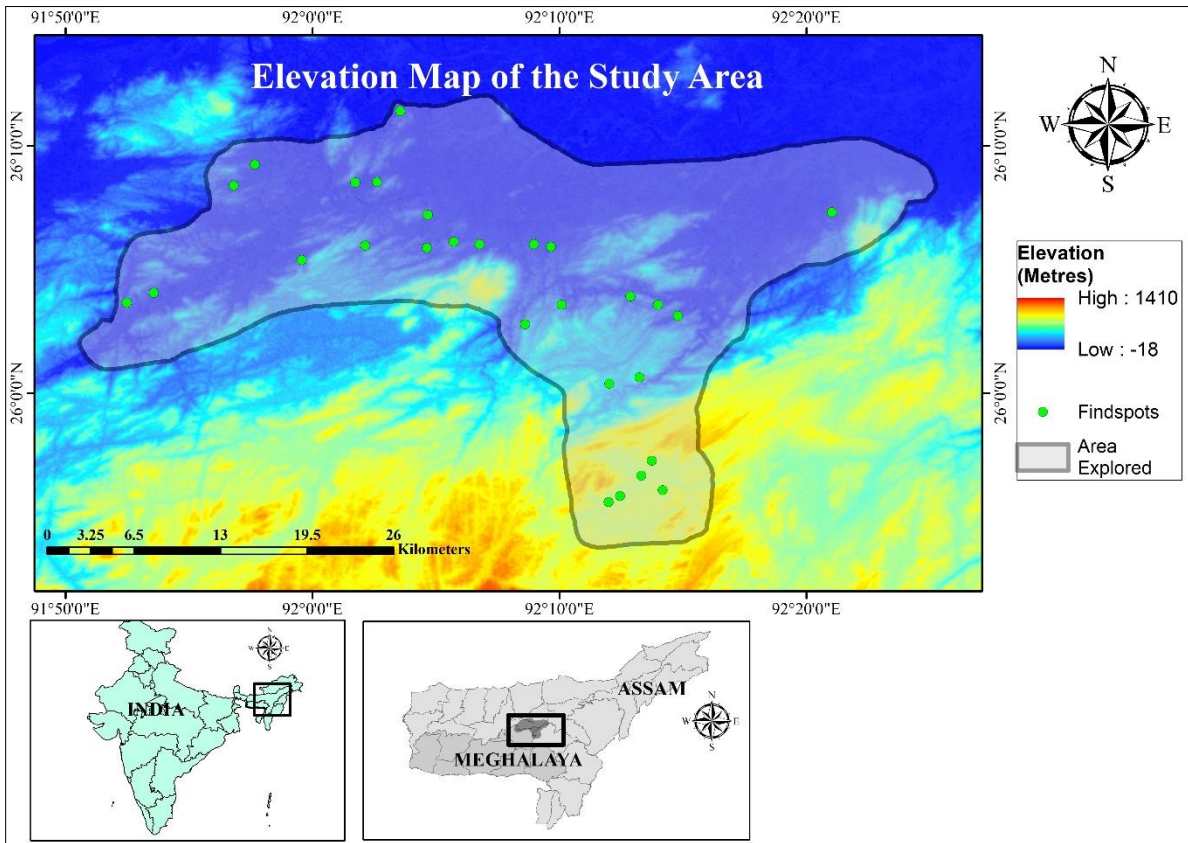
2.9.2 Aerial Mapping and Elevation Model

The Digital Elevation Model helps to understand the elevation of landforms on the earth's surface. This is a digital notation of the land surface elevation concerning any reference datum. It can be acquired through several photogrammetric, LiDAR, and land surveying techniques. ArcGis 10.2 and QGIS 3.20 software generated a digital elevation model that used remote sensing.

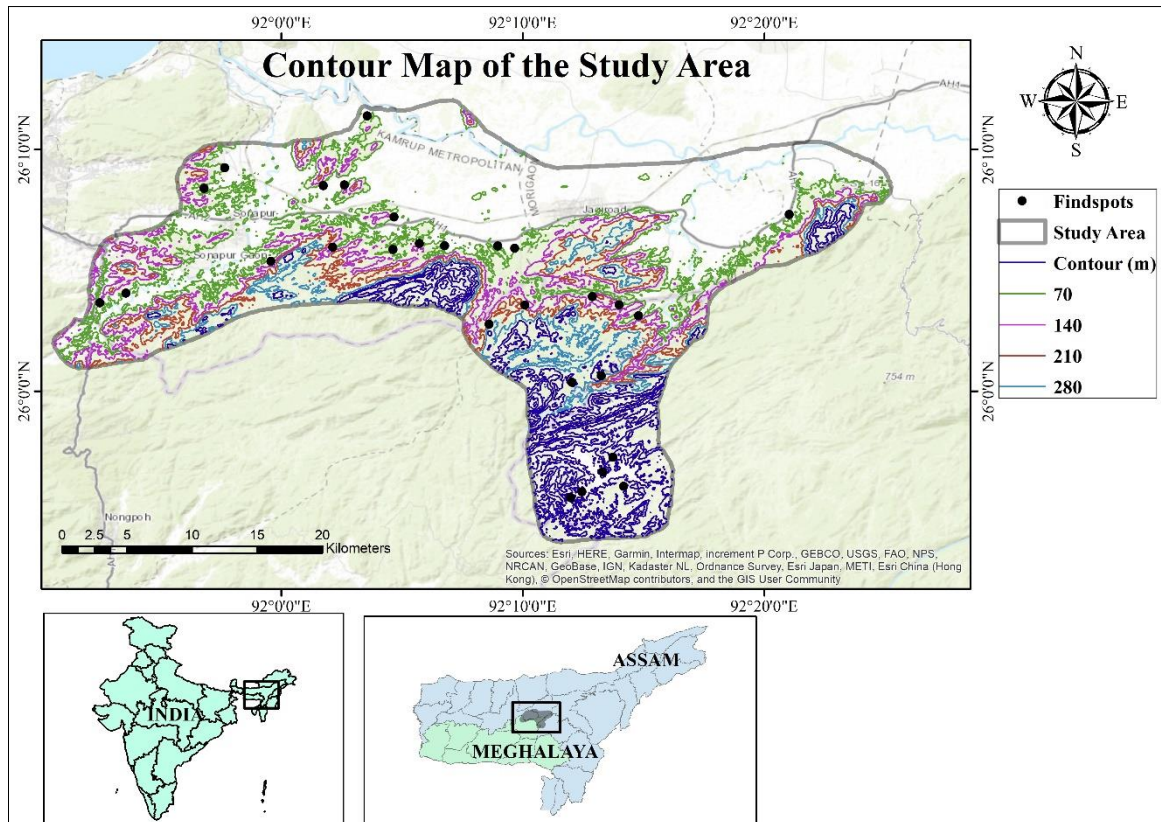
Map 2. 4: Google Earth Satellite Image of the Study Area showing important Rivers



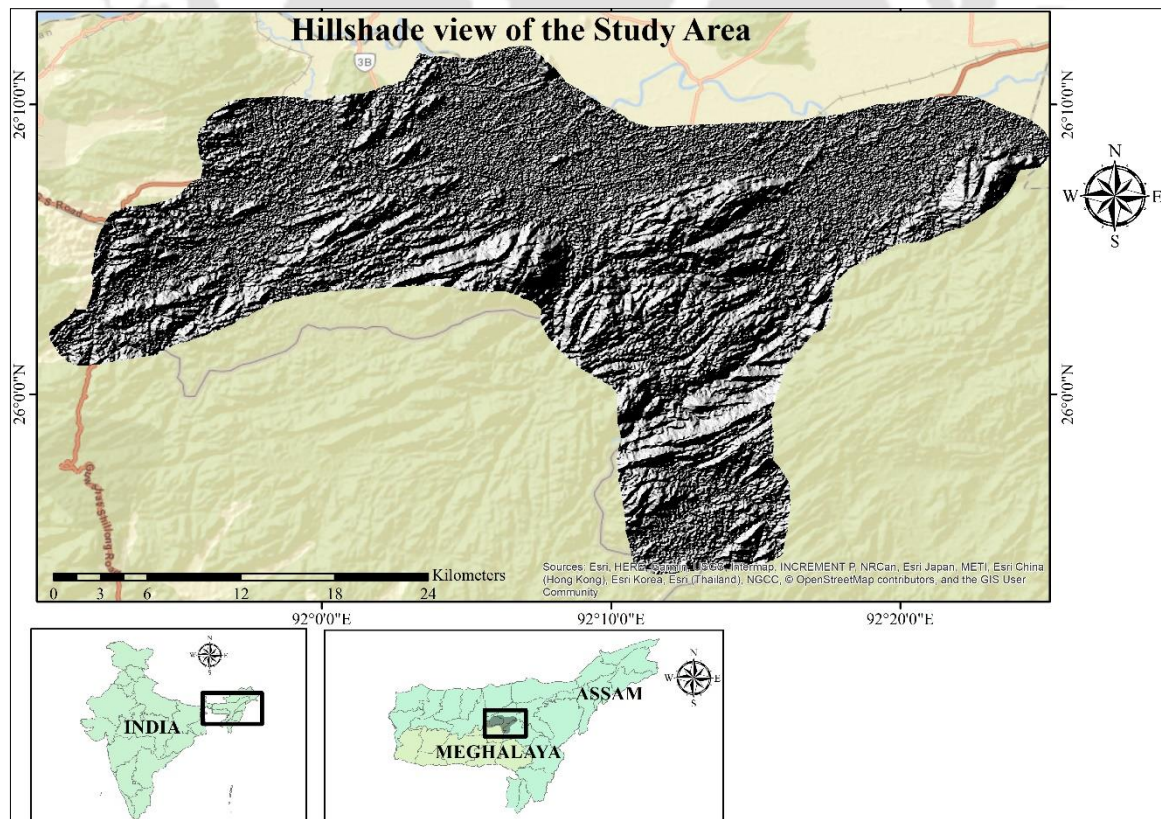
Map 2. 5: (a and b) Elevation Map of the Study Area



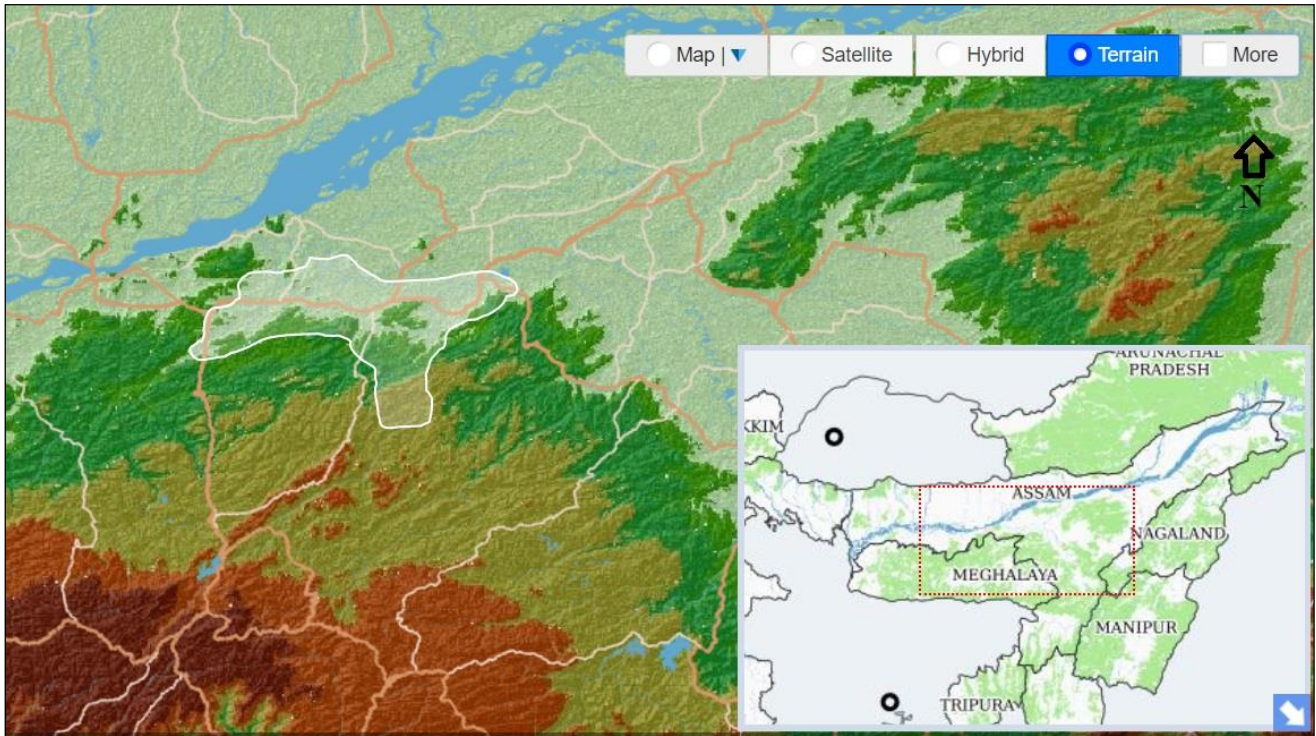
Map 2. 6: Contour Map of the Study Area



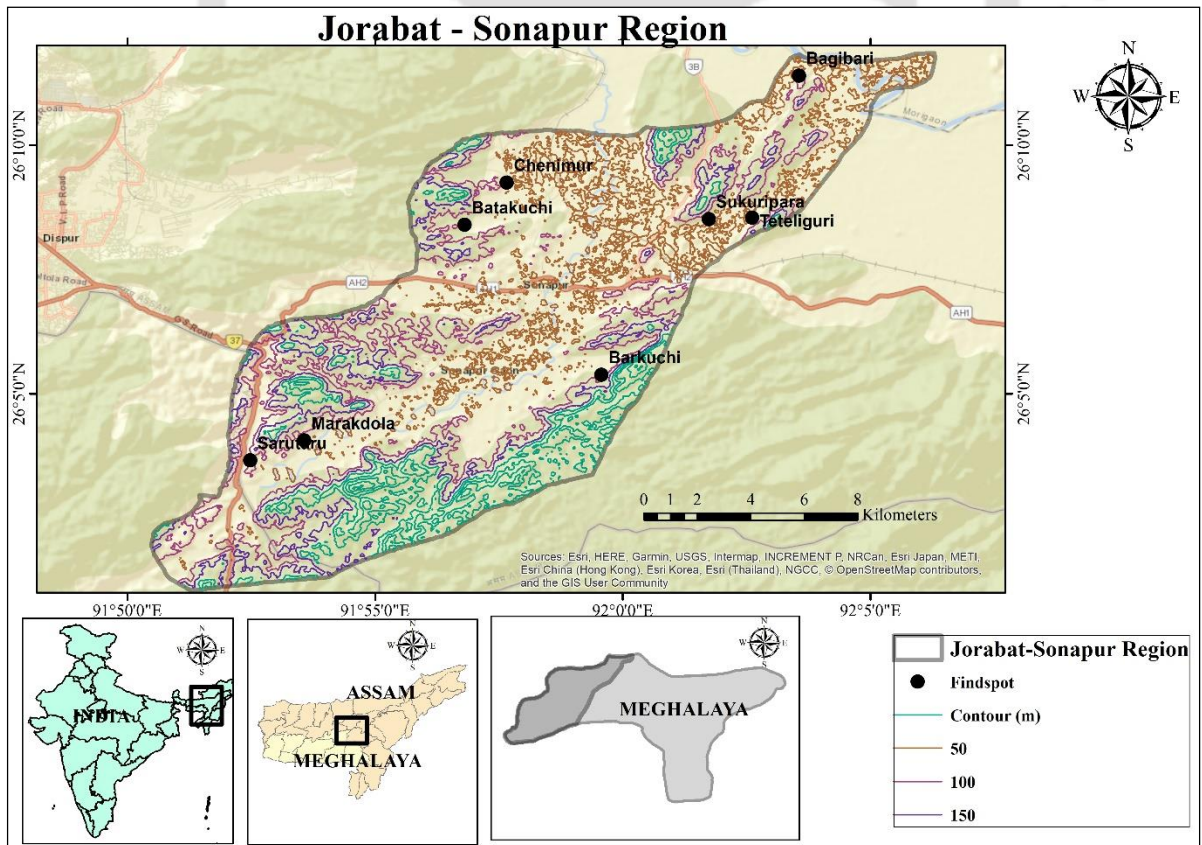
Map 2. 7: Hillshade View of the Study Area



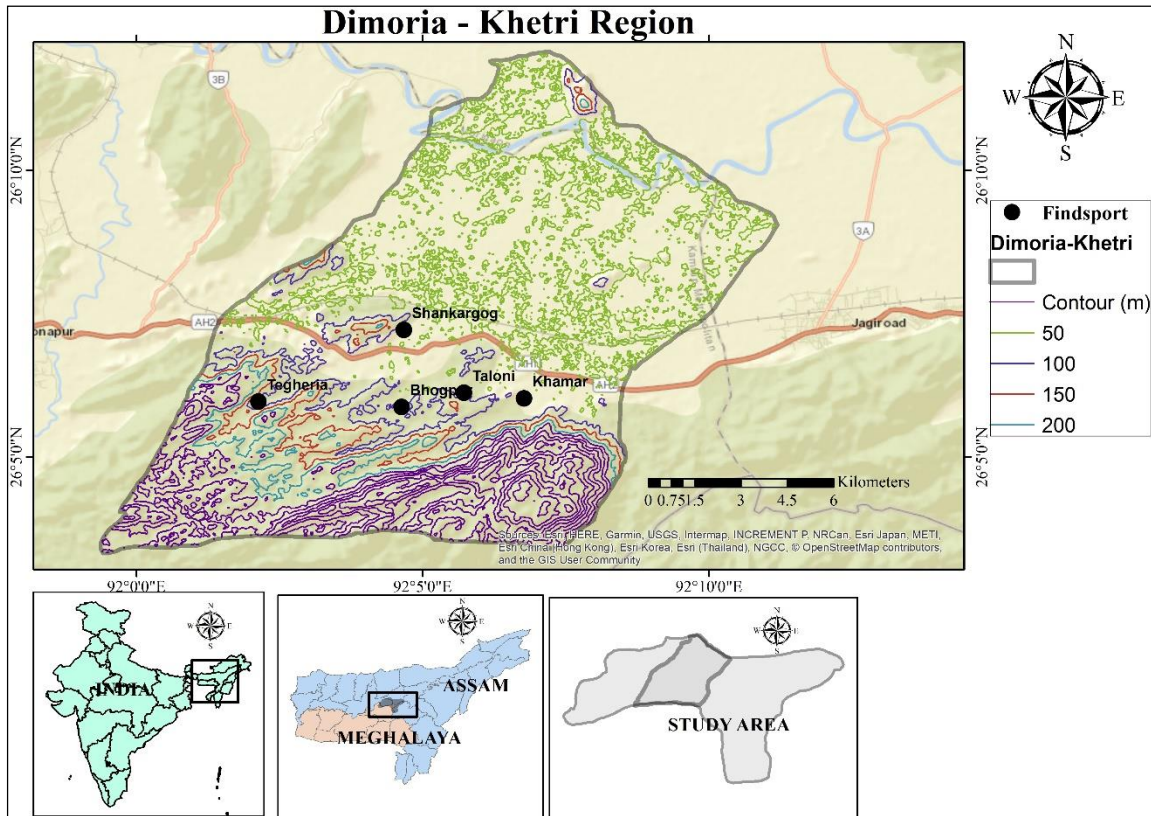
Map 2. 8: Terrain Map of the Study Area (Courtesy Bhuvan, ISRO)



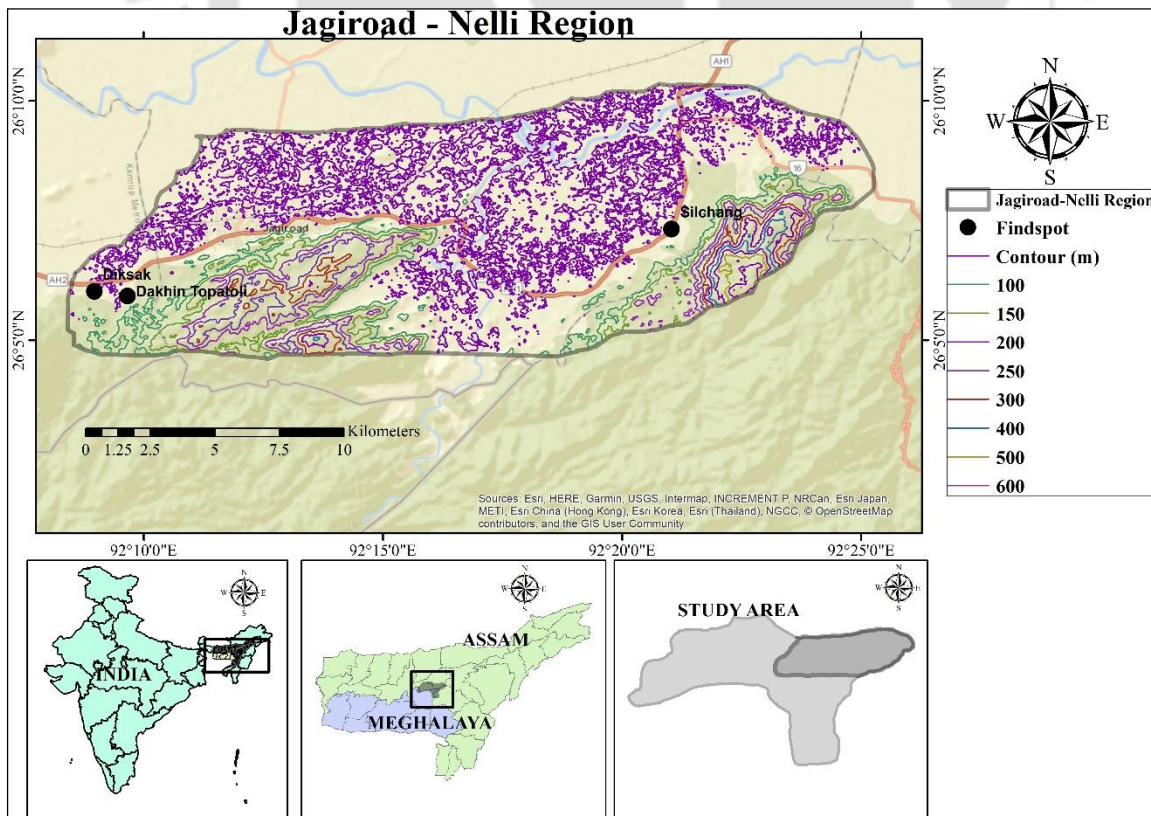
Map 2. 9: Contour Map of the Jorabat – Sonapur Region



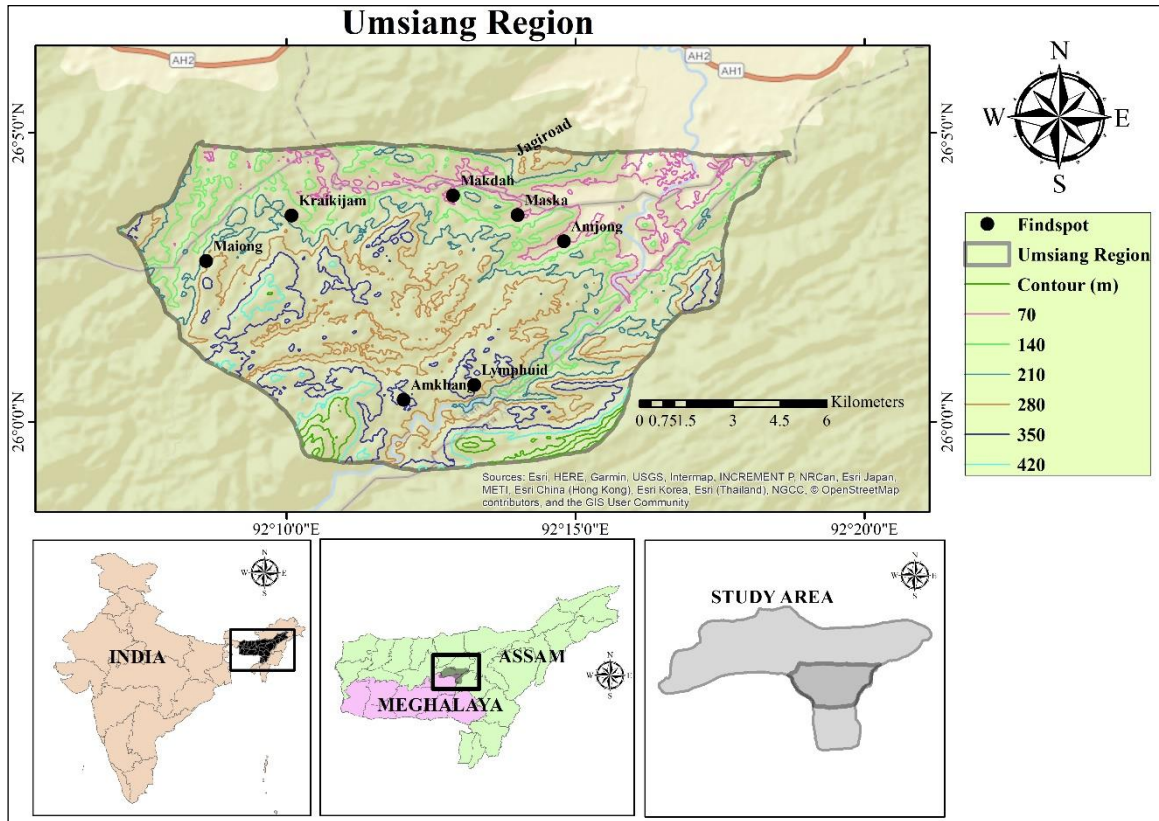
Map 2. 10: Contour Map of the Dimoria – Khetri Region



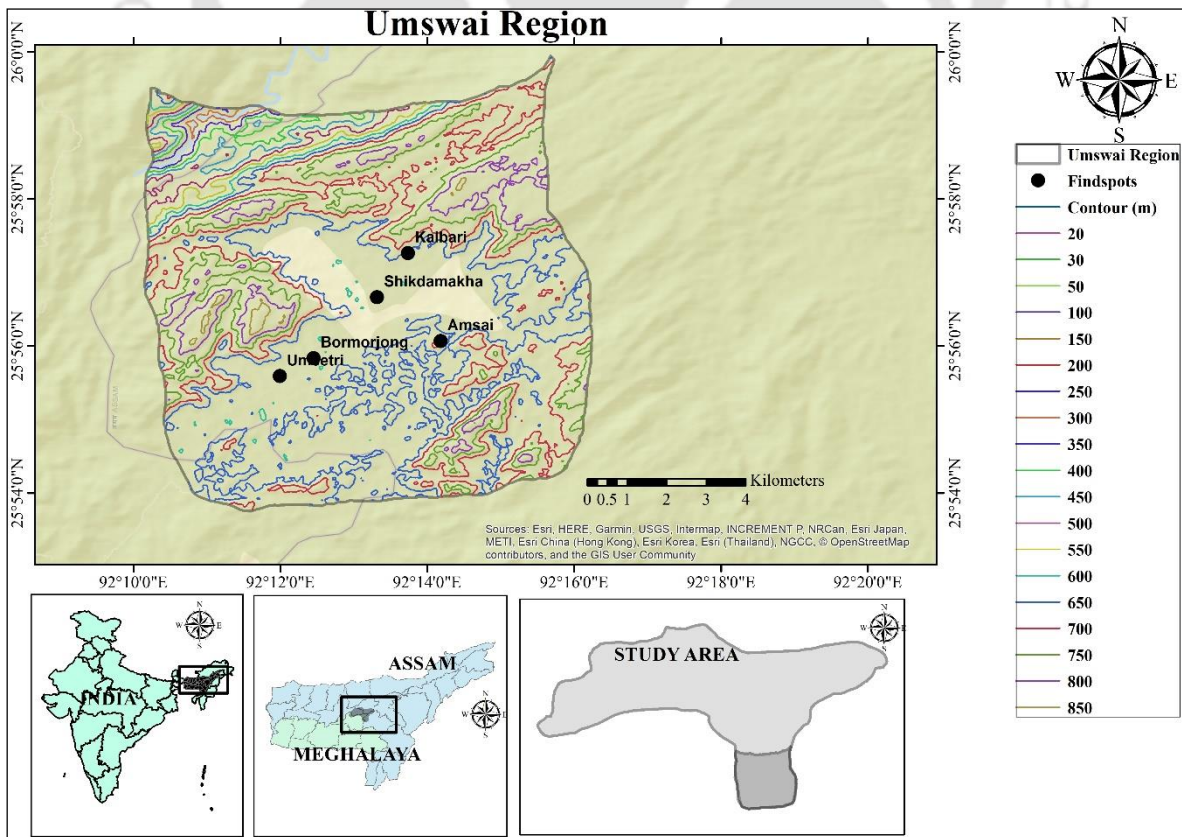
Map 2. 11: Contour Map of the Jagiroad – Nelli Region



Map 2. 12: Contour Map of the Umsiang Region



Map 2. 13: Contour Map of the Umswai Region



2.9.3 Longitudinal Profile of the Important Rivers within Study Area

The elevation to distance profile (longitudinal profile) of the Digaru, Kolong, Killing, Wah Umsiang, and Umiam rivers lies within the study have been drawn by tracing the river channel downstream using Google Earth. The elevation profile of these rivers flows from higher elevation to lower shows a change in terrain where it entered into the broad valleys in its flow (Figure 2. 13 to Figure 2. 17).

The minimum, average, and maximum elevation of the rivers within the study area are shown in Figure 2. 11. The distance covered by the Digaru river is 43.1 km, the Kolong river covers 66 km, 21.3 km by the Umiam river, 23.9 km by Wah Umsiang river, and the Killing river covers 16.8 km within the study area. Most sites are located above the river elevation or on the river terraces (Figure 2. 12). The settlement area is mainly selected on the river terraces to be free from the danger of floods, which is also a modern-day phenomenon.

Figure 2. 11: Elevation of the rivers within the study area

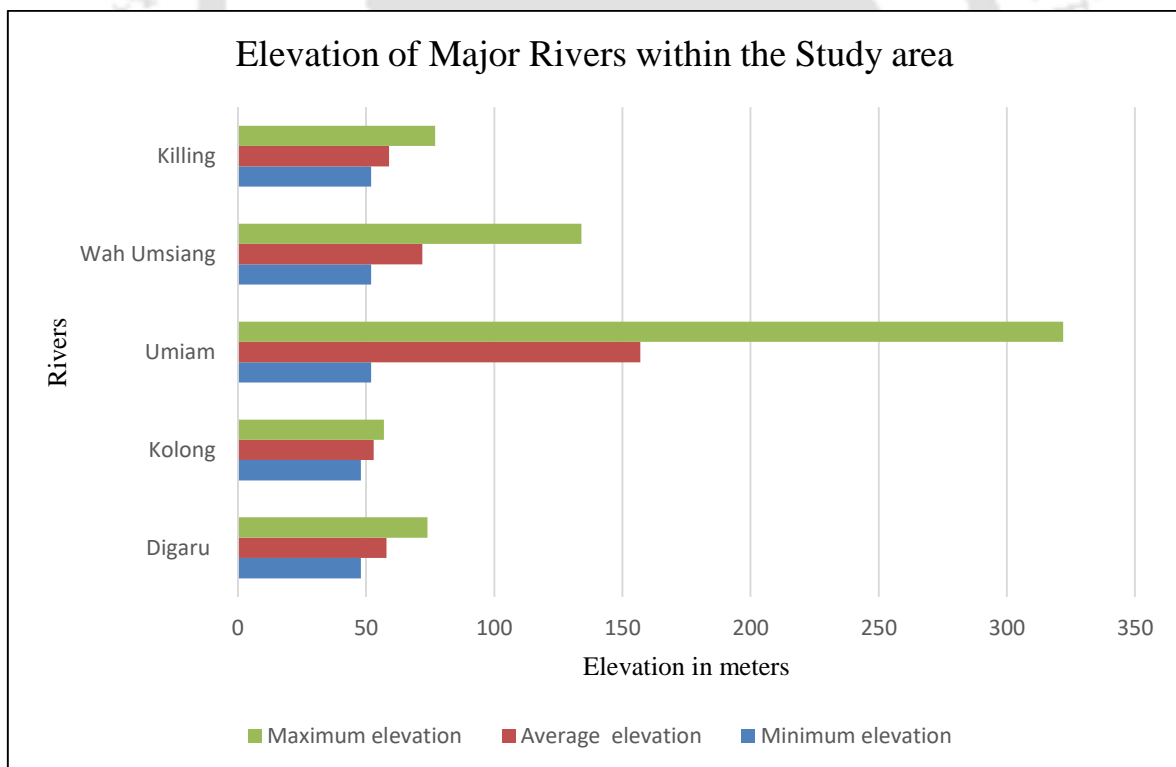


Figure 2. 12: Elevation of sites and findspots

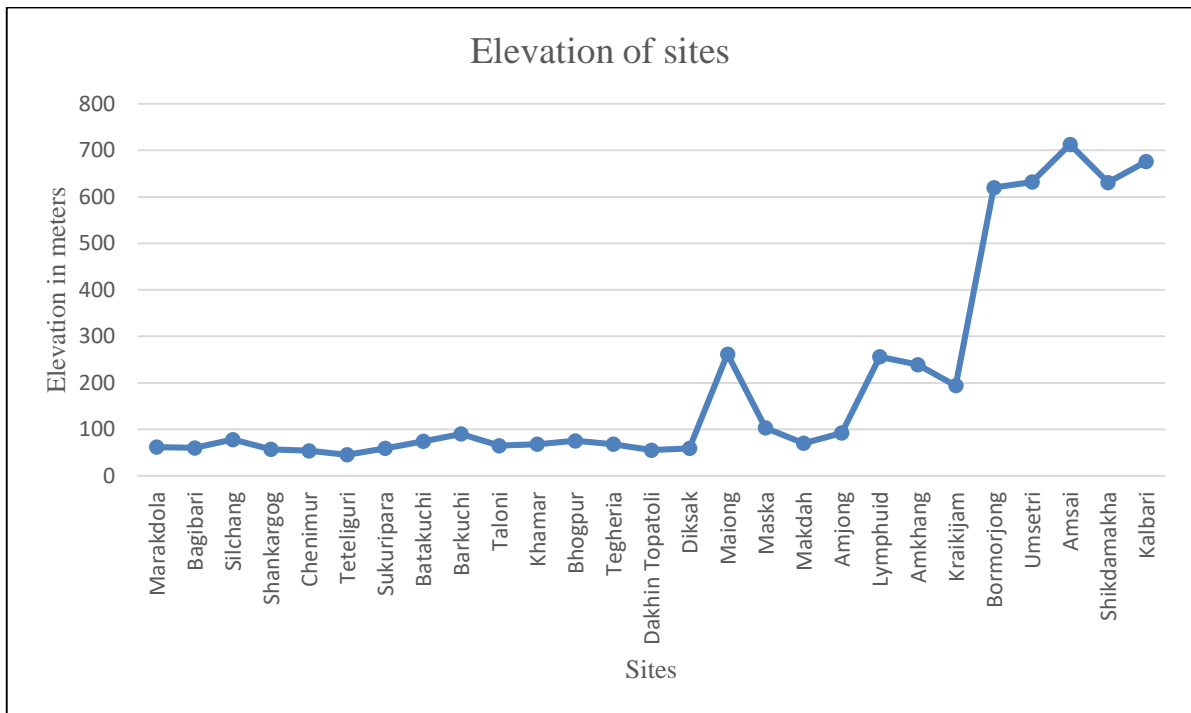


Figure 2. 13: Longitudinal Profile of Digaru River within the study area (Google Earth)



Figure 2. 14: Longitudinal Profile of Kolong River within the study area (Google Earth)

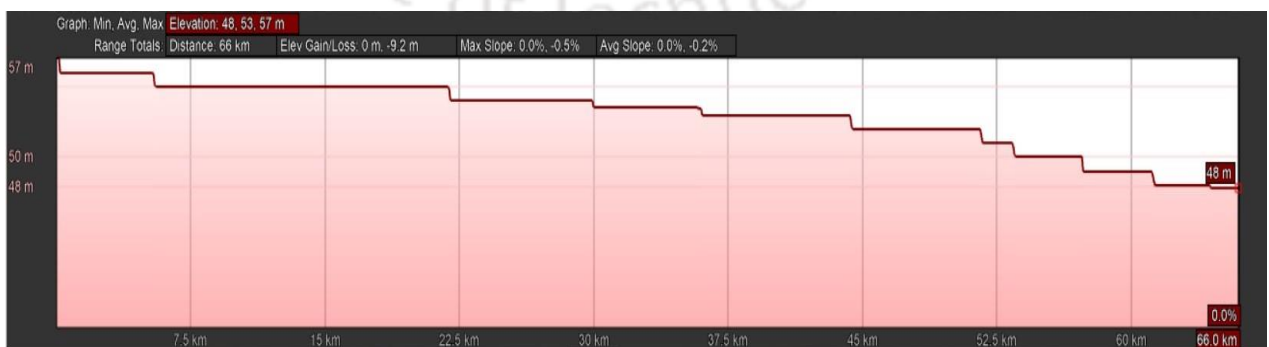


Figure 2. 15: Longitudinal Profile of Killing River within the study area (Google Earth)

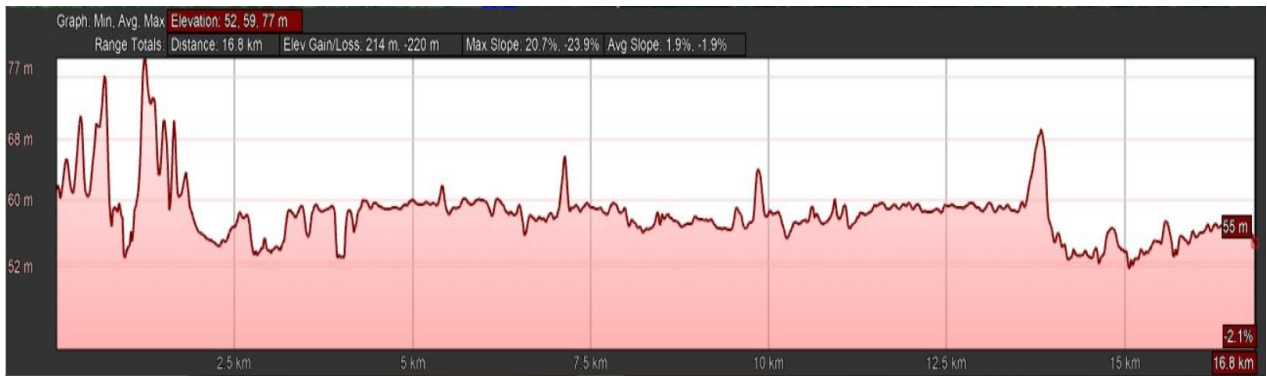
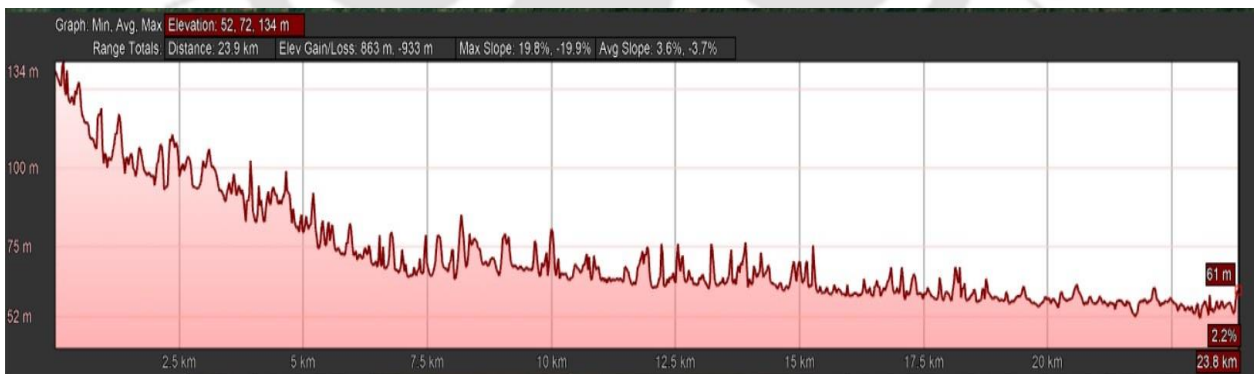


Figure 2. 16: Longitudinal Profile of Umiam River within the study area (Google Earth)



Figure 2. 17: Longitudinal Profile of Wah Umsiang River within the study area (Google Earth)



2.10 Discussion

In different field sessions, an intensive archaeological reconnaissance survey was conducted in the Digaru – Kolong river valley region. The field survey was carried out by walking across the landscape to explore the archaeological potentiality of the region. The reconnaissance survey was successful in locating different potential regions and findspots. The study area was divided into five regions based on field survey, geographic setting, and findings. Test pits were excavated at four sites: Marakdola, Bagibari, Shankargog, and Silchang, and artifacts such as potsherds, celts, sediments, and charcoal samples were collected. The significant findings as artifacts were potsherds, stone celts, and Megaliths sites. Celts recovered from this region were both finished and unfinished. The stone celts recovered from the hilly terrains were mostly unfinished and morphologically similar to the neighboring regions such as Khasi and Garo Hills. Potsherds were plain as well basket/mat impressed mostly. The megaliths found in this region are primarily associated with Karbi tribes. The morphological attributions of these structures are different from the megaliths of the neighboring region. The stone used for megaliths in the present study area were undressed. If we look at the type of stones used for megaliths in the neighboring region of Khasi hills, Shillong, and Cherrapunjee, these were well-dressed stones, and secondary work was given to achieve a better shape and smoothness over the front surface (Sharma, 2017). The communities practicing Megalith tradition in the study area do not give smoothness or secondary work over the surface; instead, they only achieve a proper shape to insert the structures into the earth.

Most of the reported sites from neighboring regions of the study area, such as Khasi – Jaintia hills, Barapani, Garo hills, and Dima Hasao, are located at higher elevations, such as Daojali Hading, Assam at 304.8m, Lawnongthron, Meghalaya at 1185 – 1200m, Myrkhan, Meghalaya at 1552m, Gawak Abri, Meghalaya at 550m, and Sites of Khowai, Tripura at an elevation of 346m above mean sea level (Goswami and Sharma, 1963; Mitri, 2016; Sharma, 2007; Ramesh, 1986). However, the evidence from the present study indicates settlements on hill slopes, river terraces, and lower altitudes. The analytical and morphological analyses of the artifacts are further explained in Chapters 3 and 4. The association and social memory of locals regarding artifacts (especially with celts) have been documented and used as data in the study. This data has been interpreted using the ethnographic method of non-participatory observation and unstructured interviews mentioned in Chapter 5.

Chapter – 3

Analysis and Interpretation of Morphological Attributes of Artifacts

This chapter provides detailed information with an overview of the artifacts recovered from the field survey and deals with various analyses. This chapter starts with the meaning of artifacts and the importance of artifact analysis. Further, the chapter is divided into three sections, i.e., Lithic analysis, Ceramics analysis, and Sediments analysis. Each section begins with a different methodological approach for analyzing the artifacts and a brief introduction to their importance and objectives. Artifacts from respective contexts are described with detailed typo-technological characteristics. This chapter explores the nature of data and synthesizes it to reconstruct the past settlement of the region. Lastly, the discussion further briefs the nature of artifacts in the study area. It compares them with the findings of earlier studies from the neighboring archaeological sites in order to trace their dialogical relation.

3.1 Artifacts as a Product of Human Workmanship: meaning and importance of analysis

The Oxford dictionary defines an artifact as an object made by a person, especially something of historical or cultural interest. Artifact is the most common and popular word in Archaeology. It is the smallest cultural unit that is a product of human workmanship. Artifacts are humanly made or modified objects, such as stone tools, pottery, and metal weapons. Artifacts are related to various activities such as architecture; food procurement, preparation, and consumption; defense; tool-making; clothing; recreational; ceremonies; and rituals. It helps us determine the diet, tools, weapons, dress, settlement pattern, technology, and cognitive approach of the prehistoric people. The location or distribution of artifacts in a site reflects a group of people's cultural, economic, and social behavior (Joukowsky, 1980). An artifact provides a window to look into the lives of people who lived before. This makes it essential to understand how it has found its meaning in archaeology. Thus, artifacts constitute an essential source of information for archaeological research. Glatfelter (1977) defines the artifact as the only material remains of behavioral patterns in a past environmental context.

"Artifact analysis is based on the premise that man develops tools, weapons, and pottery with a specific purpose, aim, or belief. The purpose of such analysis is not only to show the evolution of the type or tool itself but, more importantly, to relate the tool to other tools and artifacts which, as a group, will form a cultural assemblage, and finally, to combine the aspect of study with the total environment of the people who produced them". (Joukowsky, 1980, p. 276)

Artifact analysis plays a significant role in archaeological research. The basic concept of archaeological analysis is the attributes of artifacts. Attributes are the physical characteristics of artifacts that give them meaning and are considered traditional stylistic, typological, and historical approaches. Artifacts are sorted based on similarities and differences in their attributes such as decoration, colour, dimension, shape, size, and technological attributes such as raw materials. The material or raw material of artifacts helps further understand whether the materials were obtained locally, traded with another group, or transported far away. The scientific investigation of archaeological materials helps an independent dimension added to the description and interpretation of artifacts.

Archaeological reconnaissance survey and trial-trench excavation have revealed various artifacts from the study area, such as potsherds, stone celts, sediments, and charcoal. The potsherds are recovered in abundance from different parts of the study area. Stone celts have been retrieved from several localities as surface findings and the test pit. Similarly, sediments and charcoal samples have been collected to understand past and environmental conditions. Various methodological approaches have been applied to the analysis of artifacts. This includes techno-typological, relative or comparative, morphological, and scientific study. Laboratory investigation of artifacts can determine their composition, structure, and manufacturing history. The type of analysis selected in any particular case depends on the individual artifact's cost, time, and importance. The typo-technological detail of artifacts recovered in this study, analysis of artifacts, analysis method, results, observation, and discussion has been mentioned further in this chapter.

Every archaeological site or region has some distinct kind of archaeological assemblage¹³. A specific character of culture, technology, typology, and attributes is associated with every area. These types of special features became an identity to that culture or period. Such as OCP (Ochre Coloured pottery) and NBPW (Northern Black Polished Ware) are the

¹³ A collection of artifacts of one category at site is called an industry and industries found in close association with each other constitute an assemblage.

characteristic features of Middle Ganga Valley settlements; Beads of semi-precious stone, terracotta seals, and toys of Harappan civilization. Similarly, cord-marked, basket/mat impressed potteries and shouldered Axe are specific features of Northeast India and Southeast Asia (Ashraf (1990, 2011); Sharma (1966, 1967, 1974, 1986); Sharma (2001, 2007); Mitri (2005, 2009, 2015). The present study area of Digaru – Kolong river valley lies between the North Cachar Hills and Khasi hills. The neighboring area's archaeological artifacts primarily include Shoulder axe, shoulder adzes, bar shape axe and Axe with border edge, grinding stones; Cord impressed, incised, and stamped potsherds. Short axes are specific features of Southeast Asia and the tool assemblage of Hobinhian¹⁴ culture, and such short axes have been reported from Garo hills (Sharma, 2007). The archaeological artifacts such as stone celts and potsherds primarily belong to Neolithic and Post-Neolithic traditions.

Part I: Lithic Analysis

"Lithics are, in fact, the primary archaeological remains for more than 99 percent of human history, and that is really a very good thing because the analysis of stone tools can tell us an enormous amount about the past" (Peregrine, 2017, p. 79)

3.2 Introduction to Lithic Analysis

In general, the term Lithic constitutes all the forms of artwork made of stone, such as ornaments, stone tools, and statues, but here we are only going to consider stone tools in this category. Stone is one of the most abundant materials found on the earth, and it has been used by humankind more extensively than any other material. Stone tools are the best materials for long-term use and have been well preserved for centuries. The Stone Age is the most prolonged period in the cultural development of human history. Stone artifacts are the most common findings on prehistoric sites and form one of the significant sources of information on prehistoric life. Before the introduction of metals, a stone was the key material for tool making. Stone tools dominate a substantial part of the archaeological assemblage. It plays a significant role in the day-to-day life of prehistoric people in shaping the physical world to various needs.

¹⁴ Hoabinhian is a cultural techno-complex of Southeast Asia, both of mainland and island. It is defined purely on the basis of tool categories comprising pebble tools, utilized flakes, and a small proportion of edge ground tools and bone tools, and in the later period pottery and fully ground axes and adzes also occur. These sites are spread over a broad region from Southern China, North Vietnam, Malaya, Thailand, Laos, Cambodia, Sumatra, and Taiwan.

Studying stone tools or artifacts helps to understand the cultural and temporal markers of ancient societies. Humans have been making stone tools for millions of years, and the technique of making tools gets improved throughout the centuries. In a place of immense and crude means of predecessors, our ancestors began making smaller, sharper, and well-balanced tools using a style of flint knapping. The emergence and development of tools are studied as humans' technological advancement or cognitive development. The technological advancement and refinement of stone artifacts and other artifacts indicate prehistoric person's cognition and behavior (Andrefsky, 2005, p. 245).

The preliminary step in studying the stone artifacts is the typology, classifying artifacts on morphology and technological bases. The typological study of stone tools helps to understand the cultural and chronological framework, but it cannot yield all information alone or without other scientific methods. In other words, the typological and morphological study, along with several different scientific methods of analysis of stone tools, helps to understand the evidence concerning the habitat, the way of life, the activities, and the behavior of the prehistoric person (Odell, 1996; Peregrine, 2017; Joukowsky, 1980; Grant *et al.*, 2005; and Balme *et al.*, 2006).

The present study investigated the study area extensively and reported some stone tools. Most stone tools were collected from the surface with no pertinent information about stratigraphy, and a single celt was collected in the buried context. Stone tools reported by locals were also studied on a typological basis. The collection mainly includes Axe, adzes, shouldered, and tanged celts. These stone tools belong to the Neolithic tools assemblages. The reported stone tools and the analysis method are mentioned further below.

3.3 Methodological consideration for Lithic Analysis

The stone tool analysis involves several typo-technological trends and scientific methods that help understand the lithic assemblage. Typological classification is an integral part of artifact analysis. The physical description of stone artifacts is a widespread and fundamental aspect of the lithic study (Peregrine, 2017, p. 84). It helps us to compare with other assemblages from any other sites. Stone tools have been analyzed based on their raw material, manufacturing technique, shape and size, and working edges or function.

The tools' measurement (length, breadth, thickness, and weight) helps us determine for what purpose those tools were utilized or their functions. The typology of tools specifically

indicates their utilization in agriculture, hunting, digging, cutting, and pointing the other artifacts and materials. The maximum length, width, thickness, and weight of the stone celts were measured. The primary form of the artifacts is recorded and classified to know the types such as axe, adze, and shouldered celts. Further, retouch-type, polishing and grinding, hafting, the contour of the transverse section, nature of working edge, and butt ends are recorded to understand the utilization and function of the tools. An index has been calculated over the length, breadth, thickness, and weight to understand the functional significance of the tools (Ashraf, 2004; Duarah, 2014; Deka, 2015).

Analysis of manufacturing technique attributes through the presence of cortex (tough outer layer of core), evidence of burning (stones' properties changes when it is heated than when it is cold), measurements of the tools, and the angles formed by knapping and retouch (Joukowskyh, 1980, p. 326). Examination of their surface can determine whether they were manufactured by fracturing, pecking, or polishing the original stone. Stone celts recovered from several sites have been analyzed and classified based on typological and morphological features. All the artifacts are measured and organized based on their morphology

3.3.1 Sampling and Nomenclature of Samples

All the stone celts are surface collection except a single celt from the test pit at Bagibari. All the collected lithic or stone tools are packed individually to avoid any mixing, among others. The stone tools are cleaned with a brush to remove the surface's dust, clay, and dirt. After cleaning, all the tools were given a separate number with site abbreviation. Stone tools collected from different sites are classified based on their typological functions. The list of celt samples is mentioned below in Table 3. 1.

Table 3. 1: Description of Stone celts collected from the study area, Sh. = shouldered, L= Length, B= Breadth, T= Thickness

S. N.	Sample Name	Site Name	Context	Max. L x B x T (cm)	Weight (grams)	Type	Shape	Working edge	Edge slope	Butt end	Contour	Facet
1	MRKt1	Marakdola	Surface	7.5 x 5.5 x 1.8	98	Adze	Trapezoidal	Convex	Bibevel	Rounded	Biconvex	Unfacetted
2	MRKt2	"	"	6.5 x 6.7 x 1.4	70	Tanged	Rectangular	Convex	Unibevel	Straight	Concavo-convex	Unfacetted
3	MRKt3	"	"	7.3 x 5.6 x 1.8	94	Adze	Trapezoidal	Convex	Unibevel	Rounded	Plano-convex	Unfacetted
4	MRKt4	"	"	6.4 x 5.3 x 1.2	59	Tanged	Trapezoidal	Convex	Bibevel	Broken	Biconvex	Unfacetted
5	MRKt5	"	"	6.8 x 6.4 x 1.2	66	Tanged	Rectangular	Convex	Bibevel	Convex	Biconvex	Unfacetted
6	MRKt6	"	"	7.9 x 7.0 x 1.5	90	Tanged	Trapezoidal	Broken	Insignificant	Rounded	Biconvex	Unfacetted
7	MRKt7	"	"	7.3 x 5.3 x 1.2	58	Adze	Triangular	Convex	Unibevel	Pointed	Biconvex	Unfacetted
8	MRKt8	"	"	7.8 x 5.4 x 1.4	70	Axe	Trapezoidal	Broken	Insignificant	Rounded	Broken	Unfacetted
9	BGIIt1	Bagibari	"	7.7 x 5.3 x 1.6	87	Adze	Triangular	Convex	Bibevel	Pointed	Biconvex	Unfacetted
10	BGIIt2	"	"	7.0 x 6.5 x 1.3	77	Adze	Trapezoidal	Broken	Unibevel	Straight	Plano-convex	Unfacetted
11	BGIIt3	"	Test pit	5.0 x 5.3 x 1.3	45	Shouldered	Squarish	Convex	Bibevel	Straight	Biconvex	Unfacetted
12	BGIIt4	"	Surface	8.1 x 5.8 x 1.5	101	Adze	Trapezoidal	Convex	Bibevel	Straight	Plano-convex	Unfacetted
13	BGIIt5	"	"	6.8 x 7.2 x 0.9	72	Shouldered	Squarish	Convex	Bibevel	Straight	Biconvex	Unfacetted
14	BGIIt6	"	"	7.0 x 7.1 x 1.5	88	Shouldered	Squarish	Convex	Bibevel	Straight	Biconvex	Unfacetted
15	BGIIt7	"	"	7.1 x 6.2 x 1.4	78	Tanged	Rectangular	Convex	Unibevel	Rounded	Plano-convex	Unfacetted
16	SKGt1	Shankargog	"	13.2 x 7.0 x 1.5	224	Axe	Trapezoidal	Convex	Unibevel	Convex	Plain	Unfacetted
17	SKGt2	"	"	7.5 x 6.0 x 1.5	86	Axe	Trapezoidal	Convex	Unibevel	Convex	Plano-convex	Unfacetted
18	SKGt3	"	"	7.4 x 6.8 x 0.9	63	Axe	Trapezoidal	Broken	Insignificant	Straight	Plain	Unfacetted
19	SKGt4	"	"	6.2 x 5.9 x 1.2	53	Adze	Triangular	Convex	Bibevel	Pointed	Plano-convex	Unfacetted
20	SKGt5	"	"	7.9 x 5.8 x 1.8	114	Adze	Triangular	Convex	Bibevel	Broken	Biconvex	Unfacetted

S. N.	Sample Name	Site Name	Context	Max. L x B x T (cm)	Weight (grams)	Type	Shape	Working edge	Edge slope	Butt end	Contour	Facet
21	SKGt6	"	"	8.2 x 5.2 x 1.4	78	Adze	Trapezoidal	Convex	Bibevel	Convex	Concavo-convex	Unfaceted
22	SKGt7	"	"	7.6 x 5.4 x 1.7	105	Axe	Trapezoidal	Broken	Bibevel	Broken	Biconvex	Unfaceted
23	SLGt1	Silchang	"	10.3 x 7.1 x 2.3	135	Axe	Triangular	Straight	Insignificant	Pointed	Broken	Faceted
24	SLGt2	"	"	12.3 x 6.3 x 3.0	254	Axe	Triangular	Broken	Insignificant	Rounded	Plano-convex	Faceted
25	SLGt3	"	"	9.6 x 6.0 x 2.2	151	Axe	Triangular	Broken	Insignificant	Pointed	Broken	Faceted
26	SLGt4	"	"	11.0 x 6.3 x 2.2	147	Axe	Triangular	Convex	Insignificant	Pointed	Broken	Faceted
27	SLGt5	"	"	9.2 x 5.2 x 1.2	113	Axe	Rectangular	Straight	Insignificant	Broken	Concavo-convex	Faceted
28	SLGt6	"	"	8.1 x 3.5 x 1.7	53	Axe	Triangular	Straight	Insignificant	Pointed	Concavo-convex	Faceted
29	SLGt7	"	"	7.6 x 5.1 x 1.4	70	Tanged	Trapezoidal	Convex	Bibevel	Broken	Plano-convex	Faceted
30	SLGt8	"	"	12.2 x 6.6 x 2.8	231	Axe	Triangular	Convex	Bibevel	Pointed	Biconvex	Faceted
31	SLGt9	"	"	10.0 x 6.7 x 1.9	167	Axe	Triangular	Convex	Bibevel	Broken	Plano-convex	Faceted
32	SLGt10	"	"	8.6 x 5.8 x 1.7	121	Axe	Trapezoidal	Straight	Unibevel	Straight	Plain	Faceted
33	SLGt11	"	"	8.0 x 5.8 x 1.5	95	Adze	Trapezoidal	Convex	Unibevel	Straight	Plano-convex	Faceted
34	SLGt12	"	"	8.4 x 6.1 x 1.1	254	Axe	Triangular	Convex	Insignificant	Pointed	Concavo-convex	Faceted
35	LPDt1	Lymphuid	"	7.3 x 5.7 x 1.6	88	Adze	Trapezoidal	Convex	Bibevel	Convex	Biconvex	Faceted
36	AKGt1	Amkhang	"	7.8 x 5.4 x 1.4	79	Adze	Triangular	Convex	Bibevel	Pointed	Plano-convex	Unfaceted
37	AKGt2	"	"	6.2 x 4.0 x 0.8	28	Tanged	Rectangular	Convex	Bibevel	Broken	Plain	Unfaceted
38	KJMt1	Kraikijam	"	10.0 x 6.7 x 0.8	67	Axe	Triangular	Convex	Unibevel	Pointed	Plain	Unfaceted
39	KJMt2	"	"	8.0 x 5.6 x 1.3	74	Axe	Trapezoidal	Convex	Insignificant	Straight	Biconvex	Unfaceted
40	SDMt1	Shikdamakha	"	12.0 x 5.9 x 1.6	127	Axe	Triangular	Broken	Insignificant	Pointed	Biconvex	Faceted
41	SDMt2	"	"	9.0 x 6.6 x 0.7	62	Shouldered	Rectangular	Convex	Insignificant	Convex	Plain	Unfaceted
42	KLBT1	Kalbari	"	9.4 x 6.4 x 1.9	131	Axe	Triangular	Convex	Bibevel	Pointed	Biconvex	Faceted

3.4 Typological Attributes

The stone tools collected from the survey are analyzed in terms of typology, technology, and function. Typological classification is a crucial technique in archaeological research and artifact analysis. It helps understand the assemblage and allows comparison with other assemblages of sites. The typological attributes and their illustrations have been presented in tabular and illustrated form (Table 3. 1 and Plate 3. 1 and Plate 3. 4). The results have been interpreted with quantitative and qualitative data in the form of tabular, graphical, and drawings. In the present study, an attempt has been made to understand the region's artifacts' distribution patterns and tool typology.

3.4.1 Type of the artifacts

The lithic artifacts or the stone celts of the Digaru – Kolong river valley are classified typologically under four (4) main categories. The artifacts collected from different sites in the study area consist of 42 in number (Plate 3. 5 and Plate 3. 6). Based on the shape and probable function of the working edge, the tools are classified as follows:

Type I Axe (45.24%) – This class includes all the celts having a median working edge produced through equal bifacial grinding. There are rounded, convex, straight, or pointed butts in this category.

Type II Adze (28.56%) includes tools with a beveled working edge, manufactured either through bifacial or unifacial grinding. It comprises a straight, narrow, and rounded butt. In some tools, there is a slight trace of shoulders.

Type III Shouldered Tools (09.54%) – This category comprises all the tools having clear shoulders with a prominent tenon. Some tools have the angle between the tenon, and the body is close to a right angle produced by chipping and grinding. Some samples indicate that the tenon would have been created by sawing. The butt ends are primarily straight, narrow, and rounded.

Type IV Tanged Tools (16.66%) – In this category, tools have a small tenon with no proper angle between the tenon and the sides. The shapes of the tools in this category are roundish, rectangular, and triangular.

The tool types and their numbers and percentage are discussed below in Table 3. 2. The number of Axes collected as surface collection from the study area is 19 (45.24%). There are 04 numbers of Shouldered Celts, i.e., 09.54%. The highest number of Shouldered celt has been found in Bagibari is 3 in number. Among 3 Shouldered celts from Bagibari, one has been collected from the test pit. The Axes are the highest number, followed by the Adzes 12 (28.56%). Tanged celts have been found from Marakdola (4), Bagibari (1), Silchang (1), and Amkhang (1). The highest stone implements have been collected from the Silchang village, followed by Marakdola, Bagibari, and Shankargog. The highest number of tools (12) from the Silchang have ten axes (83.33%), 01 adzes (08.33%), and 01 tanged celts (08.33%) in numbers. In Lymphuid and Kalbari, single tools have been found that are adze and Axe, respectively.

Table 3. 2: Classification and Distribution of Tool Types from the Study Area

Site Name	Tool types									
	Axe		Adze		Shouldered		Tanged		Total	
	No	%	No	%	No	%	No	%	No	%
Marakdola	01	12.50	03	37.50	00	00	04	50.00	08	100.00
Bagibari	00	00	03	42.86	03	42.86	01	14.28	07	100.00
Shankargog	04	57.15	03	42.85	00	00	00	00	07	100.00
Silchang	10	83.34	01	08.33	00	00	01	08.33	12	100.00
Lymphuid	00	00	01	100.00	00	00	00	00	01	100.00
Amkhang	00	00	01	50.00	00	00	01	50.00	02	100.00
Kraikijam	02	100.00	00	00	00	00	00	00	02	100.00
Shikdmaha	01	50.00	00	00	01	50.00	00	00	02	100.00
Kalbari	01	100.00	00	00	00	00	00	00	01	100.00
Total	19	45.24	12	28.56	04	09.54	07	16.66	42	100.00

3.4.2 Shape of the artifacts

The tools collected from the study area have been classified into four categories. Taking the shape of the materials into account, they are classified as Trapezoidal, Triangular, Rectangular, and Squarish. The frequency and the percentile distribution of these shapes are mentioned below.

Table 3. 3: Classification and Distribution of Tools from Study Area

Trapezoidal shape	Triangular shape	Rectangular shape	Square shape
17 (40.47%)	16 (38.10%)	06 (14.29%)	03 (07.14%)

The trapezoidal form is the predominant shape of the lithic assemblage, followed by other triangular, rectangular, and square conditions.

3.5 Morphological Attributes

3.5.1 Dimension of the Artifacts

1. Length

Regarding the length of 42 numbers tools, the highest concentration is found within the range of 6.1 – 10 cm, and the minimum number of tools is found within 1 – 6 cm. The highest number (68.42 %) of tools from the tool types of Axe, Adze (100%), Shouldered celts (75%), and Tanged tools (100%) are found within the range of 6.1 – 10 cm. The highest numbers of shouldered and tanged celts are also found in the range of 6.1 – 10 cm.

2. Breadth

The highest numbers of tools from the entire categories are found within the 3.1 – 6 cm ranges in breadth, while the most negligible numbers assigned to the range of 1 – 3 cm are zero. 3 Shouldered and 4 Tanged celts are found within the 6.1 – 9 cm range. No tools within the range of 9.1 – 12 cm have been found in the collection.

Table 3. 4: Frequency and Percentile Distribution of Length of the Tools

Tool Type	Range in Length (cm)							
	1-6		6.1-10		10.1-18		Total	
	No	%	No	%	No	%	No	%
Axe	00	00	13	68.42	06	31.58	19	100.00
Adze	00	00	12	100.00	00	00	12	100.00
Shouldered	01	25.00	03	75.00	00	00	04	100.00
Tanged	00	00.00	07	100.00	00	00	07	100.00
Total	01	02.39	35	83.33	06	14.28	42	100.00

Table 3. 5: Frequency and Percentile Distribution of Breadth of the Tools

Tool Type	Range in Breadth (cm)								Total	
	1-3		3.1-6		6.1-9		9.1-12			
	No	%	No	%	No	%	No	%	No	%
Axe	00	00	09	47.37	10	52.63	00	00	19	100.00
Adze	00	00	11	91.67	01	08.33	00	00	12	100.00
Shouldered	00	00	01	25.00	03	75.00	00	00	04	100.00
Tanged	00	00	03	42.86	04	57.14	00	00	07	100.00
Total	00	00	24	57.14	18	42.86	00	00	42	100.00

3. Thickness

Thickness within the range of 1.1 – 2 cm dominates the region by showing 32 numbers, i.e., 76.20%, out of 42. It is followed by five (11.90%) within a range of up to 1 cm and 2.1 – 4 cm. Shouldered (50%) and Tanged (85.71%) celt are found within the range of 1.1 – 2 cm. In the thickness category of 2.1 – 4 cm, only 05 axes have been found.

Table 3. 6: Frequency and Percentile Distribution of Thickness of the Tools

Tool Type	Range in Thickness (cm)						Total	
	Up to 1		1.1-2.0		2.1-4			
	No	%	No	%	No	%	No	%
Axe	02	10.53	12	63.16	05	26.32	19	100.00
Adze	00	00	12	100.00	00	00	12	100.00
Shouldered	02	50.00	02	50.00	00	00	04	100.00
Tanged	01	14.29	06	85.71	00	00	07	100.00
Total	05	11.90	32	76.20	05	11.90	42	100.00

4. Weight

The highest number of tool types was found within 51 – 100 grams with 59.52 %, followed by a weight range of 101 – 155 grams with 21.43% and 201 – 300 range with 09.53%. The highest number of Axe (36.84%) was found in the weight range of 101 -150 cm, and within 51- 100 cm, the highest number of adzes (83.33%) have been found. The highest numbers of Shouldered celts and tanged celts have been found in the range of 51 – 100 cm.

Table 3. 7: Frequency and Percentile Distribution of Weight of the Tools

Range of Weight (gm.)	Axe		Adze		Shouldered		Tanged		Total	
	No	%	No	%	No	%	No	%	No	%
≤ 50	00	00	00	00	01	50.00	01	50.00	02	04.76
51-100	06	24.00	10	40.00	03	12.00	06	24.00	25	59.52
101-150	07	77.78	02	22.22	00	00	00	00	09	21.43
151-200	02	100.00	00	00	00	00	00	00	02	04.76
201-300	04	100.00	00	00	00	00	00	00	04	09.53
Total	19	45.24	12	28.56	04	09.54	07	16.66	42	100.00

3.5.2 Nature of Working Edge

The highest numbers of working edge are Convex. Convex working edge dominates in the category with 30 tools (71.43%) among 42. This is followed by broken type (19.05%) and straight (09.52%) types of working edge. The highest number of working edges of Axe are convex (9), followed by four straight. 11 adzes out of 12 have convex working edges. Similarly, six tanged celts out of seven have a convex working edge. All four-shouldered celts have a convex working edge. The working edges of eight samples from the collection are broken. The cutting edge of six Axe samples, one adze sample, and one sample of tanged celts have been found in the broken category.

Table 3. 8: Frequency distribution of Working Edge

Tool Type	Convex		Straight		Concave		Rounded		Broken		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Axe	09	47.37	04	21.05	00	00	00	00	06	31.58	19	100.00
Adze	11	91.67	00	00	00	00	00	00	01	08.33	12	100.00
Shouldered	04	100.00	00	00	00	00	00	00	00	00	04	100.00
Tanged	06	85.71	00	00	00	00	00	00	01	14.29	07	100.00
Total	30	71.43	04	09.52	00	00	00	00	08	19.05	42	100.00

3.5.3 Edge Slope of the Working End

The slopes in the working edge of all the samples are either bibevel or unibevel. In some of the samples, edge slopes were undefined or insignificant.

Regarding the edge slope of the 42 tools, the highest number is Bibevel (45.24%). There are 30.95% of tools with an undefined or insignificant slope on edge, followed by 23.81 % of unibevel edge slopes.

Table 3. 9: Nature of the Edge Slope

Nature of Edge Slope	Tool types								Total No.	% out of 42 tools
	Axe		Adze		Shouldered		Tanged			
	No	%	No	%	No	%	No	%		
Unibevel	04	40.00	04	40.00	00	00	02	20.00	10	23.81
Bibevel	04	21.05	08	42.11	03	15.79	04	21.05	19	45.24
Insignificant	11	84.62	00	00	01	07.69	01	07.69	13	30.95
Total									42	100.00

3.5.4 Nature of Butt End

The straight butt end category comprises ten tools, 23.81 % of the total collection. The highest numbers of tools consist of the pointed Butt end, i.e., 13 (30.95%), followed by a straight butt end. This is followed by broken butt ends with 7 in number (16.66%). Rounded and Convex butt ends have similar tools consisting of 6 in numbers (14.29 %).

Table 3. 10: Frequency Distribution of Nature of Butt End

Nature of Butt End	Tool types								Total No.	% out of 42 tools
	Axe		Adze		Shouldered		Tanged			
	No	%	No	%	No	%	No	%		
Rounded	02	33.33	02	33.33	00	00	02	33.33	06	14.29
Straight	03	30.00	03	30.00	03	30.00	01	10.00	10	23.81
Broken	03	42.86	01	14.29	00	00	03	42.85	07	16.66
Pointed	09	69.23	04	30.77	00	00	00	00	13	30.95
Convex	02	33.33	02	33.33	01	16.67	01	16.67	06	14.29
Total									42	100.00

3.5.5 Cross-Sectional Contour

The contour of the tools indicates that the highest number of tools which is 16 (38.10 %), is Bi-convex. This category is followed by Plano-convex (26.19%) and Plain (14.29%). The contours of the four tools are uneven or broken.

Table 3. 11: Cross-Sectional Contour of the Stone Tools

Nature of Contour	Tool types				Total No.	% out of 42 tools
	Axe	Adze	Shouldered	Tanged		
	No	No	No	No		
Biconvex	05	05	03	03	16	38.10
Plano-convex	03	06	00	02	11	26.19
Concavo-convex	03	01	00	01	05	11.90
Plain	04	00	01	01	06	14.29
Broken	04	00	00	00	04	09.52
Total					42	100.00

3.5.6 Contoural Facet

The facet of the contour of stone tools shows the different features over the surfaces. The surfaces of the Neolithic celts are mostly smooth or unfaceted due to the manufacturing technique of grinding and polishing. The faceted marks on the celts represent chipping off the flakes over the core. Only a few samples have a faceted pattern over the surface.

Table 3. 12: Nature of Facet

Nature of Contour Facet	Tool types				Total No.	% out of 42 tools
	Axe	Adze	Shouldered	Tanged		
Facetted	12	02	00	01	15	35.71
Unfaceted	07	10	04	06	27	64.29

3.6 Indices

The indices of the tools have been calculated in the following manner

$$\frac{\text{Length} + \text{Breadth} + \text{Thickness} + \text{Weight}}{4}$$

The results of this calculation have been categorized into three categories: Light Duty Tools are below 35 units, Medium Duty Tools are within the range of 36 – 70 units, and Heavy Duty Tools lie above 71 units (Ashraf, 2004; Duarah, 2014; Deka, 2015). The calculation results reveal that most of the tools belong to the light-duty category, followed by medium-duty tools.

Table 3. 13: Classification of Artifacts based on Length, Breadth, Thickness, and Weight indices

Category	Light Duty (Below 35)	Medium Duty (36-70)	Heavy Duty (above 71)
No. of tools	32	10	00

Part II: Ceramic Analysis

"Most than any other category of evidence, ceramics offers archaeologists the most abundant and potentially enlightening source of information on the Past." (Remman, 1991, p. 5)

"Pottery offers a rich field for comparative studies because of the variety of styles, techniques, and material it presents." (Shepard, 1980, p. 351)

3.7 Introduction to Ceramic analysis

The term "Ceramic," derived from the Greek word *Keramos*, means 'earthenware' or 'burned material.' It mainly describes a fired product of raw clay material (Rice, 1987, p. 3). As pointed out by Velde and Druc, Ceramic is a general form of all objects made of silicate materials and has been transformed into a physical state by heating or firing. It ranges from ware types to tiles, pipes or cast decorative pieces, and pots made on a potter's wheel (Valde and Druc, 1995, p. 5). Ceramics are objects made of clay that become durable due to heat treatment. The final product retains its shape even after encountering water. Pottery is a more technical term for Ceramics in archaeology, used to prepare or store foods or other items for storage purposes (Ellis, 2006, pp. 238-239). As Rice (1987) pointed out, there are two-overlapping meanings of ceramics, one set common to material science and another in art and archaeology. Pottery is one of several specific industries within the ceramic field that carries the artistic or aesthetic scene of people and their socio-cultural norms and technological attribution. In an archaeological context, ceramic denotes utensils made for various purposes such as storage, cooking, serving, and other objects made of clay (Rice, 1987, pp. 4-7).

It is difficult to trace the exact time in human history when they started using clay substances. Although we found stone tools more than a million years old, the clay objects were only tens of thousands of years old. However, we see evidence of using clay for painting or colouring purposes. It was only the recent or the late prehistoric time when this came into human society as a technological or social achievement to transform the soft clay by firing into something hard and durable.

Pottery is one of the essential archaeological artifacts. It survives in a different environment and provides various information about the past people and climate. Besides its importance in archaeological research and reconstructing the past, it is also the most common material archaeologists find. It provides relative dating and absolute dating evidence, which further helps understand society's socio-economic, trade, artistic, aesthetic, religious, and cultural aspects. The Ceramics assemblage gives us various aspects of cultural practices and norms which reflect people in a particular context. It also helps determine a person's social status and relation with other communities. Rice (1984, p. 27) pointed out that the frequency of pottery is high in inhabitation and burial area; even a particular type of pottery can be related to some specific or elite group of people. Joukowsky (1980, p. 332) pointed out that pottery was economically well within everyone's reach. Hence it was in everyday use. It was a marker of taste, providing a means to judge manufacturers' aesthetic and practical sense.

Pottery-making is a lengthy procedure in which the final product gets after several sequential stages such as selecting raw materials, mold, decoration, composition, style, and firing (Rice, 1987, p. 25). The ceramic analysis deals with the various specialized and standardized aspects such as preparation of the clay, methods of manufacture, mineralogical contents, and shape (Grant et al., 2005, p. 67). Based on their composition, firing and surface treatment potteries from the Prehistoric, Historical, and Modern times are grouped into various categories. The study of pottery is a fundamental method in archaeological research. It provides multiple aspects of ancient lifestyle, food behavior, technology, trade, and other social factors.

3.8 Pottery study in Northeast India

Pottery is quite a common finding in inhabitation and burial sites. It has been recovered from almost the entire region of Northeast India. The material remains of the Northeast Indian Neolithic period are distinctively famous for Cord-marked pottery with double-shouldered Celts. The Potsherds of Northeast India have been classified into several groups based on

their colour, decoration, impression, or incision on the outer body. Cord-impressed ware is one of the essential and distinctive features of the Neolithic period in Northeast India. There are several variations and manufacturing or stylistic categories in Cord-impressed pottery. The Cord-impressed pottery has several variations: cord-impressed coarse, gritty ware, cord-impressed buff ware, cord-impressed mottled ware, cord-impressed coarse grey ware, cord-hatched coarse grey ware, and cord-hatched dull redware, and cord-impressed thick brown ware (Dikshit and Hazarika, 2012; Hazarika, 2013; Singh, 2017). The other types of potsherds reported from Northeast India are Incised ware in several variations (Cross-hatched dull red, herringbone pattern grey ware, stamped coarse ware), Stamped ware, and Plain ware.

The impression or design of the potsherds includes several patterns considered an element of manufacturing techniques and decoration. Rao (1977, pp. 191-205) pointed out that the cord impression was obtained through making a vessel by hand. The upper and lower part of the vessel was formed separately by hand, and then it was beaten in leather-hard condition with a wooden paddle. The wooden paddle could be wrapped with a cord that renders the various patterns or impressions on the body of the pottery. Sharma (1967, pp. 126-28) describes the manufacturing technique of the Daojali Hading pottery. He said that these impressions were produced during the final shaping of the pot by the process known as the beater and pad method. The beater could be a piece of wood ranging from 8 to 10 inches long and 3 to 4 inches wide, wrapped with string or cord. There is also a possibility that the surface of the beater could have been made rough by engraving designs in various patterns.

The study of pottery in Northeast India can be traced back to discovering and excavating the first reported site Daojali Hading in Dima Hasao, Assam. Since then, much work has been done on pottery. Potsherds have been collected from almost all Neolithic sites of Northeast India, such as Parsi-Parlo from Arunachal Pradesh, Dajoli Hading, and Sarutaru from Assam, Nongpok, Keithelmanbi from Manipur, Gawak Abri Selbalgiri, Law Nongthroh, from Meghalaya, and Ranyak Khen from Nagaland. The earlier work mainly focuses on typological and morphological attributes. Some of the significant work done by scholars on the Northeast Indian Pottery are Sharma (1966), Rao (1973), H.C. Sharma and A.A. Asharaf (1991), and Singh (1991). Several scientific studies have been conducted in recent decades, including mineralogical analysis, chronometric dating, and province study. Singh and Sharma (2016) have done extensive work on the pottery of Northeast India. They conducted a

mineralogical study of the potsherds of Northeast India to understand the provenance and manufacturing technology.

Singh (2017), in his unpublished dissertation titled "Provenance Study of Archaeological Pottery of Northeast India," utilized several scientific tools to analyze the potsherds from various Neolithic and Historical sites of the Northeast. OSL dating has been done on the potsherd samples with several other analytical methods. This helps better understand the past, material culture, environment, technology, socio-culture, and other potters. Several other works have been done by various scholars focusing on the pottery study of multiple parts of the sites in Northeast India, such as Dikshit and Hazarika (2012), Mitri (2009, 2013, 2015, and 2016), Sharma *et al.* (2017), Singh *et al.* (2021), Sharma (2021), Sonia (2021), and Thakuria (2021).

3.9 Methodological Consideration for Ceramic Analysis

The study or the investigation of archaeological artifacts can be examined under three dimensions of variation, i.e., technological, functional, and stylistic (Rice, 1984, pp. 25-26). These attributes are interrelated, providing chronological, spatial, social, economic, and ideological information. Typological classification of pottery based on its shape, size, colour, and decoration is the primary step in the pottery analysis. The decorative style or condition of the pottery expressed in painting, decoration-incising, cord-mark, or basket/mat impression, yields insights into its manufacturing technique and the lifeway and artistic perception of the people (Singh, 2017, p. 4). Typological classification of the morphological attributes of the pottery indicates their function, manufacturing, and technological aspects.

This chapter aims to understand the type, stylistic and functional features, distribution, and other decorative features of the potteries of Digaru – Kolong River Valley. Further, this aims to understand and investigate the dialogical relation with the pottery of Northeast India. The planned analysis systematically examines the regional distribution of potsherds and their morphological attribution. In the morphological section, potsherds were reviewed on their shape, size, thickness, decoration, and manufacturing marks on the body, and illustrations were made to understand their function.

3.9.1 Sampling and Nomenclature

Potsherds samples have been collected from both test pits and the surface. Samples were collected from the test pits of four sites, and surface samples have been recovered from various localities (mentioned in Chapter 2) of Digaru – Kolong river valley. All the samples from each site are packed individually and labeled with site names and locality. The samples selected for scientific analysis have been packed separately in a plastic zip-lock bag. The samples are cleaned with a brush to remove the surface's dust, clay, and dirt. After cleaning, all the samples are given a separate number with site abbreviation and depth. Photographs have been taken of all the samples in their in-situ condition and after cleaning. For the mineralogical study, specific samples were selected among all the recovered ceramic artifacts. We have presented the illustration and photographs of only a few selected samples of potsherds recovered from the study area; not all samples obtained are depicted. The frequency and number of potsherd samples collected from each site or localities are mentioned below:

Table 3. 14: Number of different parts of Pottery collected, TP= Test Pit collection, SF= Surface finds

S. N.	Site Name	Context	Part of the Pottery					Total
			Rim	Neck	Body	Base	Miscellaneous	
1	Marakdola (MRK)	TP, SF	95	20	230	15	15	375
2	Bagibari (BGI)	TP, SF	108	12	260	8	15	403
3	Shankargog (SKG)	TP, SF	38	6	54	6	20	124
4	Silchang (SLG)	TP, SF	18	0	38	2	13	71
5	Senabar (SBR)	SF	21	0	46	6	12	85
6	Chenimur LI (CHRI)	SF	26	0	52	4	8	90
7	Chenimur LII (CHRII)	SF	12	2	36	0	5	55
8	Maiong (MNG)	SF	13	2	32	0	1	48
9	Maska (MSK)	SF	12	0	22	0	2	36
10	Lymphuid (LPD)	SF	13	0	24	0	3	40
11	Amkhang (AKG)	SF	11	0	28	0	8	47
12	Kraikijam (KJM)	SF	10	0	25	0	2	37
13	Shikdmakha (SDM)	SF	5	0	14	0	2	21
14	Kalbari (KLB)	SF	10	0	12	0	3	25
TOTAL			392	42	873	41	109	1457

3.10 Typological Attributes

Typological analysis is the systematic classification of artifacts based on similarities in form, construction, style, content, and use. The shape, size, and type of pottery reveal various products, producers, and manufacturing environments. Before the advent of the modern chronometric dating method, this also helps in the dating method. The dating of the pottery or artifacts based on typological attributes works on the theory that the artifacts that resemble each other were created simultaneously. In contrast, gradual changes in the material culture can account for the difference. Pottery was dated based on typological or stylistic attributes in material culture. Ceramic vessel characteristics can be classified and used by the analyst to generate a type series. These type series could be part of the vessel (rim, handle, base, and spout), function (cooking pot and bowl), colour, sherd size, sherd condition (state of preservation), type or condition of decoration, and impression or traits. The description of complete vessels is standardized from the base to the rim. This vessel shape is described as follows: base, body, cylindrical concave neck, everted rim, handle ovoid in section extends from the upper body to the neck.

Potsherds collected from both surface and different layers of the test pits are similar in fabric and types. The entire potsherd collection recovered from the study area is wheel-made and mixed with quartz particles. There were no full shapes found. Potsherds are fine-textured and well-fired. Very few surface findings have a coarse texture with impure clay. The potsherds have plain and basket/mat impressed and zig-zag patterns on the exterior in the form of parallel or criss-cross lines. These impressions are considered either a result of manufacturing techniques or decorative. The miscellaneous category contains the unidentified objects and other ceramic objects or parts of the pottery such as lid, spout, ceremonial object, and handles. The colours of the potsherds are reddish yellow (5YR 6/6, 6/8, 7/6; 7.5YR 8/6), dull red, buff, yellow (5Y 8/8), reddish-brown (5YR 4/3; 5/4), light grey (5YR 7/1), and light reddish brown (5YR 6/3; 6/4). The majority of potsherds are dull red, reddish-yellow, and yellow.

3.10.1 The Anatomy of a Pottery

The most common part of the vessel includes the rim, handle, base, spout, body, disk, neck, and miscellaneous (a fragment that does not fall into the type series).

The thickness of the wall or any part of the vessel is significant in the description of the pottery. Joukowsky (1980, p. 338) defined the wall of the vessel as thin if it is 4 mm or less than that. The vessel's walls thicker or equal to 1 cm are classified as thick. He further argued that the thickness of the vessel might be an indicator of function. Wide wall vessels might be used primarily for storage and other purposes, whereas thin ones were often used for tableware.

The shape of the vessel is another essential attribute in the description of the pottery. The vessel's overall shape and its details indicate the pottery function. The determination of the condition by a piece of small potsherd is a generalization that can be vague. It can be used to supplement the two-dimensional illustration (Joukowsky, 1980, p. 339).

1. Rim

The outer edge of the pottery connected to the neck or body is the rim. The aperture of the pottery is angled upward and horizontally with the rim sherds. The shape and thickness of the rim are essential aspects of pottery analysis. The shape and orientation of the rim sherds help us determine the complete vessel's size and shape. The diameter of the rim sherds is calculated using the circumference, which further allows us to define and illustrate the most probable shape of the vessels. The rim's shape can be classified as plain rim and articulated rim. The plain rim is simple, and it may be either a vertical or sloping edge of a vessel opening. Some of the rim sherds have decorative designs and incisions.

Table 3. 15: Thickness of rims of the pottery sample and percentile distribution

S. N.	Thickness of the Rim	No. of sherds	Percentage
1	0.3 – 0.5 cm	82	20.91
2	0.6 – 0.9 cm	283	72.20
3	1.0 – 1.5 cm	27	06.89
Total		392	100.00

The above result indicates that the maximum thickness of the pottery rim comes within 0.6-0.9 cm, i.e., 72.20%. The highest number of pottery rims has been collected from the Bagibari site (108), followed by Marakdola and Shankargog, respectively. The diameter of the available rims has been calculated, and illustrations of the probable shape of the pottery have been made (Plate 3. 7).

Some distinctive types of the rim's shape have been identified (identification based on Joukowsky, 1980). The most common rims type is plain rims (sloping plain, vertical plain), articulated (inverted and everted), and thickened (symmetrical, thickened externally, thickened internally). The different rim stances have been identified, such as upright vertical plain and articulated. Another common rim stance is flared rim. These are spread outward, and it has a bent point where the curvature changes from concave to convex or vice-versa. The other common and frequent rim stance types are inverted rim bent inward, everted rim, T-shaped rim, and horizontal rim (parallel to the base). An illustration of Rim stances has been shown in Plate 3. 8.

2. Neck

The neck is a part of the vessel which connects the rim to the body. The rim starts at the point where the neck ends. The length and the diameter of the neck are significant characteristics of its type. This is primarily slender than the body, and the shape of the neck is predominantly cylindrical concave or cylindrical convex. Some of the samples have parallel and circular combing incisions or concentric circles. Regarding 42 neck sherds, the highest number is found from the Marakdola (20) site, followed by Bagibari (12). Six neck sherd has been found from Shankargog, whereas two from each site Chenimur LII and Maiong.

3. Body

The body is a principal part of the vessel. It can be distinguished from the other secondary features of the vessel. The body begins with the point at which the base is attached.

A round, flat, and concave base begins from the point on which the vessel rests and extends to the neck. The inclination of the body to the neck determines the manufacturing technique of the neck. In the absence of the neck, the body is attached to the rim. The body sherds have different impressions. The shape, thickness, and size of the body sherds help determine the vessel's various features. The description of the body sherds is mentioned below.

Table 3. 16: Thickness of Body of the pottery sample and percentile distribution

S. N.	Thickness of the Body	No. of sherds	Percentage
1	0.3 – 0.5 cm	543	62.20
2	0.6 – 0.9 cm	281	32.20
3	1.0 – 1.5 cm	49	05.60
Total		873	100.00

62.20 % of Potsherds have the body thickness within the range of 0.3 to 0.5 cm, followed by 32.20 % in 0.6 – 0.9 cm. 49 number of body sherds (05.60%) are found within the range of 1.0 to 1.5 cm in the collection. The maximum body sherds are collected from the Bagibari site (260, 29.80%), followed by 230 (26.34%) from the Marakdola site. The body sherds are in different sizes; most of the sherds are small to medium sizes. The available body sherds in the collection have different shapes: spherical, oval, cylindrical, and uneven or irregular. The impressions and decorative motifs over the body have been mentioned further in the impression and decoration sub-topic.

4. Base

The base is the part upon which the vessel rests when it stands upright. It is also known as the foot of the vessel. The overall shape of the base determines their types. Only 41 numbers of base sherd have been collected from the sites mentioned above and localities. The standard base types are flat disk rings, round rings with a flattened foot, concave bases, and stump bases. The highest number of the base is found from Marakdola (15), followed by Bagibari, Shankargog, and Senabar, respectively. Most of the base shreds are broken.

5. Miscellaneous parts

We have classified other secondary or decorative pottery members in the miscellaneous section. These are handles, spouts, and other specific vessel features of Northeast India. Total 109 numbers of different ceramic objects have been categorized in this section. It consists of lids, spouts, handles, stands, and unidentified ceramic objects. Spouts are shallow channels attached to the body of the pot. Their shapes are semicircular or tubular pipes in vertical, oblique, or horizontal (Joukowsky, 1980, p. 359). Some specimen has been identified as a cult object or of religious significance. These are broken and cylindrical. They are similar to a specific type of earthen lamp found, especially in the Eastern and Northeastern parts of India.

Several potsherds have been found with a lid. A polishing tool made of ceramic has been found at the Bagibari site (Plate 3. 13). The function of this polishing stone is to give shape and polish or to soothe the surface of the pot during the leathered-hard condition. The maximum number of objects from the miscellaneous category has been collected from Shankargog, followed by Marakdola, Bagibari, and Silchang. These are often made of cement, stone, or baked clay and are locally called 'Bolia' (Singh, 2017, p. 194). The photographs of these miscellaneous objects are shown in Plate 3. 14.

3.11 Impressions and Decorative Motifs

The stylistic study of pottery is another critical dimension in ceramic analysis. The stylistic features in the form of decoration or impression on the exterior surface of pottery indicate several components of the product and producer. Joukowsky (1980) defines impression as an indentation created by pressure. The external surface of the potsherd collected from the study area mostly has basket/mat impressions in the form of different styles such as criss-cross lines, zig-zag patterns, and parallel lines (Plate 3. 15). According to some scholars, these impressions, such as cord and basket impressions, result from technological aspects while manufacturing the pot (Rao, 1977, pp. 191-205). Other than the impression over the body sherds, some rim sherds have decorative sites. The exterior part of the rim has wavy. The concentric circles over the neck or body have been found on several samples. These would be created by combing technique by a toothed tool. These are found in single or multiple bands.

Part III: Sediment Analysis

" . . . it is no more possible for us to understand the nature of the past without an understanding of soil dynamics than it is for a marine biologist to comprehend his discipline without an understanding of the nature of ocean water and its movements" (Wood and Jhonson, 1978, p. 315).

3.12 Introduction to Sediment Analysis

Soil and sediment matrix is the most abundant materials than lithic, ceramic, or faunal remains that archaeologists encounter. Perhaps, sediment is more readily available on the site. 'Soil' and 'Sediment' had been defined and explained by various scholars differently in archaeological context. Hassan (1978) states that many scholars use the term soil to refer to archaeological and non-archaeological deposits, which further misunderstands the significance and methodology of sediment analysis in the archaeological context. According to Banning (2000), soil and sediment are incompatible. Soils are products of weathering the earth's crust in situ, and sediments are layers or collections of particles that have been removed from the place where they were weathered initially from rock and re-deposited elsewhere (Banning, 2000, p. 235; Shackley, 1975). Shackley (1981) defines sediment as an assortment of mineral or rock particles that have been endured or disintegrated from their essential setting and re-deposited somewhere else. He further defines archaeological sediment as a deposit that has been directly or indirectly created due to the action of human activity (Shackley 1975; 1981).

Sediment analysis is an essential tool in archaeology as it provides valuable information on past human activities and paleoenvironments. Sediment preserves evidence for the site-formation process, paleoenvironment, site chronology, and an artifact-bearing medium. Examination of the composition, colour texture, particle size, acidity, or alkaline nature of soil provides various details about the nature of habitation and environmental condition of the site in the past. As Hussan (1978) pointed out, archaeological sediment analysis helps reconstruct climatic-morphogenetic environments, site-specific human activities, site development history, and interpret man-land relationships. The above-mentioned invaluable source of information is based on the fact that there is a relationship between the cultural deposits and associated soils and landforms.

This section aims to understand the characteristics of the sediment in the Digaru- Kolong river valley. The sediments have been studied based on their morphological, chemical, and mineralogical characteristics. Various tools have been applied to understand the characteristics of sediments. Mineralogical analysis of the sediments was compared with the potsherds sample collected from the same context to understand the provenance of the potteries.

3.13 Methodological Consideration for Sediment Analysis

Sediment analysis helps understand the activity area and interpret the process involved in the formation and destruction of archaeological sites. The methodological consideration for sediment includes proper field description and recording, sampling, and various other laboratory methods. The sediments' mineralogy, acidity or alkalinity, particle size analysis (sieving and hydrometer analysis), and chronology (AMS dating) have been studied.

Soil Colour – The morphological description of sediments is investigated in the field and laboratory. These include observation of colour, composition, and texture. Colour determination is the first and foremost step in sediment analysis. The colour of the sediment originated from its sources and post-depositional activity. Further, it is also affected by the weathering process and groundwater phenomena. Munsell Soil Colour charts are commonly used as standardized colour notations. This is a standardized colour and the best method of describing the colour of sediments. It standardizes and quantifies the colour by reference to three properties making a three-dimensional classification – the Hue (dominant spectral colour), Value (lightness), and Chroma (degree of greyness). All the samples are compared with colour chips on the chart until the nearest colour is found. The notation and the corresponding colour name have been noted for each sample.

3.13.1 Sampling and Nomenclature of Samples

Sediment samples have been collected from the test pits excavated in the study area. Test pits have been excavated at the four sites, and samples have been taken from these pits at different depths. The samples were taken into account soil variations according to profile depth and landscape area. The samples are cleaned by removing any modern material such as plastic, roots, and leaves mixed during the digging. The photographs were taken to observe the layer sequence and colour. The samples were packed in plastic zip-lock bags. A tag was attached to all the sample bags, mentioning their site name, test pit, location, profile, and

depth. Enough material was taken to conduct all the proposed experiments and tests. The description of the samples has been mentioned in the respective analysis or experiment sections.

3.14 Soil Colour

Soil colour is crucial in archaeological studies. In areas with no artifacts, soil works as an essential factor to date the site based on the colour. The chemical properties, human influence, and other soil features affect the soil's colour and indicate the materials present in the soil. (Vranova *et al.*, 2015). The accurate colour determination is helpful to understand micro-stratigraphic details that further lead to understanding the formation mode. Hussan (1987) states that the reddish or yellowish colours in sediments result from oxidation. In contrast, the darker bluish or greyish colour is produced due to the action of reducing the condition. The dark brown, black, or grey sediment represents the presence of high organic materials. The drainage condition also alters the colour of the sediments. The development of reddish and yellowish colours results from good drainage, aeration, and oxidation condition, and mottled greyish, yellowish, and brownish colours usually represent poor drainage (Hassan, 1978; Shackley, 1975, 1981; Banning, 2000). The colour of soil samples from each test pit has been identified according to the Munsell Soil Colour chart. The colour of the soil and change at various depths has been determined from the formations of different layers of test pits.

The above analysis reveals the soil's various physical and chemical properties from the investigated archaeological sites of Digaru – Kolong river valley. The colour of the soil has been noted down from the test pit excavated at different locations. The colour description has been mentioned below.

A test pit was dug at Marakdola to the depth of 130 cm from the surface. The colour of the layer varies from very pale brown (10YR 7/4) at the surface to dark brown (10YR 3/3) to 115 cm. The bottom layer, or after the depth of 115 cm, is natural brown (10YR 4/3) compact soil and archaeologically sterile.

The test pit at Bagaibari reveals the soil colour of the site. The first test pit was dug to the depth of 35 cm from the surface. The colour of the soil from the surface to the depth of 17 cm changes from yellow (10YR 8/6) to very pale brown (10YR 7/4) to pale brown (10YR 6/3), and after that, brownish-yellow (10YR 6/6) from upward to downward. The second test pit

was dug to the depth of 60 cm from the surface. The colour of the layer varies from very pale brown (10YR 7/4) at the surface to pale brown (10YR 6/3) till 19 cm and brownish yellow (10YR 6/6) again further at 18 cm. The layer below 40 cm is sterile and is composed of loose dark greyish brown (10YR 4/2) soil.

The first test pit at Silchang was dug to the depth of 70 cm from the surface. The soil colour at the surface is yellow (10YR 8/6), which changes to pale brown (10YR 6/3) at a depth of 40 cm and, after that, brownish-yellow (10YR 6/6) from upward to downward. The second test pit was dug to the depth of 65 cm from the surface. The soil colour at the surface is yellow (10YR 8/6) to very pale brown (10YR 7/4) to pale brown (10YR 6/3) at a depth of 50 cm. After 50 cm soil colour was brownish yellow (10YR 6/6).

The test pit at Shankargog was dug to the depth of 90 cm from the surface. The colour of the layer varies from very pale brown (10YR 7/4) at the surface to pale brown (10YR 6/3) till 63 cm, and the layer below 63 cm is sterile to cultural materials and is composed of loose dark greyish brown (10YR 4/2) in colour.

3.15 Discussion

This chapter briefs the types and quantity of artifacts collected from the study area. Various artifacts have been recovered from the survey, including lithic, pottery, and sediments. The morphological analysis of these artifacts reveals very crucial information about the region's material culture. A total of 42 Neolithic celts have been collected from the Digaru – Kolong river valley study area. The numbers of the stone artifacts or the celts differ from site to site and localities. Silchang consists of the highest number of artifacts, followed by Marakdola, Bagibari, Shankargog, Amkhang, Krakijam, Shikdmaha, Lymphuid, and Kalbari. The artifacts are classified into four types: Axe, adze, shouldered, and tanged celts. The highest artifact numbers are Axe (45.24%), followed by Adze (28.56%), Tanged (16.66%), and Shouldered celts (09.54%). A double-shouldered celt has been collected from the test pit at Bagibari, and the rest of the samples are the surface collection. The unfaceted surface of most of the samples indicates the grinding and polishing of the tools.

The wearing pattern or the broken working edge of several tools indicates the heavy utilization of the tools. This suggests that the stone tools' original or primary dimensions (L x B x T x W) differed. Due to the intensive use, the weight and dimensions would have been now reduced. The visual identification of the raw materials of the tools indicates a vast

number of slates, followed by sandstone, claystone, and shale. The previous work and literature also indicate the extensive use of these stones as a raw material for tool makings (Rao 1973; Deka 2015). The laboratory analysis has been conducted to determine the raw material of the tools (Chapter IV). Indices of the tools have been calculated with length, breadth, thickness, and weight to determine the probable function of the artifacts. The result indicates that most of the tools would have been used for light duty followed by medium duty. The light-duty implements suggest that these would have been used in household activities and agricultural work. The medium-duty tools would have been used for several agricultural and gathering works from forests.

Potsherds have been collected from various sites and localities in different shapes and sizes from the study area. A total of 1457 pieces of potsherds have been collected, consisting of rims, neck, body part, base, and several unidentified or miscellaneous parts of the pottery. The potsherds are wheel-thrown made, and no full shapes were recovered. The most common colour of the potsherds is dull red, reddish-yellow, and yellow. The texture of the potsherds was visually studied, and it was both coarse and fine. The rim thickness of the highest frequency of potsherds ranges from 0.6 – 0.9 cm. Different types of rim stances have been identified, such as plain, articulated, everted, and T-shaped. The body thickness of the highest frequency of potsherds ranges from 0.3 to 0.5 cm, followed by 0.6 – 0.9 cm and 1.0 – 1.5 cm. The highest number of body sherds are thin (62.20%), followed by medium (32.20%) in thickness, whereas thick body sherds were significantly less (05.60%) in number. The high number of thin body sherds further indicates the presence of tableware. There are several unidentified ceramic objects recovered from all the finding areas. The exterior surface of the potsherds was plain, and the basket/mat impressed. These impressions were in the form of different criss-cross lines and zig-zag patterns. The morphological analysis of the potsherds and their illustrations indicates several types of vessels. The following types can be deduced from the rim portions of the available potsherds: pitcher, shallow bowl, deep bowl, culinary bowl, lid, storage jar, pot, and plate. The ceramic objects from unidentified or miscellaneous categories have been identified or deduced as earthen lamps, spouts, pot polishing tools, and stands.

The methods of sediment analysis in archaeology include several tools. Analysis of the composition, texture, and colour of sediments provides different kinds of information to reconstruct the human past and paleoclimate. It helps us to recognize the activity areas in the

past. The colour of the soil has been studied from the layers of the test pit excavated at the site. The colour of most of the soil samples is varied at different depths. The soil colours at the surface to around the middle of the trench are mostly very pale brown (10YR 7/4) and pale brown (10YR 6/3). Brownish-yellow (10YR 6/6) and dark greyish brown (10YR 4/2) soils are mostly noticed after the half depth of the trench to its bottom. The yellowish colour in the soil indicates oxidation and good drainage, whereas the darker greyish colour at the bottom of some sites indicates poor drainage. Scientific analysis has been further mentioned in chapter IV to determine the other significant information, such as particle size, pH values, and amount of CaCO₃ present.



Chapter – 4

Scientific Analysis and Interpretation of Archaeological Artifacts

This chapter continues to analyze and interpret archaeological artifacts recovered from the field reconnaissance. This chapter provides detailed information on various scientific methods employed for artifacts with an overview of the methodological approach and significance. The meaning, importance of artifacts, and extent of analysis have already been discussed in the previous chapter. Therefore, this chapter focuses on the various scientific tools adapted to analyze the artifacts. Further, the Chapter is divided into four sections; Lithic analysis, Ceramics analysis, Sediments analysis, and lastly, Dating the site. Each section begins with a different methodological approach for analyzing the artifacts and a brief introduction to their importance and objectives. Various scientific analyses are employed to understand the mineralogical, chemical, and other properties of the artifacts. Lastly, the discussion further briefs the nature of artifacts from the study area and compares them with the findings of earlier studies from the neighboring archaeological sites to trace their dialogical relation.

4.1 Significance and Role of Scientific Methods in Archaeological Research

“The contribution of science to modern archaeology includes a broad range of techniques for analyzing archaeological objects. The application of this analytical system offers the greatest possible accuracy and reliability and contributes to the better understanding of human evolution.” (Liritzis, 1994, p. 361)

The application of scientific methods of artifact analysis has flourished in recent decades. It is an application of scientific techniques to analyze archaeological materials. The advancement of instruments in different enhancements and accuracy leads to successful analytical methods in archaeological research applications. The scientific tools are used to explore, excavate, and analyze the different types of artifacts. The technological advancement and use of scientific methods lead to the development of artifacts analysis, recreating the past environment, food pattern, and several other aspects of past life and society. The morphological and typological study of the artifacts is essential, and it determines crucial information. The analytical approach of the scientific study of artifacts helps determine their provenance, manufacturing technology, and cognition of the producer. The soil analysis provides insight into site

formations; the absolute dating method helps determine the chronology of the events. Spatial analysis and remote sensing examine human activities and man-land relationships.

Several artifacts have been collected from the study area in the present study, such as lithic, ceramics, and sediments. The morphological and typological analysis has been conducted of these artifacts to understand their nature (Chapter 3). The previous chapter dealt with the descriptions and importance of the artifacts. In this chapter, different scientific methods have been applied to determine the artifacts' various features, such as mineralogical composition, manufacturing technology, soil morphology, and the age of the settlements. This chapter will address the scientific methods adopted to analyze the artifacts.

Part I: Lithic Analysis

“The best preserved and most abundant evidence for 95% of the human career consists of stone tools and the debris left from making them.” (Banning 2000:141)

“... Experimental studies involving the manufacturing and use of stone tools have been integrated with studies of refitted or conjoined lithic artifacts and microware analysis. The result is a much more dynamic view of the variability in assemblages of lithic artifacts.” (Yerkes and Kardulias, 1993, p. 89)

4.2 Introduction

Apart from the morphological and typological analysis of the stone celts, the scientific study also provides essential information on their manufacturing and functional attributes. The scientific methods in the stone analysis may help to indicate the manufacturing region. It also helps in determining the provenance of the raw materials.

In the present study, Powder XRD and Thin section petrography has been done to determine the mineralogical composition of stone tools. The mineralogical analysis further helps to determine the rock type or raw materials.

4.3 Methodological Consideration for Lithic Analysis

Analyzing raw materials is an essential aspect of lithic analysis as it helps us understand the provenance or the source of the stones. Andrefsky (2005) has pointed out, *“the primary purpose of lithic raw-material identification is to determine the provenance or source of stone used to produce stone artifacts.”* Identifying raw material and locating the source

indicates whether those materials were locally available or transported from different places. The raw material has been classified based on colour, texture, and mineralogical. Powder XRD and Thin Section Petrography analyses have been conducted to understand the mineralogical composition of the stone tools. The colour and texture, along with other mineralogical methods, help us find out the raw material of the stone tools.

Thin Section Petrography

Petrography is a technique of Geological Science for locating the source of minerals. Petrography study helps determine the origin, structure, occurrence, and history of rocks and optical and chemical characterization. A polarised microscope analysis helps understand and classify rock – minerals/rock-forming minerals. The study of stone celt using the petrography method helps identify the rock types. A thin section of an artifact is cut, ground, and polished. The colour of each mineral has a distinctive colour and structure (Grant *et al.*, 2005, p. 65; Singh, 2017, pp. 26-27).

The thin section petrography method is a destructive technique. Thin section slide preparation is the first step in this method. A thin section of stone celt is cut to make a small chip that is large enough to hold with a finger. The size of the stone celt is tiny as well as it is difficult to cut a small piece without damaging the whole sample. Therefore, a small chip has been cut in the geological lab using a saw. Then, to obtain a smooth surface body of the celt, the sawing surface is polished on one side. Polishing is done using the grinding machine with the abrasive powder (carborundum powder of above 1000 mesh). Then, the polished side of the thin section is attached to a glass microscope slide using adhesive, and the other side is ground and polished to obtain a standard thickness of 0.03 to 0.02mm. After this, a thin section slide of the sample shows different minerals under the polarizing microscope. Leica Petrological Microscope is used to conduct the thin-section study.

Powder X-Ray Diffraction (XRD)

X-Ray Diffraction analysis is a powerful and influential technique for identifying the minerals in their crystalline structure. It identifies minerals in the soil, and mineral identification is based on the d-spacing and relative peak intensities (Zussman, 1977; Singh and Sharma, 2016). A German Physicist named Von Laue first used this technique in 1912. This method combines three essential elements: An X-ray tube, a sample holder, and an X-ray detector. A fine-grained powder was prepared by crushing the samples in an agate mortar.

The mortars of other materials such as iron, steel, etc., may add their elements resulting in contamination. Therefore, to avoid any impurities, agate mortar is used for powdering the samples. The ideal size of powder in XRD analysis is 10 μm . After carefully preparing the sample, it is placed over the sample holder, and the upper surface is formed even by using a glass slide (Singh, 2017, p. 28).

The XRD Spectra was recorded in the 2θ range from 10 to 80° on TTRA III Rigaku X-Ray Diffractometer using $\text{CuK}\alpha$ radiation at a wavelength of 1.5406 Å. The specific wavelengths of target materials such as Cu, Fe, and Cr, but Cu is the most common target material for XRD, with $\text{CuK}\alpha$ radiation at 1.5406 Å (Singh and Sharma, 2016).

After that, using the Origin 6.0 software, data were analyzed. The peaks obtained from XRD data have been interpreted to get 2θ values using Origin 6.0 software. After that, Bragg's law ($n\lambda = 2d \times \sin \theta$) is applied to converting each 2θ degree to get the d values. Then, the d values and available literature and online sources. It resulted in understanding the mineralogical framework of the studied samples. The references are International Centre for Diffraction Data as Powder Diffraction File (ICDD-PDF), and American Mineralogist Crystal Structure Database (AMCSD)

4.3.1 Sampling and Nomenclature of Samples

All the stone celts have been collected from the surface, and only a single celt was recovered from the test pit. All the collected lithic or stone tools are packed individually to avoid any mixing, among others. The stone tools are cleaned with a brush to remove the dust, clay, and dirt on the surface. After cleaning, all the tools are given a separate number with a site abbreviation. The sample name starts with the name of the site abbreviation. After the acronym, the presence of t denotes the tool sample. Stone tools collected from different sites are classified based on their typological functions. The list of celt samples is mentioned below in Table 4. 1, along with their finding location and sample names.

Table 4. 1: Description of Stone celt samples

S. N.	Sample Name	Site Name	Max. Length (cm)	Max. Breadth (cm)	Max. Thickness (cm)	Weight (g)	Type
1	MRKt3	Marakdola	7.3	5.6	1.8	94	Adze
2	SKGt1	Shankargog	13.2	7.0	1.5	224	Axe
3	SKGt2	Silchang	7.5	6.0	1.5	86	Axe
4	SLGt1	Silchang	10.3	7.1	2.3	135	Axe
5	SLGt4	Silchang	11.0	6.3	2.2	147	Axe

4.4 Raw Materials Analysis

The earth's surface carries various stone types based on their colour, crystalline structure, and hardness. These stone breaks differently based on their crystalline structure or grain size. The stone chosen for making tools is based on the availability of the rock in the region. The procurement of raw materials for the tools is acquired chiefly from nearby places. The lithic-poor areas would have fetched or transported the stone to a base camp from other regions. The raw materials have been classified based on colour and texture. Additionally, mineralogical studies such as XRD and thin-section petrographic methods help determine the raw material used for making stone tools.

4.4.1 Powder XRD Analysis

The principal mineral substances identified in all the samples of stone celts are Quartz, Hematite, Kaolinite, Goethite, Muscovite, Anorthite, and Orthoclase. Quartz is present in all samples as a primary mineral. Other than the minerals shown in the table, several other minerals have been identified in these samples. These are Goethite, Biotite, Albite, Amphiboles, Micas, Clinoptilolite, Anatase, Tremolite, Ilmentite, and some Expansible Phyllosilicates such as Montmorillonite.

Table 4. 2: Identified Minerals and phase obtained by XRD of stone celt samples, +++ = very abundant, ++ = abundant, + = present, - = absent

Minerals	MRK t 3	SKG t 1	SKG t 2	SLG t 1	SLG t 4
Microcline	+	+	-	+	+
Anorthite	++	+	+	++	++
Orthoclase	+	+	+	++	+
Quartz	++++	++++	++++	++++	++++
Calcite	-	-	+	+	+
Kaolinite	++	++	++	++	++
Muscovite	++	-	-	-	++
Goethite	++	++	++	++	++
Hematite	+++	+++	+++	+++	++
Oligoclase	+	+	-	+	+
Hornblende	-	+	+	-	+
Pyrite/parasite	-	+	+	-	-

4.4.2 Thin-Section Petrography

The petrography is done on all five samples SLGt4, SKGt1, SKGt2, SLGt1, and MRKt3. The description is below:

1. SLGt4: - The rock is composed primarily of elongated quartz particles and light greyish brown fine micaceous materials; irregular shape opaque grains are also found irregularly distributed throughout the mineralogy framework. Some of the opaque grains have a rounded shape. The larger quartz grains are both mono-crystalline and polycrystalline. Irregular void spaces with an opaque lining are found irregularly distributed in the mineralogy framework.

The above sample has ferruginous materials and is full of quartz. Other than that, it has Amphiboles, Micas, and carbonates. The raw material of the above sample is identified as Slate, which is a metamorphic rock.

Sample no. SKG t 1 has similar properties and is identified as a similar rock.

2. SKG t 2: - The thin section comprises feldspars laths, weathered greenish amphiboles, and opaque ferruginous (Magnetite?) grains; irregular quartz grains occurred in a minor amount within the mineralogical framework. The above sample is identified as

Shale, which is a sedimentary rock. Sample no. SLG t 1 and MRK t 3 have similar properties and are identified as similar rocks.

Table 4. 3: Raw material of the analyzed tool samples

S. N.	Sample Name	Raw material	Rock Type
01	MRKt3	Shale	Sedimentary
02	SKGt1	Slate	Metamorphic
03	SKGt2	Shale	Sedimentary
04	SLGt1	Shale	Sedimentary
05	SLGt4	Slate	Metamorphic

Slate is a foliated, homogenous metamorphic rock. Slate has a fine-grained texture, and the primary mineral compositions are quartz, mica, chlorites, feldspar, and some other minerals in smaller amounts. The dark colour of a slate is due to the presence of carbonaceous materials or finely divided iron sulfides. Shale is also a fine-grained laminated mudrock that lies in the Sedimentary rock type. The composition of shale is clay minerals and quartz.

The present study area lies in the state of Assam and Meghalaya. The Digaru – Kolong river valley and its neighboring regions have abundant rock sources, such as North Cachar hills, Khasi hills, and Garo hills. The primary rock source of Assam and Meghalaya are sandstone, rhyolite, slate, dolerite, limestone, claystone, shale, serpentine rocks, etc. Dolerite was the most common rock in making tools in Garo Hills, whereas Rhyolite in Khasi Hill. Slate is the dominating type in Assam and the nearby foothill region, besides sandstone, rhyolite, limestone, fossil wood, and claystone. (Ashraf, 2004; Deka, 2015).

Part II: Ceramic Analysis

“Scientific techniques have been of especial use in three areas of ceramic studies – dating, sourcing (provenance studies) and the study of function.” (Orton et al., 1993, p. 18)

“The nature of ceramic materials and what we need to know about them determine our selection of analytical methods.” (Shepard, 1980, p. 138)

4.5 Introduction

Pottery is the most common and essential find in the archaeological site. The analysis of pottery helps determine the settlement's technological, socio-cultural, art and aesthetic, food behavior, and chronology. The scientific technique to analyze the artifacts helps to reconstruct the past society, environment, and people. The scientific methods of analyzing ceramics have been borrowed from various natural sciences such as physics and chemistry to investigate the pottery's physical, mineralogical, and chemical properties (Singh, 2017, p. 6).

In the present study, scientific analysis of the pottery has been conducted along with typological studies to understand the mineralogical composition, manufacturing techniques (firing atmosphere and temperature), and chronology.

4.6 Methodological Consideration for Ceramic Analysis

Scientific methods play a significant role in studying the pottery's manufacturing techniques, environment, and provenance. One of the most important methods of pottery study is scientific analysis. The scientific methods help in three significant areas of pottery study – dating, provenance, and the study of function. The scientific method in pottery study helps to understand the composition of ceramics, which further highlights the technological advancement of the potters. The mineralogical study of the pottery helps us to determine the firing temperature and environment.

Scientific methods of X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FT-IR) analysis were done on the selected potshard samples to understand the mineralogical composition and firing temperature and condition. The X-Ray Diffraction (XRD) method characterizes minerals by their crystalline structure (Zussman, 1977). The XRD application and its importance have already been mentioned in the above section. The

AMS dating of the potsherds samples has been discussed in Section IV, titled ‘Dating the sites.’

Fourier Transform Infrared Spectroscopy (FTIR) analysis of archaeological artifacts is a crucial tool that provides various information. It helps identify unknown materials and the components in a mixture. The FTIR technique determines the types of clay minerals, their structural characteristic, and the lower firing temperature limit when making the pottery (Singh, 2017, p. 29).

The infrared spectrum was recorded in the mid-IR region $400\text{-}4000\text{ cm}^{-1}$ with five scan modes using Perkin-Elmer Spectrum. The KBr pressed pellet technique was used to record the spectrum. The Potassium bromide (KBr) has been dried in a hot air oven at a temperature of $60\text{-}100\text{ }^{\circ}\text{C}$ for 12 hours to avoid moisture. Then, KBr and powdered samples were ground in an agate mortar. The KBr were mixed with samples in a proportion of 0.2% to 1%. After that, the crushed mixture of the sample and KBr is pressed under extremely high pressure (maximum press up to 280 Kg/cm^2) to prepare the pellet.

After that, data analysis was done using Origin 6.0 software. Origin software is used to analyze the IR spectrum band. Then, the presence of bands at different peak positions and received states were analyzed and compared to understand the vibrational assignments with available online sources such as the American Mineralogist Crystal Structure Database (AMCSD), International Centre for Diffraction Data as Powder Diffraction File (ICDD-PDF), and several other works of literature such as Paama *et al.*, (2000), Venkatachalapathy *et al.*, (2002), Ravisankar *et al.*, (2010), Annamalai *et al.*, (2014), Velraj *et al.*, (2015), Singh and Sharma (2016), Singh (2017), and Singh *et al.* (2021).

4.6.1 Sampling and Nomenclature of samples

Potsherds samples have been collected from both test pits and the surface. Samples were collected from the test pits of four sites, and surface samples have been recovered from various localities (mentioned in Chapter 2) of Digaru – Kolong river valley. The samples selected for scientific analysis have been packed separately in a plastic zip-lock bag. All the samples from each site are packed individually and labeled with site names and locality. The samples are cleaned with a brush to remove the dust, clay, and dirt on the surface. After cleaning, all the samples are given a separate number with site abbreviation and depth. The sample name begins with the site abbreviation, and c is added before the sample number for

ceramics. Photographs have been taken of all the samples in their in-situ condition and after cleaning.

4.7 Mineralogical Characterization of Pottery

Mineralogical analysis has been carried out on potsherds samples, surface collection, and samples recovered from test pits. Minerals are identified using XRD and FTIR in the composition of analyzed pottery.

4.7.1 X-Ray Diffraction analysis of Pottery

Powder XRD provides information about mineralogical phases and the composition of the ancient ceramic. XRD is an essential technique to investigate the structural aspects of ceramics. The patterns with identified crystalline phases of analyzed potsherds samples and analysis have been mentioned in Table 4. 4 - Table 4. 5 and Plate 4. 2 to Plate 4. 10.

The significant minerals identified in all the potsherd samples (including excavated and surfaced collected) are Quartz, Kaolinite, Hematite, Goethite, Microcline, and Aragonite. The quantity of these minerals varies in all the samples.

Quartz is ubiquitous and found in all the samples as a primary mineral. The distinctive reflection identifies it at various peaks in all the samples. Quartz is an indigenous mineral found in clay deposits, making the clay self-tempered. It is difficult to determine whether it was either added intentionally as tempering material or present initially. It is less resistant to mechanical and thermal shocks (Papachistodoulou *et al.*, 2006; Singh and Sharma, 2016; Singh, 2017).

Kaolinite and Hematite is the second most abundant mineral after Quartz in all the analyzed potsherd samples. Kaolinite is a clay mineral formed either by the weathering of igneous rocks under various conditions or from the feldspar eroded from rocks. Hematite is identified in all the analyzed samples (excavated and surface collection). The presence of Hematite affects the colour and firing atmosphere of the potsherds. It is a colouring material, and its presence makes pottery reddish. The presence of Hematite also indicates that the potsherds are fired in an oxidizing atmosphere (Venkatachalapathy *et al.*, 2002; Singh and Sharma, 2016).

Feldspars mineral groups are identified in most of the analyzed samples. Microcline, Orthoclase, and Anorthite are the major minerals found in the Feldspar group. Microcline is present in all the excavated samples (test pit samples) in varying quantities. Microcline is present in all the analyzed samples of surface collection except MNGc3, CHRlc1, CHRlc2, LPDc2, and SDMc1. Orthoclase is present in SLGc3 and SKGc1 in excavated samples. Among the surface collected samples, Orthoclase is identified in SBRc1, CHRlc2, CHRlc3, CHRlc1, CHRlc2, CHRlc3, LPDc1, and SDMc3. In addition, Anorthite is identified in MRKc1, MRKc4, and BGIc4 in excavated samples and MNGc2, MNGc3, LPDc2, and SDMc1 in surface collected samples.

Goethite is present in all the samples in varying quantities. Aragonite is present in most of the analyzed samples. It is identified in all the excavated samples except in SKGc1 – 6. In the surface samples, Aragonite is identified in AKGc1-2, KJMc1-2, MNGc1-3, MSKc1-3, LPDc2-3, SDMc1-2, and KLBc1-3. Augite is identified in MRKc5, MRKc6, and BGIc2. In addition, Dolomite is identified in excavated samples in MRKc1-3, MRKc6, BGIc1-6, and SLGc2-6 in varying quantities.

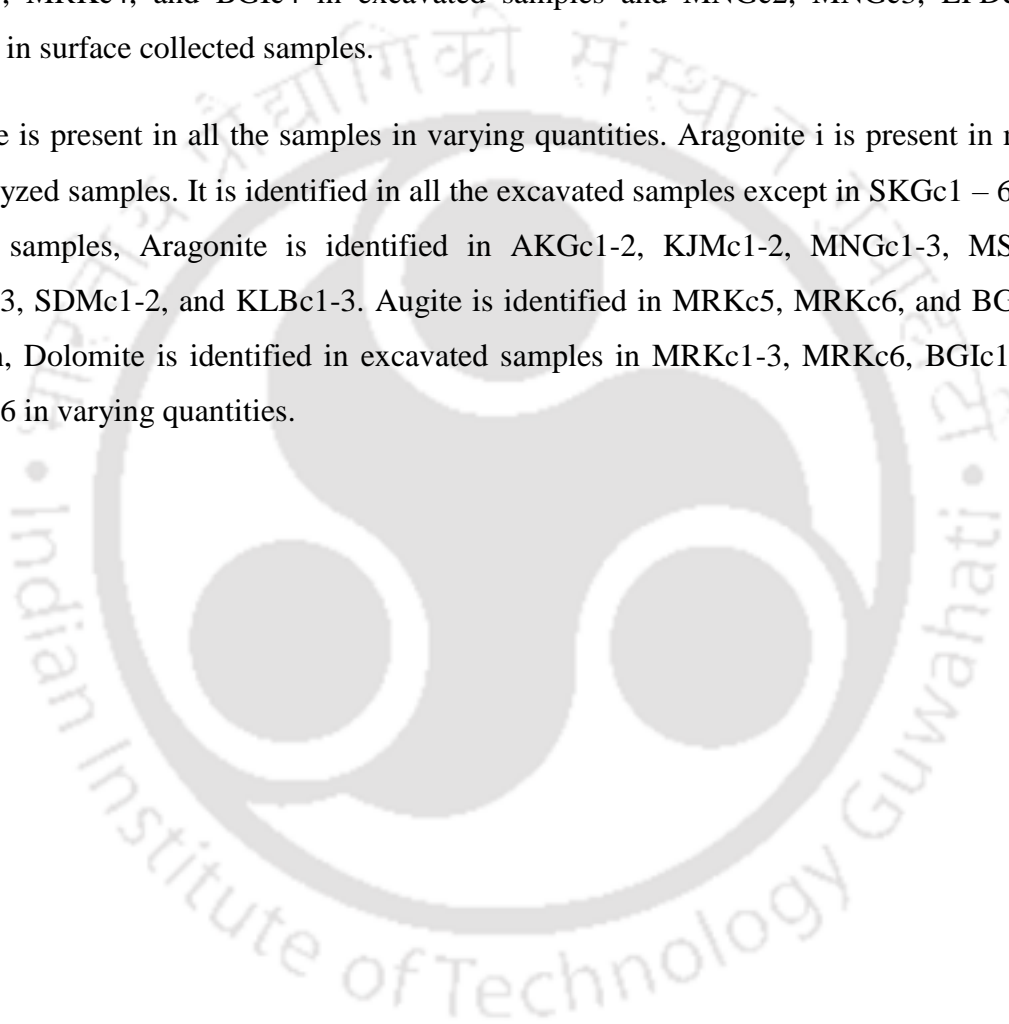


Table 4. 4: Identified Minerals and phase obtained by XRD of pottery reported from Test pits, +++ = very abundant, ++ = abundant, + = present, - = absent

Minerals Identified by XRD analysis of the potsherd samples from Test pits											
S. N.	Sample name	Quartz	Kaolinite	Hematite	Goethite	Microcline	Anorthite	Orthoclase	Aragonite	Augite	Dolomite
1	MRK c 1	+++	+++	+++	+	++	+	-	+	-	+
2	MRK c 2	+++	+++	+++	+	++	-	-	+	-	+
3	MRK c 3	+++	+++	+++	+	++	-	-	+	-	+
4	MRK c 4	+++	+++	+++	+	+	+	-	+	-	-
5	MRK c 5	+++	+++	+++	+	+	-	-	+	+	-
6	MRK c 6	+++	+++	+++	+	+	-	-	+	+	+
7	BGI c 1	+++	+++	+++	+	++	-	-	+	-	+
8	BGI c 2	+++	+++	+++	+	+	-	-	+	+	+
9	BGI c 3	+++	+++	+++	+	+	-	-	+	-	+
10	BGI c 4	+++	+++	+++	+	+	+	-	+	-	+
11	BGI c 5	+++	+++	+++	+	+	-	-	+	-	++
12	BGI c 6	+++	+++	+++	+	+	-	-	+	-	+
13	SLG c 1	+++	+++	+++	+	+	-	-	+	-	-
14	SLG c 2	+++	+++	+++	+	++	-	-	+	-	+
15	SLG c 3	+++	+++	+++	+	++	-	+	+	-	+
16	SLG c 4	+++	+++	+++	+	++	-	-	+	-	+
17	SLG c 5	+++	+++	+++	+	++	-	-	+	-	+
18	SLG c 6	+++	+++	+++	+	++	-	-	+	-	+
19	SKG c 1	+++	+++	+++	+	+	-	+	-	-	-
20	SKG c 2	+++	+++	+++	+	+	-	-	-	-	-
21	SKG c 3	+++	+++	+++	+	++	-	-	-	-	-
22	SKG c 4	+++	+++	+++	+	+	-	-	-	-	-
23	SKG c 5	+++	+++	+++	+	+	-	-	-	-	-
24	SKG c 6	+++	+++	+++	+	++	-	-	-	-	-

Table 4. 5: Identified Minerals and phase obtained by XRD of pottery (Surface collection),

+++ = very abundant, ++ = abundant, + = present, - = absent

Minerals Identified by XRD analysis of the potsherd samples (Surface collection)									
S. N.	Sample name	Quartz	Kaolinite	Hematite	Goethite	Microcline	Aragonite	Orthoclase	Anorthite
1	AKG c 1	+++	++	+++	+	++	+	-	-
2	AKG c 2	+++	++	+++	+	+	+	-	-
3	AKG c 3	+++	++	+++	++	++	-	-	-
4	KJM c 1	+++	++	+++	+	++	+	-	-
5	KJM c 2	+++	++	+++	++	+	+	-	-
6	KJM c 3	+++	++	+++	+	++	-	-	-
7	MNG c 1	+++	++	+++	+	+	+	-	-
8	MNG c 2	+++	++	+++	+	+	+	-	+
9	MNG c 3	+++	++	+++	+	-	+	-	+
10	SBR c 1	+++	++	+++	+	+	-	+	-
11	SBR c 1	+++	++	+++	+	+	-	-	-
12	SBR c 3	+++	++	+++	+	+	-	-	-
13	CHR I c 1	+++	++	+++	+	-	-	-	-
14	CHR I c 2	+++	++	+++	+	-	-	+	-
15	CHR I c 3	+++	++	+++	++	+	-	+	-
16	CHR II c 1	+++	++	+++	+	+	-	+	-
17	CHR II c 2	+++	++	+++	+	+	-	+	-
18	CHR II c 3	+++	++	+++	++	++	-	+	-
19	MSK c 1	+++	++	+++	++	+	+	-	-
20	MSK c 2	+++	++	+++	+	+	+	-	-
21	MSK c 3	+++	++	+++	+	+	+	-	-
22	LPD c 1	+++	++	+++	++	++	-	+	-
23	LPD c 2	+++	++	+++	+	-	+	-	+
24	LPD c 3	+++	++	+++	++	+	+	-	-
25	SDM c 1	+++	++	+++	+	-	+	-	+
26	SDM c 2	+++	++	+++	+	+	+	-	-
27	SDM c 3	+++	++	+++	+	+	-	+	-
28	KLB c 1	+++	++	+++	+	++	+	-	-
29	KLB c 2	+++	++	+++	+	+	+	-	+
30	KLB c 3	+++	++	+++	++	+	+	-	-

4.7.2 Fourier Transform Infrared Spectroscopy (FTIR)

FTIR is an effective analytical method for detecting chemical bonds in a molecule by producing an infrared absorption band. In the present study, FTIR determines the minimum and maximum firing temperature range and firing atmosphere of analyzed potsherds samples. The spectra have created a distinctive molecular fingerprint that is used to screen and scan the samples. FTIR spectra, peak position, and their tentative assignments of analyzed potsherds are summarized in Table 4. 6 to Table 4. 18 and Plate 4. 11 to Plate 4. 17.

The medium to strong IR spectrum around 3425 cm^{-1} and a weak to medium spectrum around 1635 cm^{-1} were observed in all samples due to the O-H stretching and O-H bending of an absorbed water molecule in samples. The weak to medium IR spectra around 3647 cm^{-1} are due to the presence of the O-H stretching of an inner hydroxyl group in SLGc2, SLGc6, CHRlc1, and CHRlc3 (Paama *et al.*, 2000; Venkatachalapathy *et al.*, 2002; Ravisankar *et al.*, 2010; Velraj *et al.*, 2015; Singh and Sharma, 2016).

The Infrared medium spectra around 3620 cm^{-1} , 3350 cm^{-1} , and 3552 cm^{-1} in MRKc5; SLGc2,3,6; CHRlc1, 3; SBRc3; LPDc1, and SDMc1 is due to the Inner O-H group of an absorbed water molecule in the samples (Venkatachalapathy *et al.*, 2002; Annamalai *et al.*, 2014; Singh, 2017). The very weak to weak IR spectra at $2950 - 2220\text{ cm}^{-1}$ and 2005 cm^{-1} are due to the C-H stretching bands present in organic materials. C-H stretching bands are detected in all the analyzed samples. Carbonate overtone/combinations are seen in all the analyzed samples around the Infrared bands 1800 cm^{-1} , 1400 cm^{-1} , and 1300 cm^{-1} .

The IR spectra band around 1034 cm^{-1} is due to red clay origin, and the band around 1080 cm^{-1} is due to white clay origin (Maniyatis and Tite, 1975). The very strong IR spectra around $1079 - 1150\text{ cm}^{-1}$ are detected in BGIc2, 3,6; SKGc5; MRKc3,6; KJMc1; MSKc3; LPDc2; and SDMc3 due to the white clay origin of Kaolinite present in the samples. Therefore, the white clay origin of Kaolinite was used to make the above pottery. The very strong to strong IR spectra band around $1040-1015\text{ cm}^{-1}$ is detected in BGIc1,4,5; SKGc3; MRKc1,2,4,5; SLGc1-6; SBRc3; MNGc2,3; MSKc1,2; LPDc1,3; and SDMc2 due to the presence of red clay origin Kaolinite, which further indicates that red clay origin of Kaolinite were used in making of these potteries. The very weak peak around 911 cm^{-1} is identified in CHRlc1 and CHRlc3 due to the Al-OH of the octahedral sheet. Al-O co-ordination vibration is detected in SLGc4 at 634 cm^{-1} with a very weak spectrum (Venkatachalapathy *et al.*, 2002; Singh, 2017).

Quartz is observed in all samples abundantly, which is also supported by the XRD analysis. The weak bands around the 778 cm^{-1} to 694 cm^{-1} are due to the presence of Quartz in all the analyzed samples. Hematite is present in all the analyzed samples. The XRD and FTIR analysis attest to the presence of Hematite. The IR spectrum around 540 and 580 cm^{-1} is due to the presence of hematite and magnetite. Hematite is present in all the analyzed samples. The very weak IR spectrum around the 535 – 560 cm^{-1} in all the analyzed samples is due to the presence of Hematite. The presence of Hematite and Magnetite indicates the firing condition of the pottery. Ravisankar *et al.* (2010) state that the iron oxides affect the firing atmosphere and differ in colour as per their firing condition. This further indicates that all the analyzed samples with Hematite in composition were fired in oxidizing conditions (Russell, 1987; De Benedetto *et al.*, 2002; Mirti *et al.*, 2006; Annamalai *et al.*, 2014).

In addition, Feldspar compound microcline is identified in all the analyzed samples. The absorption band in the sample around 480 cm^{-1} and 460 cm^{-1} are due to the presence of Microcline. The IR spectra of all the samples show a very weak to weak band due to the presence of Microcline, and it is free from any temperature effects and stable up to 800 °C.

Table 4. 6: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (MRK)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
MRK c 1		
3426	Medium	O-H stretching of absorbed water molecule
1630	Very Weak	H-O-H bending of water
1034	Very Strong	Si-O-Si (Kaolinite)
797,649	Very Weak	Si-O of Quartz
559	Very Weak	Fe ₂ O ₃
482	Very Weak	Si-O-Si bending (Microcline)
MRK c 2		
3441	Medium	O-H stretching of absorbed water molecule
1639	Very Weak	H-O-H bending of water
1035	Very Strong	Si-O-Si (Kaolinite)
797	Very Weak	Si-O of Quartz
540	Very Weak	Fe ₂ O ₃
MRK c 3		
3419	Medium	O-H stretching of absorbed water molecule
2924,2853	Very Weak	C-H stretching
1625	Very Weak	H-O-H bending of water
1087	Very Strong	Si-O-Si (Kaolinite)
796, 692, 669	Very Weak	Si-O of Quartz
517	Very Weak	Si-O-M
466	Very Weak	Si-O-Si bending (Microcline)
MRK c 4		
3426	Medium	O-H stretching of absorbed water molecule

1630	Very Weak	H-O-H bending of water
1034	Very Strong	Si-O-Si (Kaolinite)
797,649	Very Weak	Si-O of Quartz
559	Very Weak	Fe ₂ O ₃
482	Very Weak	Si-O-Si bending (Microcline)
MRK c 5		
3552	Medium	Inner O-H group of adsorbed water
2924, 2279	Very Weak	C-H stretching
1636	Medium	H-O-H bending of water
1384	Very Weak	Carbonate overtone/combinations
1037	Very Strong	Si-O-Si (Kaolinite)
798, 778,694	Very Weak	Si-O of Quartz
560	Very Weak	Fe-O of Hematite
480	Very Weak	Microcline
MRK c 6		
3419	Medium	O-H stretching of absorbed water molecule
2924,2853	Very Weak	C-H stretching
1625	Very Weak	H-O-H bending of water
1087	Very Strong	Si-O-Si (Kaolinite)
796, 692, 669	Very Weak	Si-O of Quartz
517	Very Weak	Si-O-M
466	Very Weak	Si-O-Si bending (Microcline)

Table 4. 7: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (BGI)

Peak position cm ⁻¹	As received state	Tentative Vibrational Assignments
BGI c 1		
3432	Medium	O-H stretching of absorbed water molecule
2960	Very weak	C-H stretching
2925	Weak	C-H stretching
2858	Very weak	C-H stretching
2527	Very weak	C-H stretching
1636	Weak	H-O-H bending of water
1460	Very weak	Carbonyl group (C-O)
1033	Very strong	Si-O-Si (Kaolinite)
796	Very weak	Si-O of Quartz
731	Very weak	Si-O of Quartz
697	Very weak	Si-O of Quartz
542	Very weak	Fe-O of Hematite
478	Very weak	Si-O-Si bending (Microcline)
BGI c 2		
3451	Very strong	O-H stretching of absorbed water molecule
2928	Very weak	C-H stretching
2856	Very weak	C-H stretching
2005	Very weak	C-H stretching
1880	Very weak	Carbonate overtone/combinations
1636	Strong	H-O-H bending of water
1106	Strong	Si-O-Si (Kaolinite)
796	Medium	Si-O of Quartz
695	Very weak	Si-O of Quartz
560	Very weak	Fe-O of Hematite
486	Very weak	Si-O-Si bending (Microcline)

BGI c 3		
3430	Very strong	O-H stretching of absorbed water molecule
2928	Very weak	C-H stretching
2854	Very weak	C-H stretching
2005	Very weak	C-H stretching
1884	Very weak	Carbonate overtone/combinations
1628	Strong	H-O-H bending of water
1167	Very strong	Si-O-Si (Kaolinite)
801	Medium	Si-O of Quartz
782	Medium	Si-O of Quartz
694	Weak	Si-O of Quartz
479	Weak	Si-O-Si bending (Microcline)
454	Weak	Si-O-Si bending (Microcline)
BGI c 4		
3432	Medium	O-H stretching of absorbed water molecule
2960	Very weak	C-H stretching
2925	Weak	C-H stretching
2858	Very weak	C-H stretching
2527	Very weak	C-H stretching
1636	Weak	H-O-H bending of water
1460	Very weak	Carbonyl group (C-O)
1033	Very strong	Si-O-Si (Kaolinite)
796	Very weak	Si-O of Quartz
731	Very weak	Si-O of Quartz
697	Very weak	Si-O of Quartz
542	Very weak	Fe-O of Hematite
478	Very weak	Si-O-Si bending (Microcline)
BGI c 5		
3485	Medium	O-H stretching absorbed water molecule
2921, 2346	Very Weak	C-H stretching
1639	Very Weak	H-O-H bending of water
1384	Very Weak	Carbonate overtone/combinations
1083	Very Strong	Si-O-Si (Kaolinite)
1035	Weak	Si-O-Si (Kaolinite)
797, 778	Very Weak	Si-O of Quartz
649	Very Weak	Si-O of Quartz
482	Very Weak	Microcline
BGI c 6		
3430	Very strong	O-H stretching of absorbed water molecule
2928	Very weak	C-H stretching
2854	Very weak	C-H stretching
2005	Very weak	C-H stretching
1884	Very weak	Carbonate overtone/combinations
1628	Strong	H-O-H bending of water
1167	Very strong	Si-O-Si (Kaolinite)
801	Medium	Si-O of Quartz
782	Medium	Si-O of Quartz
694	Weak	Si-O of Quartz
479	Weak	Si-O-Si bending (Microcline)
454	Weak	Si-O-Si bending (Microcline)

Table 4. 8: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (SLG)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
SLG c 1		
3485	Medium	O-H stretching absorbed water molecule
2921, 2346	Very Weak	C-H stretching
1639	Very Weak	H-O-H bending of water
1384	Very Weak	Carbonate overtone/combinations
1035	Weak	Si-O-Si (Kaolinite)
797, 778	Very Weak	Si-O of Quartz
649	Very Weak	Si-O of Quartz
482	Very Weak	Microcline
SLG c 2		
3647	Weak	O-H stretching of inner hydroxyl group
3375	Very Weak	Inner O-H group of adsorbed water
2921, 2859	Very Weak	C-H stretching
1883	Very Weak	Carbonate overtone/combinations
1688	Very Weak	H-O-H bending of water
1037	Very Strong	Si-O-Si (Kaolinite)
798, 778	Weak	Si-O of Quartz
694	Very Weak	Si-O of Quartz
559	Very Weak	Fe-O of Hematite
SLG c 3		
3552	Medium	Inner O-H group of adsorbed water
2924, 2279	Very Weak	C-H stretching
1636	Medium	H-O-H bending of water
1384	Very Weak	Carbonate overtone/combinations
1037	Very Strong	Si-O-Si (Kaolinite)
798, 778, 694	Very Weak	Si-O of Quartz
560	Very Weak	Fe-O of Hematite
480	Very Weak	Microcline
SLG c 4		
3436	Very Strong	O-H stretching of absorbed water molecule
2923, 2850	Very Weak	C-H stretching
1877	Very Weak	Carbonate overtone/combinations
1637	Very Weak	H-O-H bending of water
1035	Very Weak	Si-O-Si (Kaolinite)
798, 779, 694	Very Weak	Si-O of Quartz
634	Very Weak	Al-O co-ordination vibration
515	Very Weak	Si-O-M
471	Very Weak	Fe ₂ O ₃
SLG c 5		
3436	Medium	O-H stretching of absorbed water molecule
2923, 2850	Very Weak	C-H stretching
1877	Very Weak	Carbonate overtone/combinations
1636	Very Weak	H-O-H bending of water
1036	Very Strong	Si-O-Si (Kaolinite)
798, 778, 694	Very Weak	Si-O of Quartz
515	Very Weak	Si-O-M
482	Strong	Si-O-Si bending (Microcline)
SLG c 6		
3647	Weak	O-H stretching of inner hydroxyl group
3375	Medium	Inner O-H group of adsorbed water

2921, 2859	Very Weak	C-H stretching
1883	Very Weak	Carbonate overtone/combinations
1688	Very Weak	H-O-H bending of water
1037	Very Strong	Si-O-Si (Kaolinite)
798, 778	Weak	Si-O of Quartz
694	Very Weak	Si-O of Quartz
559	Very Weak	Fe-O of Hematite

Table 4. 9: The IR Spectra and Probable Assignments of Potsherd Samples collected from Test Pits (SKG)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
SKG 1		
3445	Very strong	O-H stretching of absorbed water molecule
2925	Very weak	C-H stretching
2338	Very weak	C-H stretching
1876	Weak	Carbonate overtone/combination
1636	Medium	H-O-H bending of water
794	Very weak	Si-O of Quartz
779	Very weak	Si-O of Quartz
692	Weak	Si-O of Quartz
SKG c 2		
3744	Weak	O-H stretching of absorbed water molecule
3441	Strong	O-H stretching of absorbed water molecule
2961	Very weak	C-H stretching
2925	Very weak	C-H stretching
2854	Very weak	C-H stretching
2330	Very weak	C-H stretching
1872	Medium	Carbonate overtone/combination
1633	Strong	H-O-H bending of water
797	Very weak	Si-O of Quartz
776	Very weak	Si-O of Quartz
694	Very weak	Si-O of Quartz
478	Very weak	Si-O-Si bending (Microcline)
SKG c 3		
3445	Medium	O-H stretching of absorbed water molecule
1638	Very Weak	H-O-H bending of water
1037	Very Strong	Si-O-Si (Kaolinite)
778, 692	Very Weak	Si-O of Quartz
537	Very Weak	Fe_2O_3
SKG c 4		
3445	Very strong	O-H stretching of absorbed water molecule
2925	Very weak	C-H stretching
2338	Very weak	C-H stretching

1876	Weak	Carbonate overtone/combination
1636	Medium	H-O-H bending of water
794	Very weak	Si-O of Quartz
779	Very weak	Si-O of Quartz
692	Weak	Si-O of Quartz
SKG c 5		
3451	Very strong	O-H stretching of absorbed water molecule
2928	Very weak	C-H stretching
2856	Very weak	C-H stretching
2005	Very weak	C-H stretching
1880	Very weak	Carbonate overtone/combinations
1636	Strong	H-O-H bending of water
1106	Strong	Si-O-Si (Kaolinite)
796	Medium	Si-O of Quartz
695	Very weak	Si-O of Quartz
560	Very weak	Fe-O of Hematite
486	Very weak	Si-O-Si bending (Microcline)
SKG c 6		
3744	Weak	O-H stretching of absorbed water molecule
3441	Strong	O-H stretching of absorbed water molecule
2961	Very weak	C-H stretching
2925	Very weak	C-H stretching
2854	Very weak	C-H stretching
2330	Very weak	C-H stretching
1872	Medium	Carbonate overtone/combination
1633	Strong	H-O-H bending of water
797	Very weak	Si-O of Quartz
776	Very weak	Si-O of Quartz
694	Very weak	Si-O of Quartz
478	Very weak	Si-O-Si bending (Microcline)

Table 4. 10: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (AKG)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
AKG c 1		
3453	Very strong	O-H stretching of absorbed water molecule
2924	Very weak	C-H stretching
2852	Very weak	C-H stretching
2342	Very weak	C-H stretching
1870	Weak	Carbonate overtone/combinations
1635	Medium	H-O-H bending of water
1386	Weak	Carbonate overtone/combinations
797	Very weak	Si-O of Quartz

692	Very weak	Si-O of Quartz
AKG c 2		
3458	Very strong	O-H stretching of absorbed water molecule
2925	Very weak	C-H stretching
2854	Very weak	C-H stretching
2350	Very weak	C-H stretching
1998	Very weak	C-H stretching
1873	Weak	Carbonate overtone/combination
1791	Very weak	Carbonate overtone/combination
1632	Strong	H-O-H bending of water
796	Very weak	Si-O of Quartz
697	Very weak	Si-O of Quartz
544	Very weak	Fe-O of Hematite
466	Very weak	Si-O-Si bending (Microcline)
AKG c 3		
3453	Very strong	O-H stretching of absorbed water molecule
2924	Very weak	C-H stretching
2852	Very weak	C-H stretching
2342	Very weak	C-H stretching
1870	Weak	Carbonate overtone/combinations
1635	Medium	H-O-H bending of water
1386	Weak	Carbonate overtone/combinations
797	Very weak	Si-O of Quartz
692	Very weak	Si-O of Quartz

Table 4. 11: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (KJM)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
KJM c 1		
3451	Very strong	O-H stretching of absorbed water molecule
2928	Very weak	C-H stretching
2856	Very weak	C-H stretching
2005	Very weak	C-H stretching
1880	Very weak	Carbonate overtone/combinations
1636	Strong	H-O-H bending of water
1106	Strong	Si-O-Si (Kaolinite)
796	Medium	Si-O of Quartz
695	Very weak	Si-O of Quartz
560	Very weak	Fe-O of Hematite
486	Very weak	Si-O-Si bending (Microcline)
KJM c 2		
3744	Weak	O-H stretching of absorbed water molecule

3441	Strong	O-H stretching of absorbed water molecule
2961	Very weak	C-H stretching
2925	Very weak	C-H stretching
2854	Very weak	C-H stretching
2330	Very weak	C-H stretching
1872	Medium	Carbonate overtone/combination
1633	Strong	H-O-H bending of water
797	Very weak	Si-O of Quartz
776	Very weak	Si-O of Quartz
694	Very weak	Si-O of Quartz
478	Very weak	Si-O-Si bending (Microcline)
KJM c 3		
3445	Very strong	O-H stretching of absorbed water molecule
2925	Very weak	C-H stretching
2338	Very weak	C-H stretching
1876	Weak	Carbonate overtone/combination
1636	Medium	H-O-H bending of water
794	Very weak	Si-O of Quartz
779	Very weak	Si-O of Quartz
692	Weak	Si-O of Quartz

Table 4. 12: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (MNG)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
MNG c 1		
3445	Very strong	O-H stretching of absorbed water molecule
2925	Very weak	C-H stretching
2338	Very weak	C-H stretching
1876	Weak	Carbonate overtone/combination
1636	Medium	H-O-H bending of water
794	Very weak	Si-O of Quartz
779	Very weak	Si-O of Quartz
692	Weak	Si-O of Quartz
560	Very Weak	Fe-O of Hematite
MNG c 2		
3432	Medium	O-H stretching of absorbed water molecule
2960	Very weak	C-H stretching
2925	Weak	C-H stretching
2858	Very weak	C-H stretching
2527	Very weak	C-H stretching
1636	Weak	H-O-H bending of water
1460	Very weak	Carbonyl group (C-O)
1033	Very strong	Si-O-Si (Kaolinite)
796	Very weak	Si-O of Quartz
731	Very weak	Si-O of Quartz
697	Very weak	Si-O of Quartz
542	Very weak	Fe-O of Hematite
478	Very weak	Si-O-Si bending (Microcline)
MNG c 3		
3426	Medium	O-H stretching of absorbed water molecule

1630	Very Weak	H-O-H bending of water
1034	Very Strong	Si-O-Si (Kaolinite)
797,649	Very Weak	Si-O of Quartz
559	Very Weak	Fe ₂ O ₃
482	Very Weak	Si-O-Si bending (Microcline)

Table 4. 13: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (SBR)

Peak position cm ⁻¹	As received state	Tentative Vibrational Assignments
SBR c 1		
3458	Very strong	O-H stretching of absorbed water molecule
2925	Very weak	C-H stretching
2854	Very weak	C-H stretching
2350	Very weak	C-H stretching
1998	Very weak	C-H stretching
1873	Weak	Carbonate overtone/combination
1791	Very weak	Carbonate overtone/combination
1632	Strong	H-O-H bending of water
796	Very weak	Si-O of Quartz
697	Very weak	Si-O of Quartz
544	Very weak	Fe-O of Hematite
466	Very weak	Si-O-Si bending (Microcline)
SBR c 2		
3437	Very strong	O-H stretching of absorbed water molecule
2924	Very weak	C-H stretching
2852	Very weak	C-H stretching
1874	Weak	Carbonate overtone/combination
1628	Medium	H-O-H bending of water
796	Very weak	Si-O of Quartz
697	Very weak	Si-O of Quartz
SBR c 3		
3552	Medium	Inner O-H group of adsorbed water
2924, 2279	Very Weak	C-H stretching
1636	Medium	H-O-H bending of water
1384	Very Weak	Carbonate overtone/combinations
1037	Very Strong	Si-O-Si (Kaolinite)
798, 778, 694	Very Weak	Si-O of Quartz
560	Very Weak	Fe-O of Hematite
480	Very Weak	Microcline

Table 4. 14: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (CHR I)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
CHR I c 1		
3712	Medium	O-H stretching of absorbed water molecule
3619	Medium	Inner O-H group of absorbed water
2921	Very weak	C-H stretching
2004	Very weak	C-H stretching
1874	Very weak	Carbonate overtone/combinations
1636	Strong	H-O-H bending of water
911	Very weak	Al-OH
799	Very weak	Si-O of Quartz
694	Very weak	Si-O of Quartz
560	Very weak	Fe-O of Hematite
423	Very weak	Si-O-Si bending (Microcline)
CHR I c 2		
3453	Very strong	O-H stretching of absorbed water molecule
2924	Very weak	C-H stretching
2852	Very weak	C-H stretching
2342	Very weak	C-H stretching
1870	Weak	Carbonate overtone/combinations
1635	Medium	H-O-H bending of water
1386	Weak	Carbonate overtone/combinations
797	Very weak	Si-O of Quartz
692	Very weak	Si-O of Quartz
CHR I c 3		
3712	Medium	O-H stretching of absorbed water molecule
3619	Medium	Inner O-H group of absorbed water
2921	Very weak	C-H stretching
2004	Very weak	C-H stretching
1874	Very weak	Carbonate overtone/combinations
1636	Strong	H-O-H bending of water
911	Very weak	Al-OH
799	Very weak	Si-O of Quartz
694	Very weak	Si-O of Quartz
560	Very weak	Fe-O of Hematite
423	Very weak	Si-O-Si bending (Microcline)

Table 4. 15: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (MSK)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
MSK c 1		
3441	Medium	O-H stretching of absorbed water molecule
1639	Very Weak	H-O-H bending of water
1035	Very Strong	Si-O-Si (Kaolinite)
797	Very Weak	Si-O of Quartz
540	Very Weak	Fe ₂ O ₃
MSK c 2		
3426	Medium	O-H stretching of absorbed water molecule
1630	Very Weak	H-O-H bending of water
1034	Very Strong	Si-O-Si (Kaolinite)
797,649	Very Weak	Si-O of Quartz
559	Very Weak	Fe ₂ O ₃
482	Very Weak	Si-O-Si bending (Microcline)
MSK c 3		
3419	Medium	O-H stretching of absorbed water molecule
2924,2853	Very Weak	C-H stretching
1625	Very Weak	H-O-H bending of water
1087	Very Strong	Si-O-Si (Kaolinite)
796, 692, 669	Very Weak	Si-O of Quartz
517	Very Weak	Si-O-M
466	Very Weak	Si-O-Si bending (Microcline)

Table 4. 16: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (LPD)

Peak position cm^{-1}	As received state	Tentative Vibrational Assignments
LPD c 1		
3639	Medium	Inner O-H group of adsorbed water
3527	Medium	Inner O-H group of adsorbed water
2922	Very Weak	C-H stretching
1639	Medium	H-O-H bending of water
1384	Very Weak	Carbonate overtone/combinations
1044	Very Strong	Si-O-Si (Kaolinite)
798, 778	Very Weak	Si-O of Quartz
481	Very Weak	Si-O-Si bending (Microcline)
LPD c 2		
3482	Medium	O-H stretching of absorbed water molecule
2924, 2850, 2605	Very weak	C-H stretching
1886	Very weak	Carbonate overtone/combinations
1635	Medium	H-O-H bending of water
1384	Very weak	Carbonate overtone/combinations
1081	Very strong	Si-O-Si (Kaolinite)
798, 778, 694	Very weak	Si-O of Quartz

471	Very weak	Fe ₂ O ₃
LPD c 3		
3777	Medium	O-H stretching of absorbed water molecule
3660	Medium	O-H stretching of absorbed water molecule
3484	Medium	O-H stretching of absorbed water molecule
2924, 2853, 2000	Very weak	C-H stretching
1639	Medium	H-O-H bending of water
1417, 1384	Very weak	Carbonate overtone/combinations
1018	Very strong	Si-O-Si (Kaolinite)
798, 778, 669	Very weak	Si-O of Quartz
535	Very weak	Fe ₂ O ₃

Table 4. 17: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (SDM)

Peak position cm ⁻¹	As received state	Tentative Vibrational Assignments
SDM c 1		
3639	Medium	Inner O-H group of adsorbed water
3527	Medium	Inner O-H group of adsorbed water
2922	Very Weak	C-H stretching
1639	Medium	H-O-H bending of water
1384	Very Weak	Carbonate overtone/combinations
1044	Very Strong	Si-O-Si (Kaolinite)
798, 778	Very Weak	Si-O of Quartz
481	Very Weak	Si-O-Si bending (Microcline)
SDM c 2		
3777	Medium	O-H stretching of absorbed water molecule
3660	Medium	O-H stretching of absorbed water molecule
3484	Medium	O-H stretching of absorbed water molecule
2924, 2853, 2000	Very weak	C-H stretching
1639	Medium	H-O-H bending of water
1417, 1384	Very weak	Carbonate overtone/combinations
1018	Very strong	Si-O-Si (Kaolinite)
798, 778, 669	Very weak	Si-O of Quartz
535	Very weak	Fe ₂ O ₃
SDM c 3		
3419	Medium	O-H stretching of absorbed water molecule
2924, 2853	Very Weak	C-H stretching
1625	Very Weak	H-O-H bending of water
1087	Very Strong	Si-O-Si (Kaolinite)
796, 692, 669	Very Weak	Si-O of Quartz
517	Very Weak	Si-O-M
466	Very Weak	Si-O-Si bending (Microcline)

Table 4. 18: The IR Spectra and Probable Assignments of Potsherd Samples collected as Surface Collection (KLB)

Peak position cm ⁻¹	As received state	Tentative Vibrational Assignments
KLB c 1		
3453	Very strong	O-H stretching of absorbed water molecule
2924	Very weak	C-H stretching
2852	Very weak	C-H stretching
2342	Very weak	C-H stretching
1870	Weak	Carbonate overtone/combinations
1635	Medium	H-O-H bending of water
1386	Weak	Carbonate overtone/combinations
797	Very weak	Si-O of Quartz
692	Very weak	Si-O of Quartz
KLB c 2		
3458	Very strong	O-H stretching of absorbed water molecule
2925	Very weak	C-H stretching
2854	Very weak	C-H stretching
2350	Very weak	C-H stretching
1998	Very weak	C-H stretching
1873	Weak	Carbonate overtone/combination
1791	Very weak	Carbonate overtone/combination
1632	Strong	H-O-H bending of water
796	Very weak	Si-O of Quartz
697	Very weak	Si-O of Quartz
544	Very weak	Fe-O of Hematite
466	Very weak	Si-O-Si bending (Microcline)
KLB c 3		
3453	Very strong	O-H stretching of absorbed water molecule
2924	Very weak	C-H stretching
2852	Very weak	C-H stretching
2342	Very weak	C-H stretching
1870	Weak	Carbonate overtone/combinations
1635	Medium	H-O-H bending of water
1386	Weak	Carbonate overtone/combinations
797	Very weak	Si-O of Quartz
692	Very weak	Si-O of Quartz

4.8 Reconstructing the firing technology

Powder XRD and FTIR results provide the mineralogical composition of the potsherds from different contexts and sites or localities of Digaru – Kolong river valley. The above analysis indicates the mineralogical composition and firing temperature of the potsherds. The presence and absence of specific minerals are used to estimate the firing temperature of ceramics (Ravisankar *et al.*, 2010). As soon as the clay is fired at a given temperature and then cooled,

the property of the clay will not change unless this is re-fired at a temperature higher than the preliminary firing temperature (Ravisankar *et al.*, 2010; Singh and Sharma, 2016). The clay composition helps determine the firing temperature range of ancient potteries. According to Singh and Sharma (2016), the IR band around 3712 cm^{-1} is due to crystalline hydroxyl, and it results in the destruction of clay structures when subjected to fire above $500\text{--}600\text{ }^{\circ}\text{C}$. The IR spectra band around 911 cm^{-1} is due to Al-OH vibrations in octahedral sheet structure that collapses near $550\text{ }^{\circ}\text{C}$. The IR spectrum band around 3712 cm^{-1} and 911 cm^{-1} is identified in CHR1c1 and CHR1c3. The presence of these two IR bands indicates that these potsherds would have been fired at around $600\text{ }^{\circ}\text{C}$. However, these two bands are absent in the rest of the analyzed potsherd samples, indicating that all the potsherds might have been fired above $500\text{ }^{\circ}\text{C}$.

All the analyzed samples detect IR bands around 560 cm^{-1} and 544 cm^{-1} due to Hematite. It also confirmed that all analyzed potsherds samples were fired in oxidizing firing atmosphere. The presence of Hematite explains the existence of iron oxide. In the oxidizing atmosphere, iron is converted into ferric minerals, which confirms firing temperature above $650\text{ }^{\circ}\text{C}$. The transformation of Hematite into Magnetite occurs around $800\text{ }^{\circ}\text{C}$ to $900\text{ }^{\circ}\text{C}$. The presence of Hematite in all the analyzed samples indicates that firing temperature should be in the range of $650\text{--}800\text{ }^{\circ}\text{C}$ under oxidizing atmosphere.

Microcline is present in all the analyzed potsherd samples. XRD also confirmed the presence of Microcline. This further highlights that the firing temperature of all the analyzed pottery would have been around $800\text{ }^{\circ}\text{C}$ (Singh and Sharma, 2016).

The FTIR analysis revealed that the Pottery was made using both white clay origin from Kaolinite and red clay origin of Kaolinite. The presence of an absorption band around 1030 cm^{-1} in analyzed samples indicates red clay in the potsherds, and an IR band around 1100 cm^{-1} indicates white clay in the potsherds. The firing limit of the red clay is much less and around $800\text{ }^{\circ}\text{C}$, whereas the white clay has higher, i.e., approximately $900\text{ }^{\circ}\text{C}$.

The above discussion provides crucial information about the firing temperature and atmosphere of pottery manufacturing. The FTIR analysis indicates that the firing temperature range of BG1c2, 3,6; SKGc5; MRKc3,6; KJM1c1; MSKc3; LPDc2; and SDMc3 (very strong IR spectra around $1079\text{--}1150\text{ cm}^{-1}$) should be within $800\text{--}900\text{ }^{\circ}\text{C}$. The firing temperature range of BG1c1,4,5; SKGc3; MRKc1,2,4,5; SLGc1-6; SBRc3; MNGc2,3; MSKc1,2;

LPDc1,3; and SDMc2 (very strong to strong IR spectra band around 1040-1015 cm⁻¹) should be within 650-800 °C. The rest of the analyzed pottery samples would have fired at approximately 650-800 °C. The presence of Hematite indicates the oxidizing firing atmosphere of all the analyzed samples. The presence of organic matters in the composition of pottery has been identified due to the C—H stretching spectra. The organic materials might have been used by potters externally as an additive for improving the plasticity of the clay.

Part III: Sediment Analysis

“By far the most abundant material that archaeologists excavate is not lithic, ceramic, or faunal; it is the soil and sediment matrix in which these things are found.” (Banning, 2000, p. 235)

“Field observations must be substantiated by laboratory analyses. In addition, many analytical techniques provide information that is otherwise unobtainable.” (Hassan, 1978, p. 205)

4.9 Introduction

The primary composition of the soil is minerals, organic matter, water, and air—the proportions of these components influence the soil properties, texture, structure, and other characteristics. The analytical method of soil analysis provides additional crucial information to understand the soil type. Some of the essential analytical methods are mineralogical composition, chemical properties, and the size of the grains. In addition, with field observation further determines several characteristics of the soil.

4.10 Methodological Consideration for Sediment Analysis

In the present section, various methods are applied to study mineralogy, acidity or alkalinity, particle size (sieving and hydrometer analysis), and dating of the sediment samples (AMS dating of sediment samples has been mentioned in Section IV of this chapter). The visual investigation and soil colour determination have been discussed in the previous chapter. The soil colour has been studied based on Munsell soil charts.

Particle Size Analysis – Particle size analysis is one of the most frequently used tools in sediment studies, archaeology, and other analytical and mechanical analysis methods.

Studying the size of the sediment particle or grain is an informative technique to determine the formation process, texture, composition, erosion, and deposition of sediments in an archaeological site. In Particle size analysis, the assessment of soil has been done by separating greater than 2 mm, such as sand (2-0.05 mm), silt (0.05-0.002 mm), and clay (<0.002 mm). The ratio of sand, silt, and clay in the fraction of soil or sediment finer than 2 mm determines its texture.

The soil samples have been analyzed using the Dry sieving technique for the particles coarser than 75 microns and Hydrometer analysis for finer particles than 75 microns. The Indian Standards IS 2720 (Part 4) - 1985 method of test for soil has been used for sieving and Hydrometer analysis.

1. Dry Sieving Technique

Sieving is the essential technique for particle size analysis. As mentioned above Indian Standards IS 2720 (Part 4) - 1985 method has been used to determine the particle size and shape. In this method, sediment has been made to pass through a series of stacked sieve meshes with defined opening sizes. In this method, the successive sieve breaks up the samples into decreasing size fractions. The fraction of sediment left in each sieve is weighed to determine its percentage relative to the whole sample. The methodological technique of the dry sieving technique is mentioned below.

I. Apparatus and Materials Required – 1. Balance; 2. Set of Sieves with lid and pan (4.75mm, 2.8 mm, 2 mm, 1 mm, 600 μ m, 425 μ m, 300 μ m, 150 μ m, and 75 μ m); 3. Rubber Pestle and Mortar; 4. Motorized Sieve Shaker; 5. Oven, 6. Trays;

II. Preparation of Sample – The soil sample collected from the field was prepared as specified in IS 2720 (Part I) 1983. The soil fractions retained on the pan and passing 75 μ IS sieves were taken separately for the Hydrometer analysis.

III. Procedure – Soil samples were dried in a thermostatically controlled hot air oven at 105 to 110°C. The weight of each sieve and pan was noted before the analysis. All the sieves were cleaned and assembled in the decreasing order of the sieve numbers (4.5 mm sieve at top and 75 μ m at bottom), and then the pan was placed below the 75 μ m sieve. The dried soil samples were carefully poured into the top sieve, and a lid was placed over that. The arrangement was then placed on the mechanical shaker and shaken for 10 minutes. After that, the arrangement was removed from the shaker

carefully. The mass of retained soil on each sieve was recorded along with the pan. The ratio of retained soil on each sieve is calculated based on the total weight of the sample taken. This further leads to calculating the percentage passing through each of the sieves. If the portion passing through the 75 μ m sieve collected in the pan is substantial, for example, 5 – 10 %, then wet sieve analysis is carried out. Then, a grain size distribution curve was plotted.

2. Hydrometer Technique

Hydrometer analysis of soil is performed to measure the particle size distribution of fine-grained soils like clay and silt. This is a very famous and common sedimentation method in geotechnical laboratories. It is based on Stokes' law that calculates the size of soil particles from the speed at which they settle out a suspension from a liquid. The hydrometer test is helpful for quantitatively determining the particle size distribution for soil particles of a size finer than 75 μ m. However, in addition to sieve analysis, it offers a complete profile of soil particle size.

Soil particles that are finer than 75 μ m in size cannot be sieved. The particle size distribution of such soils is determined by sedimentation analysis such as the Pipette and Hydrometer methods. These methods are based on Stoke's Law. In the present study, the Hydrometer method determines the particle size distribution of fine-grained soils passing through a 75 μ m sieve. The Hydrometer measures the specific gravity of the soil suspension at the center of its bulb. The specific gravity depends upon the mass of solids present.

I. Theory – The particle size (D) is given by: $D = K \sqrt{He/t}$

Where, $K = \sqrt{30 \times \mu / g (G_s - G_w)}$, He = Effective Depth (cm); t = Time (minutes),
 μ = viscosity (in perse), g = Gravity (9.81m/sec²), G_s = Specific gravity of soil,
 G_w = Specific gravity of water.

The percentage finer than the size (D) is given by

$$N = [G_s / G_s - 1] \times R_c / M_s \times 100$$

Where R_c = Corrected Hydrometer Reading, M_s = Mass of Dry soil in 1000ml suspension.

II. Apparatus – Thermometer, Hydrometer conforming to IS 3104:1965; two measuring cylinders of 1000 ml capacity, 75 μ m sieve, wash bottles containing Distilled water, stopwatch, Balance accurate to 0.001 gram.

III. Re-agents – Dispersing solution – 4% (Dissolve 5 g of Sodium Hexa-metaphosphate in de-ionized water of 125ml)

IV. Procedure

- a. Calibration of Hydrometer** – measure the volume of the hydrometer by partly filling the 1000 ml cylinder and observing the increase in the volume of the water when the hydrometer is fully immersed in it. The sectional area (A) of the cylinder is found out. This equals the volume between the two gradations on the cylinder divided by the distance between the two gradations. The bulb's height (h) is measured, i.e., the distance between the necks to the bottom of the bulb. The distance (H) from the neck of the bulb to the various major gradations (R_h) on the stem is measured. Effective Depth (H_e) = $H + \frac{1}{2} [h - V_h/A]$.
- b. Meniscus correction** – A measuring cylinder is filled with distilled water up to 1000 ml, including 100 ml of dispersing agent solution. A hydrometer was inserted into it, and the top and bottom meniscus readings on the stem were noted down. The difference between the top meniscus reading and the specific gravity of water, i.e., 1, gives the composite correction, which may be positive or negative. The difference between the top and bottom meniscus reading provides the meniscus with correction (in cm), which is positive.

The soil retained on a pan or passing 75 μ sieve was oven-dried. 100 ml of the dispersing agent solution was added to the sample, and the mixture was stirred for about 15 minutes using a high-speed stirrer. Then the soil suspension is completely transferred into the measuring cylinder. The open end of the cylinder is filled or closed using the palm of one hand, and the cylinder is turned upside down and back several times. After shaking, the cylinder was placed on a leveled surface, and a stopwatch was started. Then the Hydrometer was inserted into the suspension immediately, and the reading of the top meniscus was noted carefully at 1/4th, 1/2nd, 1- and 2-minutes intervals. Remove the Hydrometer and float it in another cylinder containing distilled water. Rinse it by a twisting motion to remove any soil particles that may have to adhere to it.

Further reading was taken after 4, 8, 15, and 30 minutes and after 1, 2, and 4 hours. After 4 hours, the reading was taken twice within 24 hours, and the final reading was recorded at the end of 24 hours. The suspension temperature was recorded once during the 1st 15 minutes and then after.

Mineralogical Analysis

Clay minerals are among the most common minerals in sediments. The mineralogical analysis of the sediment reveals crucial information. To understand the mineralogical context and further relate the raw material of ceramics, Powder XRD analysis has been done on the sediment samples. The XRD Spectra was recorded in the 2θ range from 3° to 65° (Harris and White, 2007, p. 15) on TTRA III Rigaku X-ray Diffractometer using $\text{CuK}\alpha$ radiation at a wavelength of 1.5406 \AA .

Analysis of Acidity and Alkaline Nature of Soil

Soil pH is an indicator of the acidity or alkalinity of the soil. The pH of natural soil depends on the mineral composition of the soil's parent material and the weathering reactions undergone by the parent material. It is defined as the negative logarithm of the hydrogen ion concentration and measured on a scale of 0 to 14. A number less than 7 indicates acidity, and those higher than seven, show alkali materials (Banning, 2000). It is primarily measured in the field as well as in the lab. There are several methods to measure the pH of soil. The most common and simplest method is with litmus papers or pH paper. In the present study, the pH value of sediments samples has been studied using the Universal Indicator Paper or pH paper.

- I. **Apparatus:** Litmus paper, 30 ml test tube, pH colour scale (usually attached with litmus paper), distilled water,
- II. **Procedure:** 5 grams of soil have been taken into a 30 ml test tube. Then, 10 ml of distilled water (soil to water proportion 1:2) was added. The solution has been appropriately shaken for 4-5 minutes. Then, it was left to settle for a few minutes. After 10-minute, pH indicator paper is dipped into the supernatant solution. Then, the colour of the pH paper is compared with the colour scale provided (sometimes attached with the strip of the pH paper) with the pH paper. The approximate pH of soil and soil reaction has been noted down.

Determination of Calcium Carbonate in Soils

- I. **Reagents:** N Hydrochloric Acid - Dilute 175 ml. Of concentrated hydrochloric acid to 2 liters. The solution does not require standardization; N Sodium Hydroxide – This need not be especially carbonate-free. Dissolve slightly more than 80 grams of

sodium hydroxide in 2 liters of water. Standardize against hydrazine sulfate has been done and diluted until exactly N; Brom Thymol Blue Indicator Solution.

II. Procedure: 5 grams of a soil sample has been weighted and transferred into a tall 150 ml beaker. 100 ml of N hydrochloric acid is added and covered with a clock glass through a pipette with an enlarged jet. It was then stirred several times vigorously for one hour. Then it was left to settle and pipette off 20 ml of the supernatant liquid. It was then transferred to a small Erlenmeyer flask, and 6-8 drops of Bromothymol blue indicator solution were added and titrated with N sodium hydroxide. With some soils, the colour of the indicator may fade as the endpoint is approached. In this scenario, more indicators were added to complete the titration. Blank determination was carried out to obtain the titration of the hydrochloric acid. The following expression determines the percentage of calcium carbonate:

$$\% \text{ CaCO}_3 = (\text{Blank titration} - \text{Actual titration}) \times 5$$

4.10.1 Sampling and Nomenclature of Samples

Sediment samples have been collected from the test pits excavated in the study area. Test pits have been excavated at the four sites, and samples have been taken from these pits at different depths. The samples were taken into account soil variations according to profile depth and landscape area. The samples are cleaned by removing any modern material such as plastic, roots, and leaves mixed during the digging. The photographs were taken to observe the layer sequence and colour. The samples were packed in plastic zip-lock bags. A tag was attached to all the sample bags mentioning their site name and test pit, location, profile, depth, etc. Enough material was taken to conduct all the proposed experiments and tests. The description of the samples has been mentioned in **Table 4. 19**.

Table 4. 19: Sediment samples

S. N.	Sample	Test Pit No.	Depth (in cm)	Munsell Colour
01	BGIs1	1	0-10	10YR 8/6
02	BGIs2	1	10-20	10YR 7/4
03	BGIs3	1	20-30	10YR 6/6
04	MRKs1	1	0-20	10YR 8/6
05	MRKs2	1	50	10YR 7/4
06	MRKs3	1	60-70	10YR 7/4
07	MRKs4	1	90-100	10YR 3/3

4.11 Particle Size Analysis

Sieve analysis is performed to determine the distribution of the coarse, larger-sized particles, and the hydrometer method is used to determine the distribution of the finer particles.

4.11.1 Dry Sieving Analysis

Dry sieving analysis of soil samples provides the Gravel and Sand particle percentage in the samples. The soil passed through the 75 μ and retained on the pan accumulates silt and clay particles. The outcome of the dry sieve analysis and the sand fraction of the sample is mentioned in the table. The experiment detail for Dry sieve analysis of all analyzed samples and grain size distribution curve has been mentioned in **Table 4. 20** to **Table 4. 21** and Plate 4. 18 and Plate 4. 19. Hydrometer analysis determines the different percentages of silt and clay particles.

Initially, 100 grams of soil samples were taken for dry sieving analysis. The soil passed through a 75 μ sieve and retained on the pan was analyzed again through hydrometer analysis.

Table 4. 20: Dry Sieve Analysis (BGI)

Sample Name – BGIs1, Total mass of soil taken = 100 gram						
Sieve Aperture size (mm)	Mass of empty sieve (g)	Mass of Sieve + soil retained (gram)	Mass of Soil retained	% of Soil Mass retained	Cumulative % of soil mass retained	% of soil mass finer
4.750	332.00	332.35	0.35	0.35	0.35	99.65
2.800	350.00	350.50	0.50	0.50	0.85	99.15
2.000	349.00	349.90	0.90	0.90	1.75	98.25
1.000	318.00	321.00	3.00	3.00	4.75	95.25
0.600	287.00	289.00	2.00	2.00	6.75	93.25
0.425	394.00	402.00	8.00	8.00	14.75	85.25
0.300	296.00	307.00	11.00	11.00	25.75	74.25
0.150	282.00	312.00	30.00	30.00	55.75	44.25
0.075	326.00	342.00	16.25	16.25	72.00	28.00
Pan	264	292	28.00	28.00	99.65	0.35

Sample Name – BGIs2, Total mass of soil taken = 100 gram						
Sieve Aperture size (mm)	Mass of empty sieve (g)	Mass of Sieve + soil retained (gram)	Mass of Soil retained	% of Soil Mass retained	Cumulative % of soil mass retained	% of soil mass finer
4.750	332.00	332.00	0.00	0.00	0.00	100.00
2.800	350.00	350.35	0.35	0.35	0.35	99.65
2.000	349.00	349.40	0.40	0.40	0.75	99.25
1.000	318.00	321.00	3.00	3.00	3.75	96.25
0.600	287.00	290.00	3.00	3.00	6.75	93.25
0.425	394.00	402.00	8.00	8.00	14.75	85.25
0.300	296.00	307.00	11.00	11.00	25.75	74.25
0.150	282.00	313.00	31.00	31.00	56.75	43.25
0.075	320.00	335.82	15.82	15.82	72.57	27.43
Pan	264.00	291.43	27.43	27.43	100.00	0.00
Sample Name – BGIs3, Total mass of soil taken = 100 gram						
Sieve Aperture size (mm)	Mass of empty sieve (g)	Mass of Sieve + soil retained (gram)	Mass of Soil retained	% of Soil Mass retained	Cumulative % of soil mass retained	% of soil mass finer
4.7500	332.00	332.00	0.00	0.00	0.00	100.00
2.8000	349.00	349.62	0.62	0.62	0.62	99.38
2.0000	349.00	349.28	0.28	0.28	0.90	99.10
1.0000	318.00	320.00	2.00	2.00	2.90	97.10
0.6000	287.00	289.00	2.00	2.00	4.90	95.10
0.4250	393.00	401.00	8.00	8.00	12.90	87.10
0.3000	296.00	306.00	10.00	10.00	22.90	77.10
0.1500	284.00	312.00	28.00	28.00	50.90	49.10
0.0750	322.00	337.78	15.78	15.78	66.68	33.32
Pan	264.00	297.32	33.32	33.32	99.38	0.62

Table 4. 21: Dry Sieve Analysis (MRK)

Sample Name – MRKs1, Total mass of soil taken = 100 gram						
Sieve Aperture size (mm)	Mass of empty sieve (g)	Mass of Sieve + soil retained (gram)	Mass of Soil retained	% of Soil Mass retained	Cumulative % of soil mass retained	% of soil mass finer
4.750	332.00	332.00	0.00	0.00	0.00	100.00
2.800	349.00	349.00	0.00	0.00	0.00	100.00
2.000	349.00	353.20	4.20	4.20	4.20	95.80
1.000	317.00	319.00	2.00	2.00	6.20	93.80
0.600	287.00	290.06	3.06	3.06	9.26	90.74
0.425	391.00	409.40	18.40	18.40	27.66	72.34
0.300	295.00	309.00	14.00	14.00	41.66	58.34
0.150	282.00	306.00	24.00	24.00	65.66	34.34
0.075	269.00	275.00	6.00	6.00	71.66	28.34
Pan	264.00	292.34	28.34	28.34	100.00	0.00
Sample Name – MRKs2, Total mass of soil taken = 100 gram						
Sieve Aperture size (mm)	Mass of empty sieve (g)	Mass of Sieve + soil retained (gram)	Mass of Soil retained	% of Soil Mass retained	Cumulative % of soil mass retained	% of soil mass finer
4.750	332.00	332.00	0.00	0.00	0.00	100.00
2.800	349.00	349.00	0.00	0.00	0.00	100.00
2.000	349.00	349.30	0.30	0.30	0.30	99.70
1.000	317.00	319.44	2.44	2.44	2.74	97.26
0.600	286.00	291.00	5.00	5.00	7.74	92.26
0.425	391.00	407.00	16.00	16.00	23.74	76.26
0.300	295.00	309.00	14.00	14.00	37.74	62.26
0.150	282.00	302.00	20.00	20.00	57.74	42.26
0.075	321.00	333.00	12.00	12.00	69.74	30.26
Pan	264.00	294.26	30.26	30.26	100.00	0.00

Sample Name –MRKs3, Total mass of soil taken = 100 gram						
Sieve Aperture size (mm)	Mass of empty sieve (g)	Mass of Sieve + soil retained (grams)	Mass of Soil retained	% of Soil Mass retained	Cumulative % of soil mass retained	% of soil mass finer
4.750	332.00	332.00	0.00	0.00	0.00	100.00
2.800	349.00	349.40	0.40	0.40	0.40	99.60
2.000	348.00	348.60	0.60	0.60	1.00	99.00
1.000	317.00	319.00	2.00	2.00	3.00	97.00
0.600	286.00	290.00	4.00	4.00	7.00	93.00
0.425	391.00	403.00	12.00	12.00	19.00	81.00
0.300	295.00	305.00	10.00	10.00	29.00	71.00
0.150	282.00	298.00	16.00	16.00	45.00	55.00
0.075	320.00	330.00	10.00	10.00	55.00	45.00
Pan	264.00	309.00	45.00	45.00	100.00	0.00
Sample Name –MRKs4, Total mass of soil taken = 100 gram						
Sieve Aperture size (mm)	Mass of empty sieve (g)	Mass of Sieve + soil retained (grams)	Mass of Soil retained	% of Soil Mass retained	Cumulative % of soil mass retained	% of soil mass finer
4.750	332.00	332.00	0.00	0.00	0.00	100.00
2.800	349.00	349.40	0.40	0.40	0.40	99.60
2.000	349.00	349.40	0.40	0.40	0.80	99.20
1.000	317.00	319.00	2.00	2.00	2.80	97.20
0.600	286.00	288.00	2.00	2.00	4.80	95.20
0.425	392.00	400.00	8.00	8.00	12.80	87.20
0.300	290.00	298.00	8.00	8.00	20.80	79.20
0.150	286.00	298.00	12.00	12.00	32.80	67.20
0.075	320.00	328.00	8.00	8.00	40.80	59.20
Pan	264.00	323.20	59.20	59.20	100.00	0.00

The dry sieve analysis reveals the percentage of gravel and Sand present in the sample (**Table 4. 22**). The percentage of gravel is zero in all analyzed samples except in BGIs1. As the mass coarser than 75μ is 72 %, in which 0.35 is a gravel size particle. Hence, in BGIs1, the percentage of gravel is 0.35, and sand has 71.65 %. The course, medium, and finer fractions of sand particles are further calculated from the above data. The sand particles within the range of 4.75 mm to 2 mm are considered coarse sand. The content of 2 mm to 0.425 mm is medium sand, and sand particles ranging from 0.425 mm to 0.075 mm are regarded as fine sand particles, according to the Indian standard soil classification system.

Table 4. 22: Dry Sieve analysis showing the percentage of Gravel and Sand in the soil

Sieve analysis	Mass of soil					
Sample name	(In grams)					
		Gravel %	Sand %	Course	Medium	Fine
BGIs1 (0 -10cm)	100	0.35	71.65	1.94	18.04	79.51
BGIs2 (10-20cm)	100	00	72.57	1.03	19.30	79.67
BGIs3 (20-30cm)	100	00	66.68	1.39	18.00	80.61
MRKs1 (0-20cm)	100	00	71.66	5.86	32.74	61.40
MRKs2 (50cm)	100	00	69.74	0.43	33.61	65.96
MRKs3 (60-70cm)	100	00	55.00	1.82	32.73	65.45
MRKs4 (90-100cm)	100	00	40.80	1.96	29.41	68.63

4.11.2 Hydrometer Analysis

The soil retained on the pan or finer than 75μ in all analyzed samples is greater than 10%, accumulating silt and clay. Therefore, further hydrometer analysis has been conducted to determine the fraction of silt and clay present in the soil samples.

Before starting the experiment, first, we have determined the following values;

$$V_h = \text{Volume of the bulb in ml} = 70 \text{ ml}$$

$$A = \text{Cross sectional area of the cylinder} = V_{\text{total}} / L = 1000/34 = 29.41 \text{ cm}^2$$

$$C_d = \text{Dispersing Agent Correction} = 0.0035$$

$$\text{Corrected Hydrometer Reading (R}_c) = [(R_h + C_m \pm C_T - C_d) - 1] \times 1000; \text{ Where, } C_T = \text{Temperature Correction.}$$

$$\text{Length of Hydrometer bulb (h)} = 16.5 \text{ cm; Length of Cylinder} = 34 \text{ cm}$$

$$\text{Top Meniscus} = 0.9965. \text{ Bottom Meniscus} = 0.997; \text{ Meniscus correction} = 0.0005$$

Then, the procedure mentioned above was performed for all soil samples finer than 75μ size. This reveals the percentage of silt and clay present in all the samples.

The grain size and percentage finer were calculated through hydrometer readings, and a graph was plotted. The results from this analysis present most important in classifying the fine-grained soil (passing through a 75μ sieve). According to the Indian standard soil classification system, the size of soil particles ranging from 0.075 mm to 0.002 mm is

considered silt, and soil finer than 0.002 mm is clay. The percentage of silt and clay calculated by hydrometer analysis is mentioned in **Table 4. 23**.

After that, the percentage of gravel, sand, silt, and clay is calculated considering the whole sample in one. The ratio of gravel and sand was calculated through dry sieving analysis, and the percentage of silt and clay was together in the pan. The hydrometer analysis reveals the percentage of silt and clay present in the soil sample, which was retained in the pan and finer than a 75 μ sieve. Therefore, the percentage of silt and clay was calculated by comparing the ratio of gravel and sand.

Table 4. 23: Percentage of Silt and Clay calculated using the hydrometer analysis.

Hydrometer analysis			
	Mass of soil	Silt	Clay
Sample name	(In grams)	%	%
BGIs1 (0 -10cm)	28.00	77.13	22.87
BGIs2 (10-20cm)	27.43	66.17	33.83
BGIs3 (20-30cm)	33.32	74.60	25.40
MRKs1 (0-20cm)	28.34	84.65	15.35
MRKs2 (50cm)	30.26	66.76	33.24
MRKs3 (60-70cm)	45.00	58.53	41.47
MRKs4 (90-100cm)	59.20	60.14	39.86

The particle size distribution and overall percentage of soil fraction in all analyzed samples are mentioned below.

Table 4. 24: Table showing the Gravel, Sand, Silt, and Clay fraction in soil samples.

Particle size distribution						
Sample Name	Total soil (in gram)	Gravel %	Sand %	Silt %	Clay %	Total
BGIs1	100	0.35	71.65	21.60	6.40	100.00
BGIs2	100	00	72.57	18.15	9.28	100.00
BGIs3	100	00	66.68	24.86	8.46	100.00
MRKs1	100	00	71.66	24.00	4.34	100.00
MRKs2	100	00	69.74	20.20	10.06	100.00
MRKs3	100	00	55.00	26.34	18.66	100.00
MRKs4	100	00	40.80	35.60	23.60	100.00

From the above experiment, we determine the size percentage of all particles. Based on the USDA textural classes of soil, the texture of soil samples has been classified. All the analyzed samples (except MRKs3 and MRKs4) have more than 60 % of the soil is courser than 75μ . The proportion of the different soil separates its soil texture. The textural class of soil samples BGIs1, 2, and MRKs1 is Loamy fine sand (Sand 70-86%, Silt 0-30%, and Clay 0-15%). Loamy fine sand contains 50 % or more fine sand and less than 25 % coarse and medium sand. The textural class of sample BGIs3, MRKs2, and MRKs3 is Sandy loam soil (Sand 50-70%, Silt 0-50%, and Clay 0-20%). The sandy loam soil type comprises sand and a varying quantity of silt and clay. It has a high concentration of sand that gives them a gritty feel (Shackley 1981). The sample MRKs4 is a Loamy soil with medium texture (Sand 23-52%, Silt 28-50%, and Clay 7-27%). The moisture and humus condition in the Loam soil is higher than in sandy soils. It has better drainage and infiltration of water and air than silty soils.

4.12 Mineralogical Analysis

Mineralogical analysis has been carried out on the soil samples collected from the different test pits at various depths. The patterns with the identified crystalline phase of investigated soil samples and analysis have been mentioned in **Table 4. 25**.

The significant minerals identified in all the analyzed samples are Quartz, Kaolinite, Halloysite, Microcline, Albite, Anorthite, Hematite, Goethite, Dolomite, Calcite, and Aragonite. The quantity of these minerals varies in all the samples.

Quartz is identified as a primary mineral in all the analyzed samples. The distinctive reflection at various peaks is noticed in all the samples. Quartz is an indigenous mineral present in clay (Papachistodoulou *et al.* 2006). Kaolin mineral groups such as Kaolinite and Halloysite are present in all analyzed samples. Feldspars mineral group such as Microcline, Albite, and Anorthite has been identified in various samples. Microcline is present in all the samples, and Albite is in BGIs1 and BGIs3. Anorthite is present in all samples except MRKs1, SLGs1, 2, and 3. Hematite and Goethite are identified in all the analyzed samples in different quantities. Carbonate minerals such as Dolomite, Calcite, and Aragonite have been found in some samples. Dolomite is present in BGIs1. Calcite is identified in MRKs2 and BGIs1. Aragonite is present in all the samples except in SKGs1 and SKGs3.

Table 4. 25: Identified Minerals and phase obtained by XRD of Soil samples, +++ = very abundant, ++ = abundant, + = present, - = absent

Minerals Identified by XRD analysis of the Soil Samples												
S. N.	Sample Name	Quartz	Kaolinite	Halloysite	Microcline	Albite	Anorthite	Hematite	Goethite	Dolomite	Calcite	Aragonite
1	MRKs1	+++	++	+	++	-	-	+	+	-	-	+
2	MRKs2	+++	++	+	++	-	+	+	+	-	+	+
3	MRKs3	+++	++	+	++	-	+	++	+	-	-	++
4	BGIs1	+++	++	+	+	+	+	+	+	+	+	+
5	BGIs2	+++	+	+	++	-	+	+	+	-	-	+
6	BGIs3	+++	+++	+	++	+	+	+	+	-	-	++
7	SKGs1	+++	++	+	++	-	+	++	+	-	-	-
8	SKGs2	+++	++	+	++	-	+	++	+	-	-	+
9	SKGs3	+++	++	+	++	-	+	+	+	-	-	-
10	SLGs1	+++	++	+	++	-	-	+	+	-	-	+
11	SLGs2	+++	++	+	++	-	-	+	+	-	-	+
12	SLGs3	+++	++	+	++	-	-	+	+	-	-	+

4.13 Determining the provenance of potteries based on XRD analysis

The term provenance originated from the Latin verb Provenire, meaning to come forth or to originate. In the present study, Powder XRD analysis of potsherd and soil samples has been done to understand the mineralogical compositions. The XRD analysis of both potsherds and soil samples reveals crucial information. The XRD analysis provided the mineralogical composition of soil and potsherds samples. Apart from the mineralogical composition of sediments, it also helps understand the raw material for pottery manufacturing. The XRD or the mineralogical analysis of the potsherds reveals the pottery's mineralogical composition, which shows the similarity with the composition of the soil samples. The potsherds collected from the localities and various depths at the test pits and the soil samples have similar mineralogical compositions. Mineral groups such as Quartz, Kaolin, Feldsher, and Carbonates are identical in all the samples of potsherds and soils. This further indicates that the raw material used for manufacturing the potteries would have been acquired locally.

4.14 Analysis of Acidity and Alkaline Nature of Soil

Soil pH is a measure of the acidity and alkalinity in soils. The pH value of soil samples has been measured using Universal Indicator Paper. The pH analysis of all analyzed samples has been mentioned below in **Table 4. 26** to **Table 4. 29**.

Table 4. 26: pH value of soil samples (MRK)

Site Name	Marakdola (MRK)		
Test Pit No	1		
S. N.	Depth	Ph Value	Reaction
1	0-10cm	6.00	Medium acidic
2	30 cm	5.50	Strongly acidic
3	45cm	5.00	Very strongly acidic
4	50 cm	5.00	Very strongly acidic
5	55 cm	5.00	Very strongly acidic
6	60-65 cm	5.00	Very strongly Acidic
7	70 cm	5.00	Very strongly acidic
8	75 cm	5.00	Very strongly Acidic
9	80-85 cm	5.00	Very strongly acidic
10	90 cm	5.50	Strongly acidic
11	100 cm	6.00	Medium acidic
12	120 cm	6.00	Medium acidic

Table 4. 27: pH value of soil samples (BGI)

Site Name	Bagibari (BGI)		
Test Pit No	1		
S. N.	Depth	Ph Value	Reaction
1	0-10 cm	5.00	Very strongly acidic
2	10-15 cm	5.00	Very strongly acidic
3	15-20 cm	5.00	Very strongly acidic
4	20 cm	5.50	Strongly acidic
5	20-30 cm	6.00	Medium Acidic
Test Pit No	2		
1	0-10 cm	5.50	Medium Acidic
2	10-20	5.50	Strongly Acidic
3	20-30	5.00	Very strongly acidic
4	30-45	5.00	Very strongly acidic
5	50	6.00	Medium acidic

Table 4. 28: pH value of soil samples (SLG)

Site Name	Silchang (SLG)		
Test Pit No	1		
S. N.	Depth	Ph Value	Reaction
1	10 cm	5.50	Strongly acidic
2	10-20 cm	5.00	Very strongly acidic
3	30cm	5.00	Very strongly acidic
4	40cm	5.00	Very strongly acidic
5	50cm	5.00	Very strongly Acidic
6	60 cm	5.50	Strongly acidic
7	65 cm	6.00	Medium acidic
8	70 cm	6.00	Medium acidic
Test Pit No	2		
1	0-10 cm	5.50	Strongly Acidic
2	10-20	5.50	Strongly Acidic
3	20-30	5.00	Very strongly acidic
4	30-40	5.00	Very strongly acidic
5	40-50	5.00	Very strongly acidic
6	50-60	5.50	Strongly acidic
7	65 cm	6.00	Medium acidic

Table 4. 29: pH value of soil samples (SKG)

Site Name	Shankargog (SKG)		
Test Pit No	1		
S. N.	Depth	Ph Value	Reaction
1	0-10 cm	5.00	Very strongly acidic
2	20 cm	5.00	Very strongly acidic
3	30 cm	5.00	Very strongly acidic
4	40 cm	5.00	Very strongly acidic
5	50 cm	5.50	Strongly acidic
6	60 cm	5.50	Strongly acidic
7	70 cm	5.50	Strongly acidic
8	75 cm	6.00	Medium acidic
9	80 cm	6.00	Medium acidic
10	90 cm	6.50	Acidic

The pH of soil depends on several factors. The soil pH affects the survival or preservation of some materials, especially organic materials in the archaeological context. The soil's acidity

is a result of several actions, such as the rainwater leaching¹⁵ away alkali ions (calcium, magnesium, potassium, and sodium) and the formation of strong organic and inorganic acids from decaying organic matters.

Soil pH reflects many important physical and chemical properties of the soil. In humid environments such as in Northeast India, soil pH more commonly is acidic to highly acidic. This is more frequent or categorically at the surface where organic acids reside. All analyzed soil samples were found acidic to very strongly acidic. This further indicates less chance of recovering the organic materials from sediments. Due to the high acidity of the soil, the organic material gets decomposed. The acidity of the soil is further affected by rainfall, plants, etc. In higher rainfall areas, the natural pH of the soil commonly ranges from 5 to 7. The climatic condition of the Northeastern part of India has predominantly humid subtropical with heavy rainfalls. This further supports the acidic nature of the soil in the present study area.

4.15 Determination of Calcium Carbonate in Soils

Analysis of calcium in the soil is a crucial component of identifying food preparation areas of the past. Carbonates are leached in wet climates, and iron solubility is suppressed in carbonated water (Hassan, 1978; Vranova *et al.*, 2015). Calcium carbonate, dolomite, and Aragonite are the most common carbonate mineral. The Rapid Titration Method has been used to determine Calcium Carbonate in soil samples, and the procedure has been already mentioned above (IS 2720 Part 23; Piper, 1942).

4.15.1 Calculation and Result

One milliliter of 1 N hydrochloric acid is equivalent to 0.05 g of calcium carbonate in the soil sample.

Carbonate present in the soil, % by mass =

$$= (\text{Volume of 1 N hydrochloric acid used for 5g of soil}) \times 0.05 \times 100/5$$

$$= \text{Volume of hydrochloric acid consumed for 5 g of soil.}$$

$$1 \text{ ml of N hydrochloric acid} = 0.05 \text{ g of calcium carbonate}$$

¹⁵ It is a process by which the soluble constituents of the soil dissolve in water and permeate through the soil to the lower level.

Strength of NaOH = 0.093 N; Strength of HCl = 1.023 N;

Quantity of NaOH used in titration = (mentioned in Table).

Table 4. 30: Percentage of Calcium Carbonate in soil samples

S. N.	Sample Name	Test Pit No.	Depth (in cm)	Quantity of NaOH used in titration (in ml)	Calcium Carbonate %
1	BGIs1	1	15	20	9.30
2	BGIs2	1	25	18	18.60
3	BGIs3	2	25	22	00
4	BGIs4	2	50	19	13.95
5	MRKs1	1	10	20	9.30
6	MRKs2	1	55	21.5	2.33
7	MRKs3	1	90	21	4.65
8	MRKs4	1	120	13	41.85
9	SLGs1	1	10	20	9.30
10	SLGs2	1	70	18	18.60
11	SLGs3	2	10	20	9.30
12	SLGs4	2	65	14	37.20
13	SKGs1	1	10	21.5	2.33
14	SKGs2	1	50	20.5	6.97
15	SKGs3	1	75	18	18.60
16	SKGs4	1	90	13.5	39.52

Calcium carbonate has a significant effect on soil pH. Due to the alkaline character, the carbonate minerals act as a pH buffer. From the above analysis, it can be concluded that the very strong acidic to strongly acidic soil has significantly less amount of CaCO_3 in comparison to the soil having a medium acidic nature. The soil samples at the bottom layer are mostly less acidic or have a pH value of around 6. These samples have a high percentage of CaCO_3 as compared to other samples such as BGIs2 (18.60%), BGIs4 (13.95%), MRKs4 (41.85%), SLGs4 (37.20%), and SKGs2 (39.52%). This indicates thick vegetation, humidity, and high rainfall in the present study area.

Part IV: Dating the Site

“Dating archaeological materials allows us to establish and maintain context in time. So, archaeological dating establishes the temporal context between and among artifacts, ecofacts, and features.” (Peregrine, 2017, p. 69)

“In accelerator mass spectrometry, one measures the actual number of carbon-14 atoms present, not the very small numbers that radioactively decay during the measurement time.” (Agrawal and Yadava, 1995, p. 23)

4.16 Introduction to Archaeological Dating

Dating the artifacts is one of the most significant works in archaeological research. The artifacts recovered from the excavation reveal various information about the past society and environment. Different methods and techniques have been developed to determine the artifacts' chronological frame or date in the last few decades. The various dating methods are based on wood, charcoal, terracotta, ceramics, lithics, etc. The present research has selected charcoal, potsherd, and sediment samples collected from the test pits for dating. This study aims to understand the time frame for the past settlement in the Digaru – Kolong river valley region. For this purpose, Accelerator Mass Spectrometry (AMS) method has been employed.

AMS dating method is a new revolution in the radiocarbon techniques for measuring Carbon-14 content in samples. The AMS technique of Radiocarbon dating directly determines the ratio of ^{14}C : ^{12}C atoms. Therefore, this method requires a smaller sample, which adds great importance to this technique. The tremendous significance and advantage of this method is the sample size (Agrawal and Yadava, 1995, p. 23). Radiocarbon dating using the AMS technique is one of the most popular and explored methods in Archaeology.

The samples were processed at the Inter University Accelerator Centre (IUAC), New Delhi laboratory. IUAC is a national center for ion accelerators. The center provides various ion beam-based experimental facilities and is equipped with a 15UD Pelletron accelerator. The Centre is equipped with the AMS facility for ^{14}C , ^{10}Be , and ^{26}Al radionuclide measurements based on a 500 kV tandem ion accelerator. A Graphitization laboratory is equipped for pre-treatment and graphitization of various types of samples such as charcoal, wood, macrofossils, and plant remains (Sharma *et al.*, 2018).

4.17 Methodological consideration for AMS Dating

In the present study, Accelerator Mass Spectrometry (AMS) dating method has been used to date the Charcoal, Pottery, and Sediment samples collected from different sites in Digaru – Kolong river valley region. Seven charcoal, five potsherds, and five sediment samples have been analyzed using the AMS technique at the Inter University Accelerator Centre (IUAC), New Delhi. The detail of the all-analyzed samples has been mentioned in **Table 4. 31**.

The pre-treatment and analysis of the samples have been done using the protocol adopted by the IUAC laboratory. First, samples were visually cleaned using a microscope, and extraneous materials were removed. The outer surface is cleaned with the help of tweezers and converted into small pieces using mortar and pestle. It was washed with de-ionized water. Further, the samples were chemically pre-treated using (Acid-Base-Acid) ABA protocol. The first acid wash (0.5 M HCL, 60°C) removes the Carbonates, and Humic acid is removed by the first base wash (0.1 N NaOH, 60°C). Atmospheric CO₂ is absorbed into the sample during the base wash and further removed by the second acid wash (0.5 M HCl, 60°C). A mixture of 5% NaClO₂ and a few drops of 4% HCl is used for the bleaching step, and 6-7 washes follow each step of the ABA and BABAB protocol with ultrapure water. Samples are then dried overnight in a controlled freeze dryer (Sharma *et al.*, 2018; Vahia *et al.*, 2016). After that, about 3 milligrams of this dried sample are used for further graphitization.

Graphitization of the samples was done using the automated graphitization developed by Ionplus AG and ETH at the graphitization laboratory at IUAC. Samples were processed into graphite by combusted in the elemental analyzer, and purified CO₂ was transferred to a zeolite trap in automated graphitization equipment (AGE). Purified CO₂ is reduced by H₂ gas on the surface of ion powder at 580°C. Then graphite is formed into pallets, and for the isotopic measurement, it is inserted into the ion source of the accelerator (Sharma *et al.*, 2018; Vahia *et al.*, 2016).

4.17.1 Selected Materials and Sampling

Charcoal, Potsherd, and Sediment samples have been collected from the test pits at various depths excavated in the study area. The samples are cleaned by removing any modern material such as plastic, roots, and leaves mixed during the digging, and further pre-treatment has been done in the laboratory. The charcoal samples were packed in sample tubes, whereas

potsherds and sediments were in plastic zip-lock bags. A tag was attached to all the sample bags mentioning their site name, test pit, location, profile, depth, etc.

Table 4. 31. Selected samples for AMS dating

S. N.	Sample Name	Site Name	Material	Test Pit	Depth (in cm)
1	MRK 1	Marakdola	Charcoal	1	25
2	MRK 2	„	„	1	35
3	MRK 3	„	„	1	60
4	MRK 4	„	„	1	70
5	MRK 5	„	„	1	75
6	BGI 1	Bagibari	„	1	10
7	BGI 2	„	„	1	15
8	BGIc8	„	Potsherd	1	10
9	BGIc9	„	„	1	15
10	MRKc16	Marakdola	„	1	65
11	SKGc3	Shankargog	„	1	45
12	SLGc6	Silchang	„	1	15
13	BGIs3	Bagibari	Sediment	1	25
14	BGIs4	„	„	1	30
15	SKGs1	Shankargog	„	1	50
16	SLGs1	Silchang	„	1	40
17	MRKs1	Marakdola	„	1	105

4.18 Result and Discussion

The measured results of all the analyzed samples are normalized to the standard sample OX II. AMS delta 13C values are used for the isotopic fraction correction. Background value during the measurement was (0.772 ± 0.0141) pMC (Percentage modern carbon) and that corresponds $^{14}\text{C}/^{12}\text{C}$ ratio $(8.5489 \pm 0.1554) \times 10^{-15}$. During measurement, its consensus values (pMC = 49.53 ± 0.12) was close to its experimental result (pMC = 48.88 ± 0.20) within the error.

The table below mentions the sample name, pMC (Percentage modern carbon) value, and Radiocarbon age in the Before Present (BP) value. Further, the table consists of Calibrated age range and Median age. The online program OxCal 4.4 has been used to Calibrate the

Radiocarbon dates. This program is further used to calculate the median age value. OxCal program is intended to provide radiocarbon calibration and analysis of archaeological and environmental chronological information. It is an online program available by ORAU (Oxford Radiocarbon Accelerator Unit), a radiocarbon laboratory engaged in collaborative research across many disciplines where the measurement of the radiocarbon isotope is useful (<https://c14.arch.ox.ac.uk/oxcal/OxCal.html>). The calibration curve has been reproduced for all the analyzed samples in OxCal 4.4 program.

Table 4. 32: AMS dating of Charcoal samples

S. N.	Sample Name	Sample ID	pMC value	Radiocarbon Age (BP)	Calibrated Age Range	Median Age
1.	MRK1	IUACD#19C2847	92.975 ± 0.333	585 ± 28	1299 – 1415 CE	1347 CE
2.	MRK2	IUACD#19C2848	92.028 ± 0.368	667 ± 32	1275 – 1392 CE	1316 CE
3.	MRK3	IUACD#19C2849	87.498 ± 0.359	1072 ± 33	895 – 1021 CE	947 CE
4.	MRK4	IUACD#19C2850	90.071 ± 0.326	840 ± 29	1155 – 1264 CE	1204 CE
5.	MRK5	IUACD#19C2851	90.194 ± 0.326	829 ± 29	1163 – 1262 CE	1216 CE
6.	BGI1	IUACD#19C2852	88.222 ± 0.349	1006 ± 31	976 – 1152 CE	1022 CE
7.	BGI2	IUACD#19C2853	89.239 ± 0.343	914 ± 30	1031 – 1202 CE	1103 CE

Table 4. 33: AMS dating of Potsherd samples

S. N.	Sample Name	Sample ID	pMC value	Radiocarbon Age (BP)	Calibrated Age Range	Median Age
1.	BGIc8	IUACD#21C3660	89.823 ± 0.271	862 ± 24	1051 – 1249 C.E.	1186 C.E.
2.	BGIc9	IUACD#21C3661	86.750 ± 0.296	1141 ± 27	777 – 980 C.E.	913 C.E.
3.	MRKc16	IUACD#21C3662	89.050 ± 0.274	931 ± 24	1031 – 1159 C.E.	1098 C.E.
4.	SKGc3	IUACD#21C3663	90.574 ± 0.258	795 ± 22	1213 – 1273 C.E.	1242 C.E.
5.	SLGc6	IUACD#21C3664	94.189 ± 0.294	480 ± 25	1412 – 1449 C.E.	1432 C.E.

Table 4. 34: AMS dating of Sediment samples

S. N.	Sample Name	Sample ID	pMC value	Radiocarbon Age (BP)	Calibrated Age Range	Median Age
1.	BGIs3	IUACD#21C3665	80.306 ± 0.311	1761 ±31	170 – 382 C.E.	286 C.E
2.	BGIs4	IUACD#21C3666	79.868 ± 0.295	1805 ±29	130 – 323 C.E.	209 C.E
3.	SKGs1	IUACD#21C3667	91.735 ± 0.355	693 ±31	1264 – 1388 C.E.	1291 C.E.
4.	SLGs1	IUACD#21C3668	83.418 ± 0.285	1456 ±27	560 – 649 C.E	608 C.E.
5.	MRKs1	IUACD#21C3669	79.909 ± 0.257	1801 ±25	132 – 322 C.E	217 C.E.

The above result obtained from the AMS dating of the charcoal, sediment, and potsherd samples presents a late time frame or post-Neolithic dates. The median value of radiocarbon dates of charcoal samples from the Marakdola site is 1347 CE, 1316 CE, 947 CE, 1204 CE, and 1216 CE. The potsherd sample at 65 cm depth has 1098 CE and 217 CE for the sediment sample collected from the depth of 105 cm. The radiocarbon date of the charcoal samples from Bagibari is 1022 CE and 1103 CE. The radiocarbon dates of the potsherds are 1186 CE and 913 CE. The sediment sample has the median calibrated date of 286 CE and 209 CE. The potsherd and sediment samples from the Shankargog site are dated 1242 CE and 1291 CE, respectively. The radiocarbon date of the potsherd and sediment samples from the Silchang site is 1432 CE and 608 CE, respectively.

The radiocarbon date of Charcoal samples from the Marakdola site lies around the 13th century CE to the early 14th century CE. The potsherds collected at a depth of 65 cm in Marakdola test pits date late 11th century CE. These dates are somehow identical to the dates assigned by Rao (1973). The sediment samples from the Marakdola site reveal an exciting date to the lower level of the site. The radiocarbon date of the sediment sample collected at a depth of 105 cm indicates median age of 217 CE (132 – 322 CE), i.e., 3rd Century CE. The radiocarbon date from the Bagibari site reveals very fresh information about the region. The radiocarbon dates of the potsherd sample (BGIs8) and charcoal sample (BGI1) collected at a depth of 10 cm are 12th century CE. The charcoal sample BGI2 at a depth of 15 cm dated to the early 12th century CE, and the potsherd sample at a depth of 15 cm dated to the early 10th century. The sediment sample of Bagibri at a 25 cm and 30 cm depth dated to the late 3rd century and early 3rd century, respectively. The radiocarbon date of the potsherd sample at a depth of 15 cm dated to the early 15th century CE, and the sediment sample from the depth of 40 cm dated to the early 7th century CE.

4.19 Discussion

The mineralogical composition and Thin-section petrography of the analyzed celt samples determines the raw materials of the stone tools. Using the mineralogical technique mentioned above, the analyzed samples through petrography and XRD are Slate and Shale, metamorphic and sedimentary rock, respectively. The other samples were visually analyzed based on their colour, texture, and grain size. These were analyzed and compared with the other tools assemblages reported from the nearby regions. As we already discussed, there is an abundance of rock sources in the study area. The earlier works also confirmed and found similar types of raw materials for manufacturing the stone tools, such as sandstone, rhyolite, slate, dolerite (mostly in Meghalaya), shale, and claystone (Sharma, 1966; IAR 1966-67; Rao, 1977; Ashraf, 2004; Mitri, 2005; Deka, 2015; and Dikshit and Hazarika, 2012).

Powder XRD and FTIR analysis determined the mineralogical composition and firing temperature of the potsherds. Powder XRD analysis reveals the primary mineralogical content of all the analyzed samples. The major minerals found in all analyzed samples are Quartz, clay minerals such as Kaolinite, Hematite, and non-clay minerals Feldspar. The presence of Quartz is not sure whether it is an indigenous mineral of natural clay or added intentionally as a tempering material (Singh and Sharma, 2016). It is a significant mineral that makes the clay self-tempered. Feldspar mineral groups such as Microcline, Orthoclase, and Anorthite are detected in almost all the analyzed samples and are integral to the clay matrix. In addition, with the XRD, FTIR analysis has been conducted to understand the mineralogical framework and firing temperature. The FTIR result has good agreement with the XRD results. The FTIR result revealed that most of the analyzed pottery samples would have been fired within the range of 650-800 °C. The FTIR analysis indicates the firing temperature range of BG1c2, 3, and 6; SKGc5; MRKc3, 6; KJM1; MSKc3; LPDc2; and SDMc3 should be within 800-900 °C.

The presence of Hematite minerals in all the samples shows that they were fired in open air or perfectly oxidizing atmosphere at manufacturing. The visual analyses of the potsherds show the fine grain and are well-fired which further supports that the potsherds were fired at high temperature for a long duration of time. The presence of Hematite is also responsible for the red colour of the pottery. The red colour of the pottery is due to the presence of Hematite, which indicates the atmospheric conditions (oxidizing/reducing) where the artifacts were fired. The potters would have fired these potteries at two different temperature ranges from

the above discussion. The firing temperature of the first potteries would have been within the range of 650 – 800 °C in an oxidizing condition. At the same time, other kinds of ceramics would have been fired within the range of 800-900 °C in an oxidizing atmosphere.

Analysis of the composition, texture, and colour of sediments provides different kinds of information to reconstruct the human past and paleoclimate. It helps us to recognize the activity areas in the past. The methods of sediment analysis in archaeology include several tools. The present study deals with the soil samples' colour, mineralogy, pH, % of calcium carbonate, and particle size. The colour of soil samples is varied at different depths. The soil colours at the surface to around the middle of the trench are mostly very pale brown (10YR 7/4) and pale brown (10YR 6/3). Brownish-yellow (10YR 6/6) and dark greyish brown (10YR 4/2) soil are mostly noticed after the half depth of the trench to its bottom. The yellowish colour in the soil indicates oxidation and good drainage, whereas the darker greyish colour at the bottom of some sites indicates poor drainage. The particle size distribution of soil has been determined using Sieving and Hydrometer analysis techniques. The gravel, sand, silt, and clay fraction in soil has been specified, revealing the presence of sandy soil. The soil texture is Loamy fine sand, Sandy loam soil, and one sample collected from the bottom of the trench is Loamy soil.

The mineralogical analysis of the soil has been done by the Powder XRD method. The significant minerals identified in all the analyzed samples are Quartz, Kaolinite, Halloysite, Microcline, Hematite, Goethite, Aragonite, etc. The mineralogical composition of the soil samples and the potsherds collected from the respective test pits has identical content. This further concludes that the raw material used for manufacturing the potteries would have been acquired locally. The pH test was done using universal indicator paper. The test shows that the soils are strongly acidic to medium acidic. The soil samples collected from the bottom of the pit were medium acidic. This is further attested by the determination of Calcium Carbonate in the samples. A rapid titration method has been undertaken to determine the percentage of CaCO₃ in the soil samples. The percentage of CaCO₃ was higher at the bottom layer than at the upper layer. The Digaru – Kolong river valley is a humid region with high rainfall, which is the primary reason for acidic soil. The annual flood and water retained or backwater after the flood helps to settle down the clay and silt particles to the bottom in layers.

From the radiocarbon dates mentioned above, it is observed that the age of all the samples is very late for the Neolithic period. The date of the Neolithic period from Northern India and other parts of peninsular India goes back around 7k to 6k BP. The Neolithic period of the Eastern part of India or the mid-Ganga plain shows much earlier dates. The Neolithic phase of Chirand (Bihar) dates from 1270 ± 105 ; 1375 ± 100 BCE (Agrawal, 1982). Similarly, the Neolithic site of Lahuradeva dates 6290 ± 140 ; 5320 ± 90 BP (Tewari *et al.*, 2001-02), the date of Jhusi is 7477 and 5837 BCE (Pal, 2007-08), and the Neolithic site of Koldihwa dates 6570 ± 210 BCE (Sharma *et al.*, 1980). The date of the Neolithic sites of Northeast India also goes very back, such as the date of Lawnongthrough and Myrkhan sites in Meghalaya is 2960 ± 30 BP and 3500 ± 30 B.P., respectively (Mitri *et al.*, 2015). The Luminescence date of potsherds from Daojali Hading (Assam) is 2.7 ± 0.3 ka, and Gawak Abri (Meghalaya) is 2.3 ± 0.2 ka (Sharma and Singh, 2017). Based on the stone artifacts discovered from the Daojali Hading and GawakAbri, Sharma and Singh (2017) state that these tools were used for agriculture, food processing, and foraging. Similarly, the Neolithic sites of Tripura have been dated around 3450 ± 110 BP (Ramesh and Rajagopalan, 1999). The sites of Manipur, such as Nongpok Keithelmanbi and Napachik, have been dated to 4460 ± 120 BP and 1450 BC, respectively (Singh, 1993). Dikshit and Hazarika (2012) provide a radiometric time range from circa 2500 – 1500 BCE to the Neolithic period of Northeast India in their comparative study of Neolithic cultures of Northeast India with the adjoining regions.

As discussed above, the Neolithic period in the neighboring part of Digaru – Kolong River valley and the other Northeast Indian sites have early dates compared to the present study. The present result indicates various possibilities for the time mentioned above in the region. The first and foremost interpretation of these dates would be the continuity of the tradition. The Radiocarbon dates of the present study area indicate that the tradition or the Neolithic lifestyle survived a very long period in this region. Stuart Piggott (1954) noted the acculturation of the Mesolithic people under the influence of primary Neolithic culture in Western Europe. He believed this acculturation or the social and cultural memory or continuity resulted in the earlier Neolithic cultures possessing relatively few Mesolithic traits in either technology or economy. Piggott termed these Secondary Neolithic (Piggott, 1954; Gabel, 1958). Considering the continuity of a tradition in this region, it became necessary to understand and analyze the people's present socio-cultural and religious memory. The ethnographic approach is undertaken to understand the current socio-cultural and social memory of the population. This is further discussed in Chapter V elaborately.

Chapter – 5

People, Society, and Artifacts: An Ethnoarchaeological Study

This chapter provides detailed information on the Ethnoarchaeological survey conducted in the Digaru – Kolong river valley. It presents the description of ethnic communities and their socio-cultural life and beliefs. The chapter starts with the introduction and importance of ethnographic study in archaeological research. Further, a methodological consideration and objective for the ethnography survey are mentioned. It describes the socio-cultural, religious significance, and memory associated with archaeological sites and artifacts of locals. Further, it describes the association of material culture of this region in the daily life of locals and tries to understand the continuity and change in their tradition. Lastly, the discussion compares common beliefs associated with archaeological artifacts from neighboring regions and other parts of the country.

5.1 Introduction

“ . . . the actual effort made by an archaeologist or ethnographer to do fieldwork in living human societies, with special reference to the 'archaeological' patterning of the behavior in those societies. Ethnoarchaeology, as I see it, refers to a much broader general framework for comparing ethnographic and archaeological patterning . . . Thus ethnoarchaeology may include studies of 'living archaeology' along with other approaches as well” (Gould, 1974).

Ethno-archaeology has developed as a powerful tool for the interpretation of archaeological data. It is the ethnographic investigation of contemporary or living culture from archaeological perspectives. The mechanism of ethnoarchaeology is embedded with several approaches to studying the relationship of material culture to culture as a whole. This amalgamation of archaeology and ethnography has gained general acceptance since the latter part of the 1970s. Naidoo (2012) said that ethnography is a qualitative method emerging from anthropology that lends to the study of the social interactions, beliefs, and behaviors of small societies, involving participation and observation over some time and the interpretation of the data collected (Naidoo, 2012; Denzin and Lincole, 2011; Reeves *et al.*, 2008). The introduction of this method in archaeology and its results lead to significant changes in archaeological practice and improvements in understanding of human history. James O'Connell (1995) defined it as:

"the study of relationships between human behavior and its archaeological consequences in the present" (Connell, 1995, p. 205).

He further explained that the goal of this research method is to find out and explain the patterns in this relationship and the process that determines them (Connell 1995:206). V.G. Childe said that it is impossible to recreate past knowledge on its terms. He suggests that we locate the past in its proper social and chronological context in those thoughts still living and active in our own culture. Oswalt (1974, p. 3) defines ethnoarchaeology in the following way:

"it is the study of material culture based on verbal information about artifacts obtained from persons, or their direct descendants, who were involved with the production."

Stanislawski (1974, p. 18) presented a more comprehensive definition of ethnoarchaeology that is:

"The direct observation field study of the form, manufacture, distribution, meaning, and use of artifacts and their institutional setting and social unit correlates among the living, non-industrial peoples for the purpose of constructing better explanatory models to aid archaeological analogy and inference."

Scholars have conducted Ethno-archaeological research in several parts of India to understand the ethnic communities and material culture. Northeast India has accommodated a varied tribal population, which still subsists on some primitive economy such as hunting, gathering, other distinctive traits, and a rich prehistoric treasure in their settlements (Raut, 2001).

The archaeological reconnaissance in the Digaru – Kolong river valley explored several localities and villages and located several sites or findspots. The significant artifacts collected and located were potsherds, stone celts, and megaliths monuments. The primary objective of the exploration was confined to understanding the archaeology and material culture of the region. Several social and cultural beliefs associated with artifacts, such as the celts and megaliths, came to light during exploration. The socio-religious beliefs and memory associated with artifacts were very significant. The settlement pattern on the hills and the day-to-day life of local communities are crucial in understanding archaeology and the relation of contemporary culture to the region's material culture. Due to this, the need for an ethnographic or ethnoarchaeological survey emerged. Therefore, a survey was planned to

understand the people and their socio-cultural religious beliefs and memories associated with the archaeological sites and artifacts.

5.2 Methodological Consideration for Ethnoarchaeological Study

The ethnographic method is a qualitative research approach that looks into the community or people in their cultural setting to produce a narrative account of the particular culture. Different approaches were employed to achieve the objective of this research. This included collecting primary data, site visits and surveys, interviews, and scheduled observation methods. This also includes the primary as well secondary sources. The methodological approaches undertaken for this study are mentioned below:

5.2.1 Desktop Study

As the name suggests, the desktop study includes investigating the primary and secondary sources of information. Data were collected from government departments' websites as primary sources, such as gazettes, Geological Survey of India, census, and statistical reports. Several secondary sources of materials were consulted, such as published books, research papers, journals, unpublished thesis, and previous studies on the region, for a better understanding of the history and culture of the people and community. Different types of maps (offline and published form) were studied, such as topography, drainage, and geography, to understand the location and physical context of the region under study. Different museums were visited within the study area. The Museum visited were Assam State Museum (Guwahati), Anthropology Museum (University of Guwahati, Guwahati), Anthropology Museum (Dimoria College, Khetri), and Mayong Village Museum and Research Centre (Mayong, Marigaon) to have an understanding of the material culture or archaeological collections coming from different part the study area.

5.2.2 Field Survey

An ethnographic survey was made to collect the primary data along with the archaeological reconnaissance of sites. This includes surveying several villages in the study area (mentioned in Chapter 2). The field survey, or the village-to-village survey, was carried out by walking across the landscape as most of the villages were located in dense forests and hilly slopes. The facilities for public transport or even proper roads were not available in the remote

region of the study area. The field visit helped to gain insight into the ecological setting of the culture.

5.2.3 Ethnographic Approach

Ethnographic data were collected by several approaches, such as observations, interviews, and site documents. The fieldwork typically begins with observation, later complemented by other data such as interviews and documents. This led to an understanding of the social, cultural, and religious significance and their beliefs and memory associated with the artifacts and archaeological sites in the region. The ethnographic data offered valuable information regarding peoples' use of space and their beliefs about their origin, socio-cultural beliefs, burial practices, and megaliths. This is an inductive method to collect information about the research matter.

a) The Observation Method

“Observation is a purposeful, systematic and selective way of watching and listening to an interaction or phenomenon as it takes place” (Kumar, 2005, p. 119).

The non-participant observation approach was used in the study to understand the complex social situation of the region's communities. There are two types of this method: participant and non-participant observation method. As mentioned in Chapter 2, a significant amount of time was spent in the field with locals during the research period. The communities or locals were studied by observing their daily activities, thereby getting first-hand information about their daily behavior, beliefs, and practices. A non-participant observation method was used in the study. In this approach researcher did not involve in the activities of the religious or socio-cultural practices of the group but remained a passive observer, watching and listening to their activities and documenting the events.

b) The Interview Method

“Qualitative interview is not an ordinary conversation, a normal dialogue between two evenly-matched individuals; rather, it is a guided conversation in which the interviewer establishes the topic and ensures that the interview is conducted according to the cognitive aims set” (Corbetta, 2003, p. 265).

An Interview approach to ethnography is a qualitative research method that provides meaningful information with one-on-one discussion. An informal interview or inquiry helps gather relevant data related to the aim or goal of the research. Unstructured or Informal Interviews were conducted with contemporary ethnic populations in the study area to understand their memory, ideas, and beliefs associated with archaeological artifacts. A set of questions or the query were planned as per the research objective. An informal or unstructured interview was taken with different age groups of the villagers. This primarily includes the village headmen, farmers, people associated with religious activity, market places, and other village residents aged 20 to 70 years. We noted 45 responses from different Karbi villages, 40 Tiwa villages, and ten from other communities (such as Assamese and Bodos) inhabiting nearby villages. The discussion further helps to understand the several factors or reasons behind the change or continuity of megaliths tradition or beliefs associated with stone celts. The researcher initiated the discussion by focusing on the questions mentioned below:

- I. What do you call or think of these monuments or artifacts (Megaliths, Stone celts, and Potsherds)?
- II. Do you consider them (Megaliths) as part of your tradition? If yes, do you still practice this tradition, and how? If not, who is the owner or which community installed these structures?
- III. Do they have any significance, and should we conserve them?
- IV. Do stone celts used in any day-to-day life activity? How are they come from, or how do you find them?

The responses from locals were observed and documented to understand their differences or similarities.

5.3 Ethnicities in the study area: Cultural Configuration

The states of Northeast India signify the cultural diversity and land of several communities living close to nature. Several tribal groups live with diverse cultural and religious beliefs. The significant communities inhabiting the Digaru – Kolong river valley is the Assamese, Karbis, and Tiwas. Besides these, several other communities such as Bodos, Nepalis,

Bengalis, Assamese Muslims, and Rabhas also inhabit the study area. The Karbis and Tiwas mostly live in rural and forest or hilly areas. The mainstay of these people is agriculture.

5.3.1 The Karbis

The Karbi tribe is an important ethnic group of Assam and displays a cultural dichotomy of different nature. They are primarily distributed in plain and hills and called 'Mikirs' by their neighbors. In the hills, they mainly inhabit Karbi Anglong district (Assam) and Meghalaya, and others in the plains on the southern bank of Brahmaputra in Golaghat, Nagaon, Morigaon, and Kamrup districts of Assam. The Karbis belong to the Tibeto-Burman group, particularly the Karbi (Mikir) subgroup.

a) Origin, Migration, and Physical Features

The Karbis did not have their own script, and hence they have no written record of their origin and migration (Choudhury, 2004; Ramirez, 2014). Due to the absence or scanty of written and archaeological records, it is not easy to trace the origin and history of the early settlements of the Karbis. Hence, folklore and tradition are the only and primary sources of information regarding this. There are several theories or hypotheses regarding the origin or early settlements and migration of the Karbis. Traditional sources suggest that Karbis entered Assam in one of the waves of migration from Central Asia during the protohistoric time. Stack and Lyall suggest that the eastern portion of the Khasi and Jaintia Hills bordering the Kopili River were the original settlement zones of the Karbis (Stack and Lyall, 1904, p. 4). A group of Karbis settled in the Kamrup district of Assam.

Furthermore, another part of the foothills of the Assam-Meghalaya border belongs to the Amori group of the tribe. There are references in the folklore of the Karbis that they once lived on the bank of the river of Kalang, Kopili, and the entire Kaziranga area (Duarah, 2014, pp. 70-71). They migrated for several periods to different regions due to reasons driven by the Kachari kings and Jaintias kings. The intervention of Jaintias resulted in Karbis entering the Ahom territory during the 17th Century (Devi, 1968, p. 148). During the Burmese invasion, they took refuge in the deep forest, and some of them moved towards the lower Assam, and some crossed the river Brahmaputra and settled in the North Bank.

The Karbis, as a Tibeto-Mongoloid tribe, are medium-statured, with marked cheekbones, flat nose, round face, light yellow complexion, scanty beard, coarse straight hair, and oblique eyes.

b) The Settlement, Subsistence, and Food Habits

As we already discussed (see Chapter 2), Karbis are settled in the hills as well in the plains. The Karbis from the foothills region are called Plain Karbis. They prefer to live on the hill slopes sustained by a nearby water source, firewood, availability of water, and forest resources. The typical Karbis houses are constructed using available raw materials such as Bamboo, cane, timber, and mud. Bamboo plays a significant role in the settlement and the subsistence of the Karbis. It is often plastered with a mixture of mud and cow dung from both sides, and roofs are covered by thatch.

Agriculture is the primary occupation, with the principal crop being paddy. It is cultivated on the plain as well as shifting or Jhum methods. Other crops such as ginger, brinjal, turmeric, potato, chilly, and pumpkin are cultivated in the Jhum field. Gatherings of wild and edible plants are other everyday subsistence of the locals and agriculture. Group hunting is annually practiced during the month of February/March as a ritual practice. The other food resources besides jhum crops are acquired from livestock raising and small game hunting. The common hunted wild animals are pigs, deer, goats, buffaloes, squirrels, and several varieties of birds. Fishing is another common practice among the Karbis using different methods. During January and April, communal fishing is organized by villagers annually. As a staple food of the Karbis, Rice is prepared in various methods and forms. Cooking rice in bamboo tubes is an occasional practice. One of the crucial characteristic features of the tribal groups of Northeast India is the consumption of rice beer. Rice beer has crucial importance in their day-to-day life, rituals, and festivals. It is prepared by fermentation of the cooked rice with distilled alcohol.

c) Material Culture and Other Traits

As already discussed in the previous chapters, natural materials such as wood, bamboo, and thatch play a significant role in the material culture related to settlement and subsistence or household activities of the Karbis. Bamboo, wood, and iron are commonly used raw materials for various purposes. The Karbi society is patriarchal in which sons inherit the property from their father. Five exogamous clans exist among the Karbis, namely Terang, Teron, Inghee,

Ingti, and Timung (Duarah, 2014, p. 73). Ramirez (2014) states, "in the Karbi settlements, the mother tongue is dominant – although not entirely Karbi, and lineages are associated with one of the five major Karbi clans." Duarah (2014) describes them as animists from a religious point of view. They primarily worship mountains, hills, stones, rain, trees, storm, and thunder as the Shakti symbol. Witchcraft and black magic are very prevalent among them. The Maiyong Museum showcases the history and rare book collection of magic or spellbooks in this region. Megalithic monuments in and around the Karbi villages are another significant characteristic. The Karbis are one of the tribes of Northeast India that continues the megalithic tradition with minor changes.

5.3.2 The Tiwas

Tiwas are another important ethnic group of this region and are called 'Lalungs' by their neighbors. Tiwa tribe constitutes the dominant population in the Assam – Meghalaya borderland, speaking a Tibeto-Burman dialect (Tiwa) of the *Bodo-Garo* group. The majority of hill Tiwas have become Christian, while the rest follow indigenous religion. The Tiwas from the plains do not speak the Tiwa language. They mostly follow Assamese Hinduism. The Tiwas from the plains claim to have come from the hills, but most are unsure of the exact place. Ramirez (2014) states a great cultural dichotomy between the hill Tiwas and Plain Tiwas in terms of acculturation to the Assamese-dominated culture. He further describes the plain and hill Tiwas dichotomy in the following lines:

"Most Tiwa communities in the plain do actually seem to confirm this; at first sight, several others display typical features of hill Tiwas; they speak Tiwa, run a youth dormitory next to the nam ghar, and perform Sakra puja, when a dance troupe visits each of the lineages' root houses in turn, thus 're-assembling the village' lineages. Some of these villages are obviously situated at the foot of the hills, and they are made up of recent immigrants who often marry hill dwellers – which would confirm the Assamisation thesis. However, other such communities live deep in the plains, have kept no memory of their arrival, and have very little contact with the hills" (Ramirez, 2014, p. 20).

a) Origin, Migration, and Physical Features

The origin and the references of the Tiwas are sporadic, and most studies have been conducted based on folk culture. Duarah (2014) describes the Tibet region as the original homeland of the Tiwas. However, their movement towards the plain is still a matter of

discussion. Tiwas are called Lalungs, where La means water and Lung means rescued. There are several other legends or folk stories about the origin of the Tiwas. Among many legends, it is believed that three divisions of the Bodos, namely Tipra, Tiwa, and Dimasa, lived along the bank of a lake near Tibet. They have entered Assam through the Northeast passes. The Tifra became or pronounced as Tippera in the local tongue. They introduced themselves as Tiwa Libing or Libung, the prefix Tiwa was eliminated, and Lalung became more common (Bordoloi *et al.*, 1987). It is believed the Tiwas migrated to the plains in the middle of the 17th century. According to a legend, Lalungs, originally inhabiting the Jayania Hills, moved into the plains of the Nagaon district due to several socio-cultural and religious factors such as matriarchal systems and the practice of human sacrifice by the Jayantias (Grierson, 1967).

The Tiwas are mostly medium-statured, strongly built, and generally white-complexioned people, which are significant features of the Mongoloids. They have straight hair, broad faces with flat noses, and scanty beard and mustaches.

b) The Settlement, Subsistence, and Food Habits

Tiwas are inhabited in the hills as well plains in the study area. The household structures and others, such as animal shelter, granary, and watch hut for the field, are similar to the neighboring tribes and non-tribal communities. The villages are mostly surrounded by agricultural fields and forests or water bodies. The number of houses varies from 20 to 100 and is scattered over the hills. The Tiwa villages have a well-managed dormitory system. They are significantly agriculturists. Shifting cultivation on the hill and slopes are significant characteristics of Tiwas. The hill Tiwas primarily practiced the 'slash and burn,' or shifting cultivation method, whereas wet rice cultivation methods influenced the plain Tiwas. Apart from the significant rice crops, they also produce sesame, mustard, ginger, chilies, and jute. Other than cultivation, weaving, gathering by women from Jungels, fishing, and occasional or ceremonial hunting is a significant parts of the subsistence of Tiwas. The Food habits of the Tiwas are similar to the other tribes and inhabitants of Northeast India. Rice is a staple food; they cook several other food items from the rice.

Along with rice, meat, fish, or eggs, fowl and pork are considered the primary good. They enjoyed locally brewed rice beer daily as well ceremonial or at festivals. Drinking rice beer is still an essential part of certain religious and cultural ceremonies among the Tiwas.

c) Material Culture and Other Traits

The material culture of the Tiwas is very similar to the Karbis and other neighboring inhabitants. Natural materials such as Bamboo, wood, thatch, cane, and leaves are the primary raw materials used for household activities. Iron plays an essential role in their life or is an essential tool for agriculture, hunting and gathering, and other household activities. The Tiwas are divided into several clans. Every clan has several positions, and specific jobs are assigned to them. Major clans found among the Tiwas are Amshi, Khorai, Pumah, Amphai, Muni, Darphang, Sogra, and Kholar (Bordoloi, 2016). Monogamy is the socially approved form of marriage among Tiwas. Disposal of the dead is done by both cremation and burial method. The Tiwas are regarded as Shaktas (non-Christianized) and worship Lord Shiva. The hilly Tiwas worship the stone images of deities, while the plain Tiwas do not install any image on the alter (Duarah, 2014, p. 88). Most Tiwas are converted into Christian (Catholic and Protestant) in the study area. However, they follow the cultural and social traits of tribal belief and attend the Christian Church.

Figure 5. 1 A Tiwa family



5.4 Concept and Meaning of Stone Celts: common beliefs and socio-cultural memory

Humans have utilized stone for a long time due to its durability and strength. The history of the technological development of humans could be seen in the light of tools made of natural materials, stones, and metal, respectively. The Stone Age is considered the most extended duration in the development of human history. During this development journey, the production of stone tools underwent several changes and refinements. The Neolithic period is associated with the stone celts, grounded and polished and more refined and controlled than the previous tools. Similarly, Neolithic culture witnessed sedentary life and controlled the reproduction of focal plant and animal species.

The study of the concept and meaning of celts and their purpose is an intriguing subject in archaeological study. There are numerous explanations for the use and manufacturing of the celts. However, the study of celts associated with the shared beliefs and socio-cultural memory of the local tribes unfold valuable information. The locals' traditional practices and belief systems associated with celts have carried them from generation to generation, which helps us understand the past and aid archaeological recourse.

5.4.1 The Concept of ‘thunder Axe’ and ‘thunderstones’

The peculiar nature of the Neolithic celts has always mystified the commoner. The stone axes or adzes have been considered “thunder Axe, thunderstones, and thunderbolt” and are one of the many ancient belief systems worldwide phenomena that probably date back to a very remote period. The notion of a ‘thunder Axe’ became a widespread belief throughout Africa, Europe, Asia Minor, India, and the Far East, even among almost all the tribes of Northeast India. (Mitri, 2008, p. 55).

Apart from the concept of ‘thunderstones’ and association with the lighting, several other beliefs are associated with these artifacts. In Britain, the stone artifacts such as flint arrowheads are considered thunderstones and used as luck charms (Gardner, 1942, p. 98). In Germany, there is a belief that the thunderstone comes down with lightning and penetrates the earth before surfacing after a definite period. In Denmark, thunderstones (celts) are believed to fall from the sky during the thundering and lightning (Hazarika, 2017). Similarly, the Swedish tradition also considered the stone artifacts as thunderstones. In Latvia, stone axes are regarded as ‘Thunderball’ (Vasks, 2003, p. 30). It is believed that thunderstones bring back luck to the house and protect it from strokes of lightning and evil spirits across

several parts of the globe. It is also used as a medicinal remedy or healing purpose. Prior to the scientific study of stone artifacts, plenty of studies had been conducted globally on the concept of thunderstones. The concept of thunderstone was challenged after the 16th century. Later, an attempt was made to interpret these artifacts as manufactured artifacts. Maria Leach (1972) describes the different belief systems of the thunderstones in various parts of the globe, such as France, South Africa, Switzerland, Sumatra, Malaysia, Philippines, Japan, Burma, Ireland, Sweden, and America. Natural historians and antiquarians challenged the theory of ‘thunderstones’ and objects of mysteries or magical objects and theorized them as man-made objects (Trigger, 1989).

There is no reference to the concept of ‘thunder axe’ or ‘thunderstone’ from the mainland of India. However, the Southern part of India showed evidence of stone implements being placed at the shrine as an object of worship (Narasimhaiah, 1980).

Figure 5. 2: Stone celt reported by local at Kalbari Village



5.4.2 Locating the concept of ‘thunderstone’ in the Digaru – Kolong River Valley

The earliest stone tool had been reported from Northeast India by Sir John Lubbock in 1867 was a polished blue jadeite celt. Several tribal communities have collected the stone artifacts from their agricultural fields across the entire Northeastern region of India and in the study area (see Chapter 2). The various tribes of Northeast India called them ‘thunder Axe or thunderstones’ in their local dialects. The Assamese and other ethnic communities from the study area called stone celts as *vajraxila* (thunderstone) or the god's axe.

The Kachari tribe of Assam named these in their local language as *Sarak, ni-Ongthai* (Sarak – Heaven, ni – of, and Ongthai – stone). The Garos of Meghalaya consider them god lightning, i.e., *Goera gitchi* (Goswami and Bhagabati, 1959, p. 313). In the Santhali dialect, these stones are called *Ceter* or thunder Axe. The Adi tribe of Arunachal Pradesh called these stones *Lidar*, which means a thunderstone. The Khasis call these artifacts *side pyrthat*, meaning lightning axes. The Jaintia tribe of Tripura calls these stone artifacts *Fwirang* or *Pherang*, which means thunderstones (Mitri, 2008).

The ethnic tribe and non-tribal communities of the study area, the Assamese, Karbis, and Tiwas, have also preserved the tradition and concept of thunder axe or stones. The Karbis and Tiwas of Assam and Northern Meghalaya call these stone celts *Choteracho* or *Ster ku*, meaning thunderstone. Besides *Choteracho* and *Vajraxila*, several other names have been provided for these artifacts, such as *Parashu kutha* (axe of lord Parashu) and *bajra pathor* (thunderstone). The local inhabitants of the Assam-Meghalaya border have fascinating aspects, concepts, beliefs, and traditions associated with these prehistoric stone artifacts. From the present study area of Digaru – Kolong river valley, these ideas, beliefs, and concepts of thunderstones are prevalent along the region's length and breadth. The Karbis and Tiwas believe that *vajraxila* (celts) falls from the sky and go down the earth during the thundering. After an extended period, it surfaces. During the ethnographic research, several social and religious beliefs associated with thunderstones were studied. The observations of these concepts and beliefs are mentioned below.

a) Thunderstone as an object of fortune, prosperity, and magical cult

Several religious, social, and cultural beliefs have been observed associated with the stone celts among the locals of the Digaru – Kolong river valley. It is believed that thunderstones bring luck to the house and are considered celestial objects, prepared by God in heaven to kill

the demons. It is believed that keeping it at house protects from the strokes of lightning. They keep them as valuable possessions of prosperity symbols to bring good luck to the family. Thunderstones protect the home, granary, farms, and crops and keep the pets safe from wild animals and nightmares. During the field survey, stone celts were found in the huts at agricultural fields in the Umsiang and the Umswai region to protect the crops.

Similarly, it was found at the pig barn at Bagibari, Silchang, Marakdola, and several other villages. The stone celts are also used for magical purposes to protect from evil spirits. The conversation with locals in Bagibari, Marakdola, Chenimur, Silchang, villages of the Umsiang region, and Umswai region further attested to the magico-religious belief associated with the stone celts. Locals from several villages in the Jorabat – Sonapur region (in Chenimur village) state that thunderstones are objects of fortune and should not be shown to others. Another significant observation associated with celts was noted among Bagibari, Marakdola, and Maiong village locals. During the interaction with the locals, some of them identified celts as thunderstone, which they had found during cultivation, but they did not have any idea or consider them of any use; hence they discarded or threw them away.

b) Thunderstone as a medicinal object

Thunderstones are also used for medicinal or healing purposes. The powder obtained from the stone celts by scraping or small bits of stones is given to the suffering ones, and sometimes the stone is stroked at the painful area. It is used for several purposes, such as rheumatism, toothache, stomach and chest pains, and during childbirth for quick and safe delivery of babies. In Bagibari village, a local is interviewed (informal interview) who uses the thunderstones for healing people in different pain and diseases. He said that thunderstone is rubbed on a stone with water, and the solution is given to the patient. This solution works in stomach pain, chest pain, delivery pain during childbirth, and other illnesses and aches. An observation is made during the field survey in the Marakdola village that a local heated the celt by putting it into the fire till it became red, and then he soaked the celt in water. The solution was then used for massaging the affected area of the body.

c) Concept of living and dead stone

Another significant observation regarding the stone artifacts in the study area was the concept of '*jia xil*' (living stone) and '*mora xil*' (dead stone) among locals. The inhabitants of the study area usually identified megaliths and stone celts as *jia xil* and *mora xil*. As per their

belief, the living stone grew gradually and became longer. The living stones are believed capable of moving or running away from the house on their own. They further believe that only living stones (also in contemporary times as a living tradition of Megaliths) were used to build the Menhirs. An attempt has been made to find out the differences between living and dead stones as per their belief. Usually, stone tools with dark colour or texture, polished surface, and heavyweight are considered living, while others with lightweight and texture are considered dead. The concept of the living stone of megaliths was that those stones grow. It may be because their bottom part sometimes gets buried by earth and when they excavate them, the exposed height increases, as we noticed in Diksak village.

5.5 Megaliths in Digaru – Kolong River Valley: Continuity and Role of Social Memory

The disposal of the dead and the study of burial practice is one of the essential sources to understand ancient people's socio-economic structure and society. The different way of disposal of burials is an ancient tradition in the human past and can be traced back to prehistoric times. Every society and community disposes of the dead with great care and respect and has followed different methods as per their beliefs and traditions since the ancient period (Mendaly, 2015; Shekhar *et al.*, 2014). Megaliths are an essential feature in the study of archaeology. The practice of erecting monuments in the memory of the dead is a well-known phenomenon in different parts of the world, including India. Memorial monuments provide data as a primary source for reconstructing people's past life and socio-cultural history. The tradition of erecting megaliths is still continual in a few communities or societies (Marak, 2012). The meaning and the purpose of erecting the megaliths are varied among different societies. According to Renfrew (1976), the study of megaliths offered a socio-political, economic, and ideological life of prehistoric societies and how they played a significant role in the beginnings of early agricultural communities.

Megaliths are distributed in different parts of India, particularly in South India, Central India, Eastern, and North-eastern India. The meaning and context of megaliths are very different and independent customs in different regions. The megaliths of South India are associated with black-and-red pottery and iron. Therefore, the megaliths of South India are datable to the Iron age. The megaliths found in Central India and Eastern India show living traditions with deep social memory. There is a morphological and functional difference between the megaliths of Central, Eastern India, and South India. The memory associated with tradition,

social and cultural beliefs, and practices are diverse (Mendaly, 2015; Marak and Jangkhomang, 2012; Shekhar *et al.*, 2014).

The Northeastern part of India occupies a prominent place on the archaeological map of the world due to its rich megalithic remains. In Northeast India, megaliths are distributed profusely and continued as a living tradition until contemporary times, with modifications among different tribes and societies. The megalith in this region has specific typological and functional classifications (Devi, 2017). Mills pointed out the glory and significance of the megaliths tradition of Assam –

“An Archaeological characteristic of Assam of worldwide fame is its wealth of megaliths. Indeed, it is one of the few places in the world where monuments of this type are still erected”
(Mills, 1933, p. 36).

An archaeological survey is undertaken in the present study area with an objective to understand the Megalithic tradition and its distribution, meaning, and association with the people of Digaru – Kolong river valley. The ethnographic data offered valuable information regarding peoples’ use of space and their belief about the burial practice and megaliths. The new data and some previous work in this region allow us to formulate a clear and specific sense of what the megalithic of this region looked like and how they were used, maintained, and abandoned.

5.5.1 Megalithism: Socio-cultural belief, memory, and continuity of Tradition

The states of Northeast India occupy a prominent place in the archaeology of India. Several tribal groups live with diverse cultural and religious beliefs. Some of the tribal groups of Northeast India still practice megaliths as a living tradition with some changes or modifications. The megalithic monuments are widely distributed along the length and breadth of different states of Northeast India. The Assam – Meghalaya borderland is mainly populated with Karbi and Tiwa tribes and a few others. The present study area of the Digaru – Kolong river valley in Assam – Meghalaya borderland is rich in archaeological evidence.

During the present exploration in the foothills of Meghalaya, the Megaliths are primarily located in the hilly region and low hill mounds, mainly near the Karbi and Tiwa villages (see Chapter 2). Some of them were protected by the villagers, whereas others were abandoned. The newly erected menhirs are usually installed near old megaliths sites, sometimes among

them also. The megaliths located in Tiwa village were primarily abandoned in the study area. These were mainly located at the hilltop in buried or scattered conditions in Meghalaya. To understand the present condition of these megaliths monuments and their socio-cultural association with these communities, we tried to understand their belief and memory of these monuments. There are different beliefs and concepts as well as the ownership regarding the megaliths monuments among these tribes. There are mainly three functions of megaliths that overlap in this region: worshipping the dead, celebrating heroes, and marking roads or boundaries—the meaning and shape of megaliths vary depending upon the localities and the people (Ramirez, 2014).

The Karbis of this region primarily believe that these structures belong to their ancestors. They still erect the memorial stones in memory of their dead ones, and they carry this tradition through oral memory or from their elder ones. They use the term *Long-e* for the menhirs and *Cheng-e* for the dolmens. The Menhirs are mainly observed outside of the village as well as nearby the habitational area. Several megaliths can easily be identified as recently constructed memorials. They erected commemorative stones as well for funerary purposes. These are mainly constructed with cement and brick; sometimes, they use a similar stone block as the earlier menhirs (Figure 5. 3). The name of the deceased one with their date of death is usually mentioned over the menhirs. The erecting of memorial stones varies or depends upon the various conditions. In the Karbi villages, commemorative memorials are in large numbers. In some villages, memorial stones for the person who died unnaturally (killed by animals or other accidents) are erected separately.

Figure 5. 3: Megaliths at Sukripara village



The association of megaliths with the Tiwa tribe is very different from the Karbi people in the present study area. The megaliths monuments at Tiwa village are located in the Silchang (Morigaon), Umswai (West Karbi Anglong) in Assam, and Umsiang in the Ri-Bhoi district of Meghalaya. They use the term 'orlong' for the megaliths, which means stone in the Tiwa language. Most of the locals of Tiwa village in the present study area do not consider the megaliths as part of their tradition. The conversion into Christianity of hill Tiwas is one of the primary reasons for cultural change. This also affects the social, religious, and lifestyle of people. The Christianised hill Tiwas are dominant over the non-Christianised Tiwa population, which is comparatively lesser. The concept of Christianization can understand the scenario of hill Tiwas and their cultural amalgamation or change. The Christianised tribal population started following the Christian way of prayer in the church or burying their dead as per the belief of Christianity. This may be the reason for abandoning the megalithic monuments or the practice. Although, if we look at the cultural transformation due to Christianity among the tribes of Northeast India and in the study area, it highlights how Christianity, in its localized form, developed a complex sense of cultural belonging and identity. Bhattacharya and Pachuau (2019) mentioned as:

“Most recent studies suggest that the history of Christianity in the colonies reveals a complex cultural dialogue. We know now that this history did not unravel in continuous time. As Christianity spread in the colonies, it was refigured by local cultures and local histories. Pre-existing local beliefs and practices defined what was accepted and rejected. Christian teachings were read through the grid of local beliefs, transforming its original ‘essence,’ bathing it in local colours, creating many ‘vernacular’ Christianities” (Bhattacharya and Pachuau, 2019, p. 14).

The Christianised hill Tiwas did not give up all the traditional beliefs and rituals. The religious and some other socio-cultural traits are now followed as per Christianity, but the concept of a tribal ideal is still prevalent among them. In Silchang village (Morigaon) and Bormorjong village (West Karbi Anglong) in Assam, locals considered megaliths as their heritage or as part of the culture. In both villages, the megaliths are protected and arranged in the manner of a King's court and seats for other nobles. In Bormorjong village, an anthropomorphic figure is inscribed on one menhir. Several menhirs are installed near the village road, village entrance, and weekly village market. These are identified as boundary or road marking megaliths. The menhirs around the village market are considered a place of ritual and political affairs (see Ramirez, 2014, Chapter 4).

The megaliths reported from other Tiwa villages have been found scattered and abandoned. In the Umsiang and Umswai region, most of the megalith monuments were abandoned in dense forests. Most of the locals in Umsiang (Ri-Bhoi) did not identify the megalith as part of their culture or traditions; neither did they claim ownership of these monuments.

5.5.2 Ethnographic Observations

The megalithic sites in Digaru – Kolong river valley of Assam – Meghalaya borderland have not yielded any chronological evidence. To understand the cultural status and chronology, excavating megalithic sites in this area is very difficult, as mostly these structures are considered living monuments and protected by the respective villagers. They associated their tradition and belief with those monuments and regarded them as their ancestors' memory. The present study area is culturally heterogeneous and does not match any single administrative unit. The new data collected from the field exploration and ethnography (unstructured interviews and observation method) and the results of previous works allow us to formulate a more detailed sense and present condition of the megaliths of Assam – Meghalaya borderland. This further helps us understand the social memory, tradition, and association of megaliths with the locals.

The informal interviews were informally conversation with locals to understand their thoughts and beliefs about megaliths and other archaeological artifacts. The conversation was initiated by focusing on the question mentioned above in the methodological section of this chapter. The discussion further helps to understand the several factors or reasons behind the change or continuity of the megaliths tradition.

The responses from locals were mixed. In Karbi villages, megaliths are mainly considered part of their tradition, which is still a living tradition. As mentioned above, they call Long-e for the menhirs and Cheng-e for the dolmens. Megaliths were found in abandoned conditions in some of the Karbi villages. They consider them their tradition, but now they do not practice anymore. There were very positive responses to the conservation of megaliths. In the Tiwa settlements of the present study area, the locals of Silchang village and Bormorjong village consider megaliths as their heritage. These are considered as King's thorns. They call megaliths '*Orlong*,' which means stone. The megaliths in other Tiwa settlements are mostly abandoned and scattered condition. Both Christianised Tiwa and the non-Christianised Tiwa do not consider megalithic as part of their tradition in most parts of the study area. It has

become challenging to document megaliths due to their buried and scattered condition. Only the boundary marker and the village market megaliths are in a standing condition. Several menhirs were reused for construction, roads, pillars, and other works. There was an inadequate positive response to conserve the megaliths from the Tiwa people.

In a conversation with a 70-year-old Karbi man in Teteliguri village, we noticed that they still practice the megaliths tradition. He said the old structures or menhirs were present before his birth and related to their clan or tribal community. He explains the process of erecting megaliths and rituals. The stones are selected chiefly from a nearby hill, as rocks are readily available in the hills. After selecting the stone to erect it at their place, there are several rituals in which they sing traditional songs or hymns and offer different objects such as betel nut and leaf. On the tenth day of installing the stone, they again perform rituals, among which the Purificatory ritual is essential. This is a family-confined ritual and is performed any time of the year when the family is willing to do it. This ritual is organized near the river or water source with reeds, hens, eggs, and bamboo baskets. They formed a structure with reed and pass through it, and water is sprinkled with hymn over the person while passing. Then they return to the burial place or the menhir place and offer rice, betel nut, and leaves to the deceased's soul.

The concept of *jia xil* and *mora xil* is also associated with megalith monuments. There is also a belief that only 'living stone' can be used for megalithic or memorial monuments. It was observed that 'living stone' regarded the un-weathered, uneroded stones. While the stones are fragile, light, and not fresh-looking, they considered them 'dead stones.' They believe that the living stone grows gradually, so the length of the menhirs increases after some years. Locals show us several megalith sites to show grown menhirs, like in Diksak village. Due to the deposited soil from the quarried hill and dense vegetation, the bottom part of the menhirs got buried, and a small top portion was visible. Once the area was cleaned or mounds were quarried, the length of the menhirs became more apparent, and people considered them a growing phenomenon. Other than their belief and traditions, megaliths also tell us about the socio-structure of the society and community. Since the selection of stone for the installation, male members of the society mainly participate in erecting the megaliths.

Another important observation was the **nature and type of the stone used for megaliths**. The stone used for megaliths in the present study area is undressed. Let us look at the type of stones used for megaliths in the neighboring region of Khasi hills, Shillong, and

Cherrapunjee. These are well-dressed stones, and secondary work was given to achieve a better shape and smoothness over the outer surface (Sharma, 2017). The locals in the present study area do not provide secondary work over the rock's surface; instead, they achieve an elongated shape to insert the structure into the earth. The tradition of megalithism is passed over from generation to generation with some modifications or changes; it shows both continuity and change in tradition. The change and the continuity of the megalithic tradition result from several factors mentioned above.

5.6 Concept of Artifact as a man-made object among locals

There are several beliefs and ideas associated with stone celts, mostly sacred and magical objects, among the locals of the study area. However, we cannot completely ignore the idea that some locals were aware of the concept and meaning of these artifacts. During interactions and interviews with the locals, we encountered several people who identified these artifacts as manufactured objects of the past. During the conversation with a local resident of Bagibari named Moon Talukdar, he and his family members identified stone axe and adze as prehistoric tools. Moon Talukdar had accidentally reported five polished stone celts in this farm during cleaning for cultivation.

Similarly, several locals at the Maiong, Sonapur, Dimoria, Jorabat, and other regions have identified the stone celts, potsherds, and megaliths as man-made objects. They considered these artifacts the importance of humankind's history and had a very positive approach to conserving them. A local informant at Bagibari states that *"these artifacts are our identity, and we should conserve them."* The approach to conservation and protecting the findspots are very prevalent among this group of people. As we have already mentioned, the menhirs were preserved in several villages. Several locals preserve the celts in their houses as past treasure and sometimes inform the local authorities for further research in their regions.

This awareness among the locals could be traced to modern education, as most informants in this group were young. However, several old informants did not have any modern school or university education; but had a proper understanding of these artifacts.

5.7 Ethnographic data and Archaeological findings: analysis and interpretation

The ethnographic data offers valuable information regarding the material cultural, socio-cultural beliefs, and man and environment relationships. The archaeological materials recovered from the study area indicate several hypotheses about the past culture and man-land relationship. Material culture refers to the material artifacts humans develop to improve their standing in their environment. The imperishable stone artifacts with few other materials are the only surviving materials of our ancient times for recreating our past. Although archaeological data have limitations, this could not speak enough about their identity, functions, or values unless the fragments of ancient culture, beliefs, and practices are seen or found in the life of contemporary societies in any form. Thus, in attempting to understand prehistoric society and culture, analyzing contemporary society and its socio-religious and cultural memory plays a crucial role. The present study area of Digaru – Kolong river valley is archaeologically affluent, and several find spots and artifacts have been recovered during this study (see Chapter 2). In addition to the artifacts recovered from the study area, the ethnographic survey helped to understand the day-to-day life, social, cultural, and religious aspects of the contemporary communities inhabiting the region. The contemporary socio-cultural beliefs and memory were analyzed with the archaeological artifacts to understand the past life of the region.

The insight into contemporary behavior helps to gain an idea about the ancient life pattern. Much ethnographic information suggests that some of the cultural traits are inherited from the descendants of prehistoric people. The settlement pattern of contemporary communities is mainly rural; households and other structures are mostly constructed using natural materials. The archaeological findings were located on the slopes, plains, and hilly terrain, similar to the contemporary patterns. Most of the houses and other shelters in the forest resemble Neolithic huts.

The local environmental factors further determine material culture and local technology. The iron tools used for cultivation and other activities in the present time are very similar to the shape of stone axe and adzes. These are mostly hoe, shouldered and tanged axe, and adzes. The hafting of iron tools could be understood for stone celts also. Bamboo, wood, and cane are the most frequently used raw materials for several activities. Bamboos are prevalent throughout the study area and are deep-rooted in their culture and tradition. The tools assemblage from the region indicates the subsistence of the society. Jhum or shifting

cultivation is still prevalent among the communities. The morphological analysis and illustration of rim sherds deduced the following utensils: pitcher, shallow bowl, deep bowl, lid, storage jar, and plate. Further, the utensils utilized by contemporary society show similar types.

The date of the sites based on the analyzed samples indicates very late for the Neolithic period (see Chapter 4). As already mentioned, the late date of these sites indicates the continuity of the Neolithic tradition. Ethnographic observation and data further help to formulate other possibilities regarding this. The study area has represented dynamicity in terms of culture and traditions. The Digaru – Kolong river valley region was never remote or untouched; it always had relation or contact with neighboring settlements. In context to the dates of the artifacts find out from this study, there is evidence of inscription writings, sculpture makings, and temple construction in and around the study area. Nazirakhat Archaeological site, located at Sonapur, showcases the ruins of temple and sculpture architecture and belongs to 11th – 12th c. CE. However, the present research suggests the parallel existence of late medieval art and architecture and the Neolithic way of life.

There are several beliefs associated with the stone artifacts, and due to this, they still preserve these artifacts. Locals utilized celts for various purposes such as fortune or luck, medicinal use, security from various evil things, and ancestors' antiquity. It would be possible that people had this belief associated with artifacts long back, and they stored them for the same. The use of iron tools has been found in several regions of Northeast India and nearby sites during the time frame of the Digaru – Kolong river valley region (see Mitri and Neog, 2016; Tzudir *et al.*, 2019). This further indicates that people would be aware of iron in this region or nearby areas.

5.8 Discussion

In attempting to understand the past culture of the region, archaeological and ethnographic sources play a crucial role. The combination of archaeology (studying the material remains) and ethnography (study of present culture) is a holistic approach that studies the living communities from the point of view of archaeological material remains (Raut, 2001). The ethnographic study helps in every possible way to make non-living artifacts speak. The present chapter has been an attempt to understand the socio-cultural beliefs, memory, and ideas of the communities inhabiting the present study area. As we have already discussed, the

locals have defined archaeological artifacts differently. The archaeological records reported, such as stone tools, potsherds, and megaliths, are connected with several myths and beliefs among locals. The concept and meaning of these artifacts are not confined to the study area, as it is prevalent all across the globe (mentioned above). Humans describe or associate these monuments with several myths and stories that travel from generation to generation and are deeply rooted in their socio-cultural memory.

The concept of 'thunderstone' is prevalent all across the globe as well in the present study area. Several myths and beliefs are associated with celts and used for several purposes such as medicinal, magical cult, and object of fortune. However, many people were aware that these objects were man-made and used by past societies. Among these, the locals mainly defined potsherds as man-made objects without any mythical beliefs. Megaliths monuments were another significant remaining located all around the study area. These structures are associated with several tribes of Northeast India. In the present study area, megaliths were mainly associated with Karbis. However, megalith structures were located in the Tiwa settlements, but Tiwas do not consider them part of their culture. Further, this indicates that Tiwas might have followed megalithism during ancient times. Other possibilities would be that these regions might have been populated with the Karbis or the communities that follow the megalithism.

Another fascinating observation was the living tradition of megaliths among the Karbis with some changes or modifications. Human society experiences changes in different domains from time to time. Various sociologists and anthropologists have understood the concept of change in culture, tradition, modification, or continuity of traditions regarding development, modernization, westernization, universalization, social development, and great and small traditions. The change in tradition varies for several reasons. People may change their ways in response to perceived problems or contact other people, introducing foreign ideas, leading to changes in existing values and behavior. However, not all change is adaptive. The change mechanism depends on several factors such as innovation, cultural loss, diffusion, and acculturation (Haviland, 1975).

The ethnographic study helped us understand the life pattern of the present society living in the study area. The day-to-day life, settlements, subsistence, material culture, and other contemporary traits indicate or refer to good agreement with the archaeological findings. The archaeological sites and materials remain primarily located on the slopes, hills, and forests,

similar to the present settlements. The mode of subsistence, such as local technology and other modes of product procurement, were similar, which further shows an extension of past culture. Megalithism is one of the best examples of continuing or surviving past elements among the locals.

The settlement and subsistence pattern above indicates that the communities lived the Neolithic lifestyle. Although the similarity with the Neolithic pattern does not assign these contemporary settlements as Neolithic villages, instead, the current lifestyle of the people has some common elements or continuity with the Neolithic way of life. Roy (1981) studied the modern agricultural pattern of the Garo Hills and investigated the past agrarian system. He pointed out the relationship as "Chronologically the culture under study is modern but economically Neolithic" (Roy, 1981, p.193). The archaeological records and ethnographic results suggest that the people inhabiting the area practiced the agricultural economy.

The concept and beliefs associated with artifacts further help understand the traits of past cultural elements among the locals. Stone celts are mainly understood as 'charms' and believed to fall from the sky during thunder strikes, also used as a medicinal object. The identical beliefs might have existed thousands of years ago. The life pattern of contemporary communities within the study area indicates a borrowing from the very early stage. So, it is evident that in a region like Northeast India, where tradition persists, many ancient tool types may continue in unadulterated forms.

Chapter – 6

Conclusion

This chapter concludes the study by summarizing the key research findings in relation to the research aims and questions and the value and contribution thereof.

This thesis is about the ground and polished celts and pottery found together with menhirs and dolmens in the eastern boundary of the present city of Guwahati, which is the principal city of Northeast India. The area lies between the foothills of the Meghalaya plateau and the river Brahmaputra. In the thesis, the study area is referred to as the Digaru – Kolong river valley. The Digaru river originates in the Khasi Hills and debauches into the Kolong river, and the Kolong river originates in the Karbi hills and debauches into the Kopili river in the Nagaon district. The Kopili is a significant tributary of the Brahmaputra river. Besides these two main rivers, there are many first-order and second-order streams in the region, making the drainage dendritic. In this type of drainage system, the deposits are continuously recycled, which increases the fertility of the soil.

There are also abandoned beds of rivers or river terraces which are created sporadically in the region due to local weather conditions during different time periods. Due to high rainfall in the hills, the sediment load of the rivers might increase in certain periods of time, and due to less rainfall, the river might lose its capacity to carry the sediments further down in one particular year. Rounded top low hillocks or river terraces occur more densely near the foothills of the Meghalaya plateau, which can result from landslips or may have been deposited by the river immediately after it reached the plains. They become sporadic further downstream when the valley widens as it reaches the banks of the Brahmaputra river. The present-day villages are on these rounded top low hillocks. The top layers of many of these terraces have been removed, and these have been either converted to homestead land or agricultural fields. During the removal of the top layers, villagers have reported finding ground and polished celts and pottery. In some places, the density of pottery is very high. Potsherds recovered from the cross-section exposed at Marakdola and Shankargog were 1 to 1.5 meters of deposition. The deposition of pottery exposed at Bagibari and Chenimur was very high and thick. The pottery in the buried context recovered from test pits at Marakdola, Shankargog, and Bagibari also has a high density from the top layer to the mid-depth of the pits.

Menhirs and Dolmens are also found in the southern side of the study area in association with the pottery and ground and polished stone tools. These are, on average, 4 ft tall with an associated sitting stone. Erecting menhirs in the memory of the dead is a living tradition in the area. However, the modern menhirs are smaller in size, roughly hewn, without the sitting stone. In contrast, the menhirs and dolmens associated with the ground and polished celts and pottery are comparatively large dressed stones. The menhirs at Marakdola are an average height of 4ft; however, the tallest menhir is 8ft high. Similarly, the average height of menhirs at Khamar, Teteliguri, Diksak, Kraikijam, and Tegheria varies from 4 to 5ft tall. The average height of modern menhirs at Chenimur, Sukuripara, Batakuch, Barkuchi, Taloni, Bhogpur, Dakhin Topatoli, and Lymphuid are 2ft tall.

The main objective of the thesis was to establish the archaeological potential of the area. Following the press reports of sporadic finds of stone tools and pottery, an attempt was made to find out if there are archaeological sites in the region besides Sarutaru and Marakdola, the two already reported sites. A planned archaeological exploration undertaken in the area for three field seasons resulted in the discovery of nine new sites while Sarutaru could never be located. The Marakdola site reported by S.N Rao in 1971 was located and further investigated.

The study began by asking the question if this area was a continuous habitation zone and had similar developments like the Dima Hasao district and Khasi-Jaintia hills during the period starting from 3000 BP to approximately 1000 BP. The AMS dates available from the site clearly deny this. It was not a continuous habitation zone, but as per the study, human settlements began here approximately 1000 years before the present.

In Northeast India, till now, almost all the evidences of the ground and polished celts have come from the hills, and it was understood that people using these tools in Northeast India adapted to a highland region only. In 1988 for the first time in Northeast India, Prof. P.C. Saikia from Dibrugarh University (Saikia, 1988) reported ground and polished celts from a valley region, the Dibru – Saikhowa Valley, and now the findings of this thesis in the Digaru – Kolong river valley establishes the fact that people using these tools lives in the valley regions of Northeast India too.

Seventeen AMS dates from the study area give us a time frame of the archaeological evidence starting from 1141 B.P. to 585 B.P. The data we are handling was developed in 556

years. The earliest date of the sediment samples from the sites is 1805 B.P. These sediment samples were collected from a depth of half a meter or slightly less than a meter. The average height of an entire terrace section in the area is 35 to 40 meters, of which almost 30 meters on average have already been removed. In the remaining 5 meters at a depth of 45 to 50 cms, pottery and tools are found. Thus, the cultural layer is sitting on a deposit of at least 4 meters which was formed approximately 2000 years before the present.

During that period, there was much happening in the surrounding areas. In Daojali Hading, about 150kms south of the site, approximately 3000 years ago, people were using stone querns and pestles, making tools of jadeite, a semi-precious stone (Goswami and Sharma, 1963; Sharma and Singh, 2017). In Lawlongthroh, 50 km south of the site, approximately 3500 years before the present, people were weaving, using iron fish hooks, eating domesticated varieties of cereals like *Oryza* sp. (cf. *Officinalis*), *Ziziphus* sp. (jujube), *Embllica officinalis* (Indian gooseberry), *Coix* sp. (locally called sohriew), and *Echinochloa* sp. (foxtail millet) (Mitri *et al.*, 2015; Mitri and Neog, 2015). In Cherrapunjee, people were smelting iron and making iron tools approximately 2000 years ago (Prokop and Suliga, 2013).

In the immediate vicinity of the area, there was a growth of an urban way of life. The evidence of the Ambari excavation site speaks of a flourishing atelier of the craftsman (Ansari and Dhavalikar, 1970; Dhavalikar, 1973) of the ancient state of Kamarupa that had developed into a stable polity. A complete genealogy of kings starting from c.350 C.E. to c.1255 C.E. is available. Almost twenty-four inscriptions provide an epigraphical record of the formation of a polity. These grants speak of land donations, horse sacrifice, paddy cultivation, and temple construction. There was habitation in the Brahmaputra Valley, strong royal power, an education system, and an economy based on agriculture and trade (Barpujari, 1990). Using Sanskrit, the eastern variety of the Gupta Alphabet, the eastern variety of the Brahmi script, eastern variety of the North Indian alphabet of the 9th-century inscriptions were written by kings. In the Digaru-Kolong river valley, too, the evidences of the period are found. In a site called Nazirakhat, there are sculptures and ruins of a stone temple dated to 1100 CE (Protected archaeological site and Monuments, Directorate of Archaeology, Govt. of Assam). At Hatisila, sculptures and a rock inscription dated to the 10th century CE are found.

With all this activity happening in the surroundings and also in the Digaru – Kolong river valley in the approximately 500 years under study, a group of people lived for whom the ground and polished stone celts were still relevant. They used pottery, erected megaliths, and perhaps practiced shifting cultivation. Iron tools were available. In Ambari, iron chisels have been found. Iron dowels were used in the temples dated to the 10th to 12th century CE in and around Guwahati city. Iron was also found in Lawlongthroh (Mitri and Neog, 2016). The question then is, were these people using stone axes and chisels when people in the same area were using iron tools? From the ethnographic data, now it is known that they are understood as “charms” by some people. They are also part of the village medicine men’s kitty. People in the area largely believe they fall from the sky when thunder strikes. Can we also infer that similar beliefs prevailed one thousand years ago? As an archaeological record, they occur sporadically. They are finely distributed across the valley dotted with menhirs, dolmens, and pottery.

The occurrence of the menhirs and pottery during the time period can be explained, but the occurrence of the ground and polished celts is an intriguing fact. The data collected, analyzed, and studied here is unable to explain this occurrence.

Continuity of certain cultural traits is a common occurrence. In many Indian homes today, the stone mortar and pestle or stone grinder exist together with iPhones, high-end computers, and other advanced electronic gadgets. Continuity unites the past, present, and future. Since human action is based on cognition, it is inevitable that decisions as to causal linkages will be grounded in and bounded by past knowledge and current perception. Continuity is defined as a phenomenon that is real (Smith, 1982). The past is often “repeated.” Of a cultural complex major part of it might be replaced, while some traits might survive and travel in time like the mortar and pestle, a Neolithic cultural trait found in the present. The ground and polished celts found in the study area had also travelled in time. They may not be able to tell us much about the lifeways of the people of that period to which they have been dated. The present population of the area has an esoteric connection to these tools. We can conclude by continuing the enigma and defining them as “Bajra Pathar” or thunderstones only. The hands which grinded them, polished them, and shaped them as Neolithic celts have become too remote in the area where they are contesting for recognition as archaeological evidence with a script, iron tools, sculptures, nagara temples, copper plate inscriptions, etc. The thesis humbly

submits and ends with a question “Why do we find Neolithic celts in the Digaru-Kolong river valley in a strata dated to the 10th century AD”?



Bibliography

- Adam, R. (1965). *Land Behind Baghdad: A History of Settlement on the Divale Plains*. Chicago: University of Chicago.
- Agarwal, K. (1996). *Biodiversity*. Agra: Botanical Publishers.
- Agarwal, M. (1994). Geomorphology and Environmental Management of Umiam Basin East Hills, Meghalaya. *Unpublished doctoral dissertation submitted to North-Eastern Hill University*. Shillong.
- Agrawal, D. (1982). *The Archaeology of India*. London: Curzon Press.
- Agrawal, D., & Yadava, M. (1995). *Dating the Human Past*. Pune: Indian Society for Prehistory and Quaternary Studies.
- Ahsan, S. K. (1993). A Study of Palaeolithic site formation processes in subhumid environment of Centra India with special reference to Samnapur paleolithic site Madhya Pradesh. *Unpublished doctoral dissertation submitted to Savitribai Phule Pune University*. Pune.
- Algaze, G. (1989). A New Frontier: First Results of the Tigris-Euphrates Archaeological Reconnaissance Project. *Journal of Near Eastern Studies*, 48, 241-281.
- Allchin, F., & Allchin, B. (1968). *Birth of Indian Civilization: India and Pakistan before 500 B.C*. Harmondsworth: Penguin Books.
- Allen, B. (1905-06). *Assam District Gazetteers Volume IV Kamrup*. Allahabad: Pioneer Press.
- Allen, B. (1906). *Assam District Gazetteers Volume X The Khasi and Jaintia Hills, The Garo Hills and the Lushai Hills*. Allahabad: Pioneer Press.
- Anderson, J. (1871). The Stone implements of Yunnan with a notice of bronze axe-like weapon from the Sundra valley. *Expedition to Western Yunnan via BHAMO*, (pp. 410-415). Culcutta.
- Andrefsky Jr, W. (2005). *Lithics Macroscopic Approaches to Analysis*. Cambridge: Cambridge University Press.
- Annamalai, G., Ravisankar, R., Rajalakshmi, A., Chadrasekara, A., & Rajan , K. (2014). Spectroscopic characterization of recently excavated archaeological potsherds from Tamilnadu, India with multi-analytical approach. *Spectrochimica Acta Part A: Molecular and Bimolecular Spectroscopy*, 133, 112-118.
- Ansari, Z., & Dhavalikar, M. (1970). Excavations at Ambari (Gauhati). *Journal of the University of Poona*, 30, 79-97.

- Ashmore, W., & Willey, G. R. (1981). A Historical Introduction to the Study of Lowland Maya Settlement Patterns. In W. Ashmore, *Lowland Maya Settlement Patterns* (pp. 3-18). Albuquerque: University of New Mexico Press.
- Ashraf, A. (1990). *Prehistoric Arunachal: A Study on Prehistory and Ethnoarchaeology of Kamla Valley*. Itanagar: Directorate of Research, Government of Arunachal Pradesh.
- Ashraf, A. (2004). Stone Age Tradition of Meghalaya: A Study of Variation and Continuity. *Unpublished doctoral dissertation submitted to Gauhati University*. Guwahati.
- Ashraf, A. (2011). On the Discovery of Prehistoric Sites in Northeast India. In T. Baruah, *People of Contemporary Northeast India* (pp. 268-79). Guwahati: Pratisruti Publishers.
- Balme, J., & Paterson, A. (2006). *Archaeology in Practice A Student Guide to Archaeological Analysis*. Oxford: Blackwell Publishing.
- Banning, E. B. (2000). *The Archaeologist's Laboratory: The Analysis of Archaeological Evidence*. USA: Springer, University of California.
- Barpujari, H. (1990). *The Comprehensive History of Assam: from the pre-historic times to the twelfth century A.D.* Guwahati: Guwahati Publication Bord.
- Barua, K. (1939). Prehistoric Culture of Assam. *Journal of the Assam Research Society*, 7(2), 35-41.
- Bezbaruah, D. (2003). Megalithic Ruins in Karbi Anglong District of Assam: A Study in the Context of Karbi Culture. *Unpublished doctoral dissertation submitted to Gauhati University*. Guwahati.
- Bhan, S. (1977). The Protohistoric settlement pattern in Harayana. *The Indus Civilization: problem and issues*. Simla.
- Bhattacharya, D. K. (1991). *An outline of Indian Prehistory*. New Delhi : Palaka Prakashan.
- Bhattacharya, N., & Pachuau, J. L. (2019). *Landscape, Culture, and Belonging: Writing the History of Northeast India*. Cambridge: Cambridge University Press.
- Binford, L. (1980). Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement System and Archaeological Site Formation. *American Antiquity*, 45(1), 4-20.
- Bora, B. (2012-13). Ceramic Neolithic of Northeast India with special reference to Daojali Hading. *Bulletin of the Department of Anthropology, Gauhati University*, XIV, 92-104.
- Bordoloi, B. N., Thakur, G. S., & Saikia, M. C. (1987). *Tribes of Assam, Part - I*. Guwahati: Tribal Research Institute.

- Bordoloi, L. (2016). Traditional Socio-Political Institutions of the Tiwas. *Journal of Humanities and Social Science*, 21(4), 1-05.
- Brown, C. (1917). Catalogue of Prehistoric Antiquities in Indian Museum. 130-33. Calcutta.
- Butzer, K. (1982). *Archaeology as Human Ecology: Method and Theory for a Contextual Approach*. Cambridge: Cambridge University Press.
- Cameron, C. M., & Tomka, S. A. (Eds.). (1993). *Abandonment of settlements and regions Ethnoarchaeological and archaeological approaches*. Cambridge: Cambridge University Press.
- Campton, R. R. (1985). *Geology in the Field*. New York, USA: John Wiley & Sons.
- Chang, K. (1968). *Settlement Pattern in Archaeology A Note*. Addison Wesley Modular Publication U.S.A.
- Chapman, H. (2006). *Landscape Archaeology and GIS*. Gloucestershire: The History Press.
- Chauhan, P. (2008). Large Mammal Fossil Occurrences and Associated Archaeological Evidence in Pleistocene Contexts of Peninsular India and Sri Lanka. *Quaternary International*, 192, 20-42.
- Childe, V. (1951). *Man Makes Himself*. New York: The New American Library.
- Chitalwala, Y. (1977). Harappan settlement patterns in Gujrat. In B. P. D.P. Agrawal, *Archaeology and Ecology of western India* (pp. 93-98). Delhi: Concept Publishing co.
- Chitalwala, Y. (1982). Harappan settlement in the Kutch-Saurashtra region: patterns of distribution and routes of communication. In G. Possehl, *Harappan Civilization: A Contemporary Perspective* (pp. 197-204). New Delhi.
- Choudhury, K. (2004). The Megaliths and Their Associated Remains in Dimoria Area of Kamrup District, Assam. *Unpublished doctoral dissertation submitted to Gauhati University*. Guwahati.
- Choudhury, P. (1944). Neolithic Culture of Kamrupa. *Journal of the Assam Research Society*, 11(1-2), 41-47.
- Cockburn, J. (1879). Stone implements from the Khasi Hills. *Journal of Asiatic Society of Bengal*, 1(48), 133-137.
- Connell, O. J. (1995). Ethnoarchaeology Needs a General Theory of Behavior. *Journal of Archaeological Research*, 3(3), 205-255.
- Corbetta, P. (2003). *Social Research Theory, Methods and Techniques*. New Delhi: Sage Publications India Pvt. Ltd.
- Dani, A. (1960). *Prehistory and Protohistory of Eastern India*. Calcutta: Firma L. Mukhopadhyay.

- Dasgupta, H. (1913). On two shouldered stone implements from Assam. *Journal of Asiatic Society of Bengal*, 9, 291-293.
- Deka, R. (2015). The Ground Lithic Artifacts and Spatial Variation: A Study Based on Collection from Northeast India. *Unpublished doctoral dissertation submitted to Gauhati University*. Guwahati.
- Devi, L. (1968). *The Ahom Tribal Relations*. Guwahati: Lawyers Book Stall.
- Devi, P. (2017). Concepts of Megaliths in 21st Archaeology of India. *Sociology & Anthropology*, 5(9), 719-731.
- Dhavalikar, M. (1973). Archaeology of Gauhati. *Bulletin of the Deccan College Post-Graduate and Research Institute*, 31(2), 137-49.
- Dhavalikar, M., & Posshel, G. (1974). Pattern of Early Farming Community in Western India. *Puratattva*, 7, 39-46.
- Dikshit, K. (1979). The Late Harappan Cultures in India. In D. A. Chakrabarti, *Essays in Indian Protohistoric* (pp. 123-133). Delhi: B.R. Publishing Corporation.
- Dikshit, K., & Hazarika, M. (2012). The Neolithic Cultures of Northeast India and Adjoining Regions: A Comparative Study. *Journal of Indian Ocean Archaeology*, 7, 98-148.
- Duarah, A. G. (2014). Survival of Prehistoric Traditions in the Foothills Region of Southern Assam with Reference to its Highland Counterpart. *Unpublished doctoral dissertation submitted to Gauhati University*. Gauhati.
- Dutta, S. (2002). A Structural Study of the Precambrian Rocks around Hajo and Sualkuchi Kamrup District, Assam. *Unpublished doctoral dissertation submitted to Gauhati University*. Guwahati.
- Ellis, L. (2006). Ceramics. In J. Balme, & A. Paterson, *Archaeology in Practice: A Student Guide to Archaeological Analyses* (pp. 235-259). Oxford: Blackwell Publishing.
- Fitting, J. (1969). Settlement Analysis in the Great Lake Region. *Southwestern Journal of Anthropology*, 25, 360-377.
- Flemming, A. (1971). Territorial Pattern in Bronzew Age Wesssex. *Proceedings of the Prehistoric Society*, 37, pp. 136-166.
- Friesem, D. E., Lavi, N., Madella, M., Ajithprasad, P., & French, C. (2016). Site Formation Process and Hunter-Gatherers Use of Space in a Tropical Environment: A Geo-Ethnoarchaeological Approach from South India. *Plos One*, 1-30.
- Gabel, W. C. (1958). European Secondary Neolithic Culture A Study of Prehistoric Culture Contact. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, 88(1), 97-107.

- Gardner, G. (1942). British Charms, Amulets and Talismans. *Folklore*, 53(2), 95-103.
- Geological Survey of India (GSI). (2009). Geology and Mineral Resources of Assam. *Geological Survey of India Miscellaneous Publication no. 30, part iv, vol. 2(i) Assam*. Guwahati: Government of India.
- Gifford, D. (1980). Ethno-archaeological Contribution to the Taphonomy of Human Sites. In A. Behrensmeyer, & A. Hill, *Fossils in Making: Vertebrate Taphonomy and Palaeoecology*. Chicago: University of Chicago Press.
- Gladfelter, B. G. (1977). Geoarchaeology: The Geomorphologist and Archaeology. *American Antiquity*, 42(4), 519-538.
- Godwin Austin, H. (1875). A celt found at the Khasi Hills Shillong. *Journal of Asiatic Society of Bengal*, 158-159.
- Goldberg, P., & Macphail, R. (2006). *Practical and Theoretical Geoarchaeology*. Oxford: Blackwell.
- Goswami, M., & Bhagabati, A. (1959). A Preliminary Report on a Collection of Neolithic Tools from Western Assam. *Man in India*, 39(1), 312-24.
- Goswami, M., & Sharma, T. (1963). A Brief Report on the Investigation into Prehistoric Archaeology in the N.C. Hills. *Journal of the Gauhati University*, 13(2), 63-66.
- Gould, R. A. (1974). Some current problems in ethnoarchaeology. In C. B. Donnan, & William C Clewlow jr, *Ethnoarchaeology* (pp. 29-48). Los Angeles: University of California.
- Grant, J., Gorin, S., & Fleming, N. (2005). *The Archaeology Course Book An Introduction to Study Skills, Topics and Methods*. Oxon: Routledge.
- Grierson, G. (1967). *Linguistic Survey of India*. Calcutta: Superintendent Government Printing India.
- Gupta, A. B. (1977). Geology of Assam-Arakan Region. *The Quaternary Journal of the Geological, Mining and Metallurgical Society of India*, 49, 1-54.
- Gupta, A. D., & Biswas, A. (2000). *Geology of Assam*. Bangalore: Geological Survey of India.
- Harris, W., & White, N. (2007). X-ray Diffraction Techniques for Soil Mineral Identification. In *Methods of Soil Analysis Part 5 Mineralogical Methods* (Vol. 5, pp. 1-36). Madison: SSSA Book.
- Hassan, F. A. (1978). Sediments in Archaeology: Methods and Implications for Paleoenvironment and Cultural Analysis. *Journal of Field Archaeology*, 5(2), 197-213.

- Haviland, A. W. (1975). *Cultural Anthropology*. Harcourt Brace & Company, Fort Worth.
- Hazarika, M. (2006). Neolithic Culture of Northeast India: A Recent Perspective on the Origins of Pottery and Agriculture. *Ancient Asia Journal of the Society of South Asian Archaeology*, 25-43.
- Hazarika, M. (2012). Lithic Industries with Palaeolithic Elements in Northeast India. *Quaternary International*, 269, 48-58.
- Hazarika, M. (2013). Cord-impressed Pottery in Neolithic-Chalcolithic Context of Eastern India. In K. Dikshit, *Neolithic-Chalcolithic Cultures of Eastern India* (pp. 78-110). New Delhi: Indian Archaeological Society.
- Hazarika, M. (2017). *Prehistory and Archaeology of Northeast India Multidisciplinary Investigation in an Archaeological Terra Incognita*. New Delhi: Oxford University Press.
- Hutton, J. (1928). Prehistory of Assam. *Man in India*, 8(4), 228-32.
- Indian Archaeology: A Review (IAR). (1965-66,1967,1979-80,1981-82,1985-86). New Delhi: Archaeological Survey of India.
- Indra Gandhi National Centre For the Arts. (2015). *The Rock Art Sites of Brahmaputra Valley in Western Assam, Assam*. New Delhi: IGNCA, New Delhi.
- Isaac, G. (1967). Towards the Interpretation of Occupation Debris: Some experiments and observations. *Kroeber Anthropological Society*, 37, 31-57.
- Johnson, M. (2002). *Archaeological Theory An Introduction*. Oxford: Blackwell Publishers Ltd.
- Jones, G. (1961). Settlement Pattern in Anglo-Saxon, England. *Antiquity*, 35, 221-232.
- Joukowsky, M. (1980). *A Complete Manual of Field Archaeology: Tools and Techniques of Field Work for Archaeologists*. New Jersey: Prentice Hall Inc.
- Knudson, S. (1978). *Culture in Retrospect*. Chicago: Rand M.C. Nally College, Publishing Company.
- Kohl, P., & Heskell, D. (1980). Archaeological Reconnaissance in the DarrehGaz Plain: A Short Report. *British Institute of Persian Studies*, 18, 160-172.
- Krishnaswami, V. (1962). The Neolithic Patterns of India. *Ancient India*, 16, 25-64.
- Kumar, R. (2005). *Research Methodology A step by step guide for beginners*. Pearson.
- Lahiri, N. (1991). *Pre-Ahom Assam: Studies in the Inscriptions of Assam between the Fifth and the Thirteenth Centuries AD*. New Delhi: Munshiram Manoharlal Publishers Pvt Ltd.

- Lal, M. (1985). The Settlement Pattern of the Painted Grey Ware culture in the Ganga valley. In V. M. Bellwood, *Recent Advances in Indo-Pacific Prehistory* (pp. 373-379). Leiden: E.J. Brill.
- Leach, M. (1972). Flint. In M. Leach, *Funk and Wagnalls Standard Dictionary of Folklore, Mythology, and Legend* (pp. 394-5). New York: HarperCollins.
- Lincoln, D. (2011). *The Sage Handbook of Qualitative Research*. USA: Sage Publications.
- Liritzis, L. (1994). Archaeometry: Dating the Past. *Ekistic*, 61(368-369).
- Luccock, J. (1867). The Stone Age of Assam. *Athenaeum*(2069), 822.
- Manyatis, Y., & Tite, M. (1975). Examination of ancient pottery using the scanning electron microscope. *Nature*, 257, 122-23.
- Marak, Q. (2012). Megaliths, types and its living traditions among the Jaintias of Northeastern India. *Journal of Indo-Pacific Archaeology*, 32, 45-53.
- Marak, Q., & Jangkhomang. (2012). Matriliney and the megalithic practices of the Jaintias of Meghalaya. *Indian Anthropologist*, 42(9), 67-82.
- Maswood, M. (1973). Geology of the Precambrian Rocks around Gauhati. *Unpublished doctoral dissertation submitted to Gauhati University*. Guwahati.
- McCarter, S. F. (2007). *Neolithic*. New York: Routledge Taylor & Francis Group.
- McNee, R. (1955). On the Value of Sketch maps. *The Journal of Geography*, 54(8), 416-417.
- Medhi, B. (1991). Glimpses of Village and House Types of the Karbis. *Journal of North-East India Council for Social Science Research*, 15(2), 8-10.
- Medhi, D. (1990). Prehistory of Assam. *Asian Perspectives*, 29(1), 37-44.
- Medlicott, H. (1875). A short hatchet from Dibrugarh, upper Assam, Proceedings of the Asiatic Society of Bengal. *Proceedings of the Asiatic Society of Bengal*, (p. 159).
- Mehrotra, S., & Golani, P. (1988). *Report on Systematic Geological Mapping in Parts of Kamrup District, Assam and East and West Khasi Hills District, Meghalaya Progress Report for the Field Season 1984-85*. Geological Survey of India. Government of India.
- Mendaly, S. (2015). A Study of Living Megalithic Tradition Among the Gond Tribes, District Nuaparha Odisha. *Ancient Asia*, 6(9), 1-6.
- Mills, J. (1933). Assam as a field for research. *Journal Assam Research Society*, 1(1), 3-6.
- Mishra, S., Abbas, S., Naik, R., Sonali, Shete, Gurudas, . . . Rajaguru, S. (2009). Excavations at the Early Acheulian site of Morgaon, Maharashtra (2000-2007). In K. Paddayya, K.

- Joglekar, P. Basa, K. Sawant, & Reshma, *Recent Research Trends in South Asian Archaeology*. Pune: Deccan College Postgraduate and Research Institute.
- Mitri, M. (2005). A Report on the Neolithic Tools from Sohpet Bneng Hill of Ri-Bhoi District in Meghalaya (An Ethno archaeological Study). *Proceedings of the North East India History Association*, 26, pp. 87-95.
- Mitri, M. (2008). Archaeological Investigation in the Khasi and Jaintia Hills: A Study on the Distribution Patterns of Neolithic Sites (An Ethno-archaeological Approach). *Unpublished doctoral dissertation submitted to The North Eastern Hill University*. Shillong.
- Mitri, M. (2009). *An Outline of the Neolithic Culture of the Khasi-Jaintia Hills of Meghalaya, India: An Archaeological Investigation*. Oxford: BAR International Series 2013.
- Mitri, M., & Neog, D. (2016). Preliminary Report on the Excavation of Neolithic sites from Khasi Hills Meghalaya. *Ancient Asia*, 7(7), 1-17.
- Mitri, M., Jamir, T., Mepusangba, Syiemlieh, H., Darnei, L., Thakuria, T., & Kharpuri, L. (2022). Recent research on the stone jars of Northeast India: Evidence from East Jaintia Hills of Meghalaya. *Archaeological Research in Asia*, 31.
- Mitri, M., Kharmawphlang, D., & Syiemlieh, H. (2015). A Preliminary Report on the Excavation of the Neolithic Site at Law-Nongthroh (SohpetBneng Hill), Khasi Hills, Meghalaya. *Man and Environment*, 40(1), 33-42.
- Mughal, M. (1982). Recent archaeological research in the Cholistan Desert. In G. Possehl, *Harappan Civilization* (pp. 86-95). New Delhi: Oxford and IBH.
- Naidoo, L. (2012). Ethnography: An Introduction to Definition and Method. In L. Naidoo, *An Ethnography of Global Landscapes and Corridors* (pp. 1-8). Croatia: Intech.
- Narasimhaiah, B. (1980). *Neolithic and Megalithic Cultures in Tamil Nadu*. Delhi: Sandeep Prakashan.
- Odell, G. H. (1996). *Stone Tools: Theoretical Insights into Human Prehistory*. US: Springer.
- Orton, C., Tyers, P., & Vince, A. (1993). *Pottery in Archaeology*. Cambridge: Cambridge University Press.
- Oswalt, W. (1974). Ethnoarchaeology. In C. Donnan, & C. Clewlow, *Ethnoarchaeology Monograph IV, Institute of Archaeology*. UCLA.
- Paama, L., Pitkanaen, I., & Peramaki, P. (2000). Analysis of archaeological samples and local clays using ICP-AES, TG-DTG and FTER techniques. *Talanta*, 51, 349-357.
- Paddayya, K. (1982). *The Acheulian Culture of Hunsgi Valley (Peninsular India): A Settlement System Perspective*. Pune: Deccan College.

- Paddayya, K. (1985). The Acheulian Culture of the Hunsgi Valley, South India: Settlement and Subsistence Patterns. In V. Mishra, & P. Bellwood, *Recent Advances in Indo-Pacific Prehistory* (pp. 59-64). New Delhi: Oxford and IBH Publishing Co.
- Paddayya, K. (1987). The Place of the Study of Site Formation Process in Prehistoric Research in India. *Natural Formation Process and the Archaeological Record*, 352-385.
- Paddayya, K., & Petraglia, M. (1993). Formation Processes of Acheulean Localities in the Hunsgi and Baichbal Valleys, Peninsular India. In P. Goldberg, D. Nash, & M. Petraglia, *Formation Process in Archaeological Context* (pp. 61-82). Madison: Prehistory Press.
- Pal, J. (2007-08). The Early Farming Culture of the Middle Ganga Plain with Special Reference to the Excavations at Jhusi and Hetapatti. *Pragdhara*, 18, 263-281.
- Pandey, V. (2015). Harrapan Archaeology of North-West India: A study based on Settlement Pattern in Haryana. *Unpublished doctoral dissertation submitted to Banaras Hindu University*. Varanasi.
- Papachristodoulou, C., Oikonomou, A., Loannides, K., & Gravani, K. (2006). A Study of ancient pottery by means of X-ray fluorescence spectroscopy, multivariate statistics and mineralogical analysis. *Analytica Chimica Acta*, 573-574.
- Pappu, S. (1996). *Pleistocene Environments and Stone Age Adaptations in the Kortallayar Basin, Tamil Nadu*. Pune: University of Pune.
- Parcak, S. H. (2009). *Satellite Remote Sensing for Archaeology*. Oxon: Routledge.
- Peregrine, P. N. (2017). *Archaeological Research A Brief Introduction* (2 ed.). New York: Taylor & Francis Group.
- Persons, J. R. (1972). Archaeological Settlement Patterns. *Annual Review of Anthropology*, 1, 127-150.
- Piggott, S. (1954). *The Neolithic Cultures of the British Isles A Study of the Stone-using Agricultural Communities of Britain in the Second Millennium B.C.* Cambridge: Cambridge University Press.
- Piper, C. (1942). *Soil and Plant Analysis*. New Delhi: Scientific Publishers.
- Prokop, P., & Suliga, I. (2013). Two thousand years of iron smelting in the Khasi Hills, Meghalaya, North East India. *Current Science*, 104(6), 761-768.
- Raktim, P. (2018). The Tiwa an Ethnohistory. *Unpublished doctoral dissertation submitted to North-Eastern Hill University*. Shillong.
- Ramchandran, K. (1980). *Neolithic Cultures of India: An Annotated Bibliography*. Tamil Nadu: Tamilnadu State Department of Archaeology.

- Ramesh, N., & Rajagopalan, G. (1999). Late Quaternary Sediments of North-Eastern India: A Review. *Gondwana Geological Magazine*, 14(1), 13-35.
- Ramirez, P. (2014). *People of the Margins Across Ethnic Boundaries in North-East India*. Guwahati: Spectrum Publication.
- Rao, S. (1973). The Neolithic Culture of Sarutaru, Assam. *Bulletin of Department of Anthropology*.
- Rao, S. (1977). Excavation at Sarutaru: A Neolithic Site in Assam. *Man and Environment*, 1, 39-42.
- Raut, M. (2001). Neolithic culture of eastern and North Eastern India an ethnoarchaeological study. *Unpublished doctoral dissertation submitted to University of Calcutta*. Calcutta.
- Ravisankar, R., Kiruba, S., Chandrasekaran, A., Senthikumar, G., & Maheswaran, C. (2010). Analysis of ancient potteries of Tamilnadu, India by spectroscopic techniques. *Indian Journal of Science and Technology*, 3(8), 858-862.
- Ray, R. (1983). Ancient Settlement Patterns of Eastern India (Prehistoric Period). *Unpublished doctoral dissertation submitted to University of Calcutta*. Calcutta.
- Reeves, K., & Hodges. (2008). Qualitative research methodologies: ethnography. *British Medical Journal*, 337.
- Renfrew, A. (1976). Megaliths, territories and populations. In S. D. Laet, *Acculturation and Continuity in Atlantic Europe* (pp. 198-220). Bruges: de Tempel.
- Rice, P. (1987). *Pottery Analysis A Sourcebook*. London: The University of Chicago Press.
- Roy, S. (1981). Aspects of Neolithic Agriculture and Shifting Cultivation, Garo Hills, Meghalaya. *Asian Perspectives*, 24(2), 193-221.
- Russel, J. (1987). Infrared Methods. In M. Blackie, *A Hand Book of Determinative Methods in Clay Mineralogy*. London.
- Sadowski, R. (2017). Neolithic Revolution. In P. Thompson, & D. Kaplan, *Encyclopedia of Food and Agricultural Ethics*. Springer, Dordrecht.
- Saikia, P. (1988). *Stone Tools of Dibru Valley*. Dibrugarh: North East Museum Society.
- Saikia, R. (2021). *Geomorphology of North East India With Special Reference to Kopili Basin*. Guwahati: EBH Publishers.
- Salunkhe, D. P., Chvansd, G., Bartakke, R. N., & Kothavale, P. R. (2017). An Overview on Methods for Slope Stability Analysis. *International Journal of Engineering Research & Technology*, 6(3).
- Sankalia, H. (1977). *Prehistory of India*. New Delhi: Humanities Press.

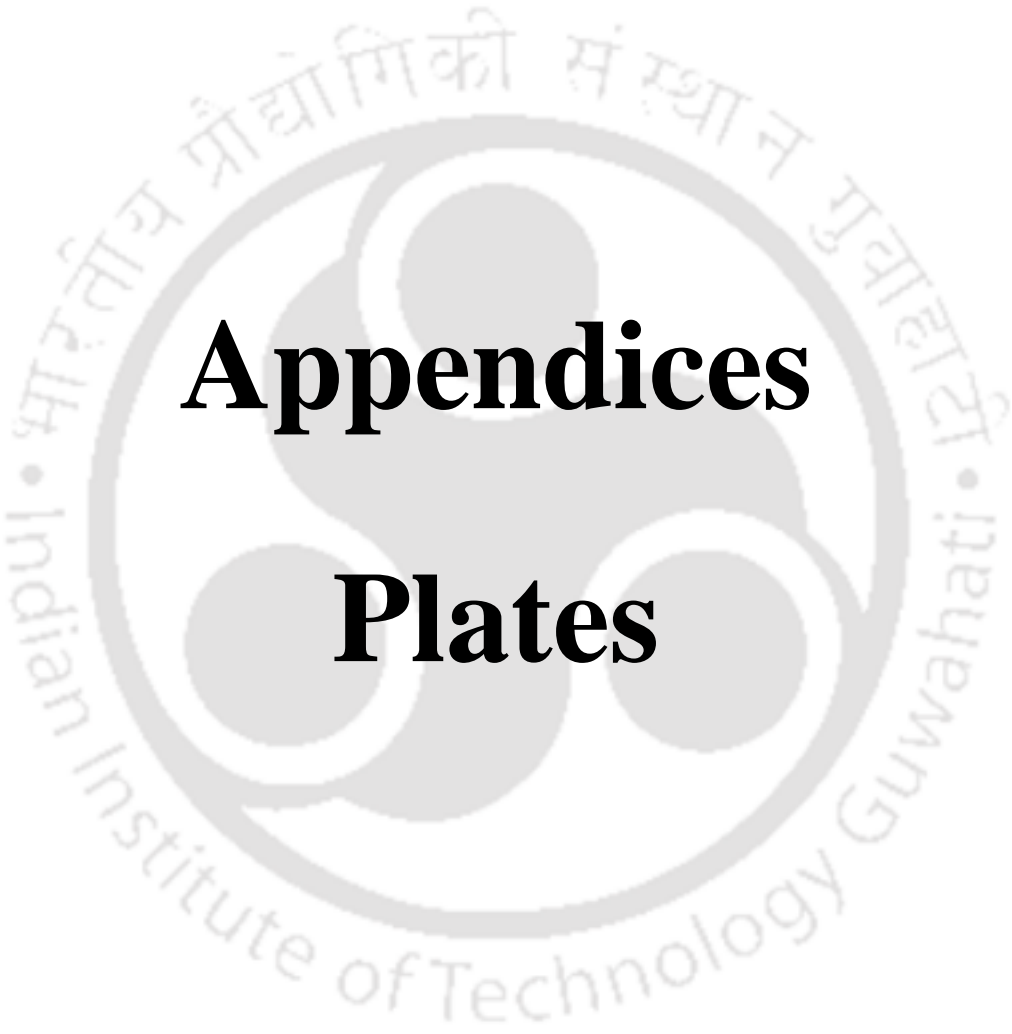
- Sarma, P. J. (2007). River Bank Erosion and its Impact on Dwellers of Brahmaputra Valley in Morigaon District of Assam. *Unpublished doctoral dissertation submitted to North-Eastern Hill University*. Shillong.
- Schiffer, M. (1972). Archaeological context and systemic context. *American Antiquity*, 37(2), 156-165.
- Schiffer, M. (1987). *Formation Process of the Archaeological Record*. Albuquerque: University of New Mexico Press.
- Shackley, M. (1975). *Archaeological Sediments A Survey of Analytical Methods*. London: Butterworths.
- Shackley, M. (1981). *Environmental Archaeology*. Unwin Hyman.
- Sharma, G., & Mandal, D. (1980). *Excavations at Mahagara 1977-78 (A Neolithic settlement in the Belan Valley)*. Allahabad: University of Allahabad.
- Sharma, G., Misra, V., Mandal, D., Misra, B., & Pal, J. (1980). *Beginnings of Agriculture*. Allahabad: Abhinav Prakashan.
- Sharma, P. (2019). River Dams and Livelihood Security A Study on the Downstream Impact of the Kopili Hydro Electric Plant in Assam. *Unpublished doctoral dissertation submitted to Gauhati University*. Guwahati.
- Sharma, P. (2021). Pottery Technology of the Brahmaputra Valley: A Micro Study of Pottery Fabric (7th - 17th Centuries CE). In M. Chauley, & M. Hazarika, *Archaeology in Northeast India: Essays Celebrating 150 Years of Research - Recent Trends and Future Prospects* (pp. 205-225). New Delhi: Research India Press.
- Sharma, R., Umopathy, G., Kumar, P., Ojha, S., Gargari, S., Joshi, R., . . . Kanjilal, D. (2018). AMS and upcoming geochronology facility at Inter University Accelerator Centre (IUAC), New Delhi, India. *Nuclear Instruments and Methods in Physics Research B*, 438, 124-130.
- Sharma, S. (2001). Cultural Affinities between Southeast Asia and Northeast India during Prehistoric Times with Special Reference to Ganol and Rongram Valley in Meghalaya. *Unpublished doctoral dissertation submitted to Deccan College Post-Graduate and Research Insititute*. Pune.
- Sharma, S. (2007). *Celts, Flakes and Bifaces - The Garo Hills Story*. England: British Archaeology Reports International Series.
- Sharma, S. (2017). The People, the Megaliths of Cherrapunjee. *Journal of Heritage Management, Ahmedabad University*, 2(1), 76-88.
- Sharma, S., Singh, P., & Das, M. (2017). The Past and the Present of the Craft of Pottery in Assam. In S. Deo G., A. Baptista, & J. Joglekar, *Rethinking the Past: A Tribute to*

- Professor V.N. Misra (pp. 330-342). Indian Society for Prehistoric and Quaternary Studies.
- Sharma, T. (1966). Prehistoric Archaeology of Assam: A Study of the Neolithic Culture. *Unpublished doctoral dissertation submitted to University of London*. London.
- Sharma, T. (1966). Researches on the Prehistoric Archaeology of Assam. *Journal of the Assam Science Society*, 9.
- Sharma, T. (1967). A Note of the Neolithic Pottery of Assam. *Man, New Series*, 2(1), 126-8.
- Sharma, T. (1967). Assam in Prehistoric Times. *Souvenir, XII Session*. Guwahati: All India Science Teachers Conference.
- Sharma, T. (1974). Recent Archaeological Discoveries in Northeastern India. *Puratattva*, 7, 17-19.
- Sharma, T. (1986). Recent Advances in Prehistory and Archaeology of Northeast India. *Journal of the Assam Research Society*, 27, 1-2.
- Shea, J. (2013). *Stone Tools in the Paleolithic and Neolithic Near East*. Cambridge: Cambridge University Press.
- Shekhar, H., Pawar, K., & Jun, K. (2014). Living Megalithic Tradition Amongst the Munda Community of Jharkhand. *Journal of Multidisciplinary Studies in Archaeology*, 2, 705-719.
- Shepard, A. O. (1980). *Ceramics for the Archaeologist*. Washington, D.C.: Carnegie Institute of Washington.
- Shinde, V. (1984). Early Settlement in the Central Tapi Basin. *Unpublished doctoral dissertation submitted to Deccan College Post Graduate and Research Institute*. Pune.
- Sikka, U. (1989). Settlement Patterns in Ancient Haryana Earliest times to c. 1200 A.D. *Unpublished doctoral dissertation submitted to Maharshi Dayanand University*. Rohtak.
- Singh, O. (1991). *Neolithic Stone Tools of Manipur: A Catalogue of Neolithic in the People's Museum, Kakching*. Imphal: People's Museum, Kakching.
- Singh, O. (1993). Stone Age Culture of Manipur. *Unpublished doctoral dissertation submitted to University of Manipur*. Imphal.
- Singh, P. (2017). Provenance Study of the Archaeological Pottery of Northeast India. *Unpublished doctoral dissertation submitted to Indian Institute of Technology Guwahati*. Guwahati.

- Singh, P., & Sharma, S. (2016). Thermal and spectroscopic characterization of archaeological pottery from Ambari, Assam. *Journal of Archaeological Science: Reports*(5), 578-563.
- Singh, P., Tamta, P., & Sharma, S. (2021). Exploring the Bamuni Hills Remains: An Archaeometric Study of Pottery. In M. K. Chauley, & M. Hazarika, *Archaeology in Northeast India: Essays Celebrating 150 Years of Research - Recent Trends and Future Prospects* (pp. 226-238). New Delhi: Research India Press.
- Smith, M. (1982). The Process of Sociocultural Continuity. *Current Anthropology*, 23(2), 127-142.
- Sonia, H. (2021). Pottery Making Tradition of Apatani Community of Arunachal Pradesh. In M. K. Chauley, & M. Hazarika, *Archaeology in Northeast India: Essays Celebrating 150 Years of Research - Recent Trends and Future Prospects* (pp. 245-252). New Delhi: Research India Press.
- Souvatzi, S. (2007). The identification of Neolithic households: unfeasible or just disregarded? In N. Fisher, R. Westgate, & J. Whitley (Eds.), *Building Communities: House, Settlement and Society in the Aegean and Beyond* (Vol. 15, pp. 19-28). British School of Athens.
- Spoers, R. (1969). Settlement Farming Technology and Environment in the Nochitzlan Valley. *Science*, 166, 557-569.
- Stack, & Lyall, C. (1904). *The Mikirs*. London: William Clowes and Sons. Limited.
- Stanislawski, M. (1974). The relationships of ethnoarchaeology, traditional, and systems archaeology. In C. Donnan, & C. Clewlow, *Ethnoarchaeology Monograph IV, Institute of Archaeology*. UCLA.
- Steel, E. (1870). Celt found among the Namsang Nagas. *Proceedings of the Asiatic Society of Bengal*, (pp. 267-68). Calcutta.
- Stone, G. (1993). Agricultural abandonment: a comparative study in historical ecology. In C. Cameron, & S. Tomka (Eds.), *Abandonment of settlements and regions Ethnoarchaeological and archaeological approaches* (pp. 74-81). Cambridge: Cambridge University Press.
- SubbaRao, B. (1958). *The Personality of India*. Baroda: M.S. University.
- Taher, M. (2004). Northeast India: The Land and People. In T. Vattathara, & E. George, *Peace Initiative: A North East India Perspective*. Guwahati: Don Bosco Institute, Centre for Human Development, Leadership and Research.
- Taher, M., & Ahmed, A. (2010). *Geography of North-East India*. Guwahati: Mani Manik Prakash.

- Tewari, R., Srivastava, R., Saraswat, K., Singh, I., & Singh, K. (2006, January 18-20). Early Farming at Lahuradewa. *Paper presented in the International Seminar on the First Farmers in Global Perspective, Lucknow*. Lucknow, India.
- Thakuria, G. (2021). Pottery Remains in Assam: An Overview of Archaeological Investigations. In M. K. Chauley, & M. Hazarika, *Archaeology in Northeast India: Essays Celebrating 150 Years of Research - Recent Trends and Future Prospects* (pp. 253-263). New Delhi: Research India Press.
- Thakuria, T. (2019). Stone Jars of Assam, North East India: A Comprehensive Overview. *Journal of Neolithic Archaeology*, 151-162. Retrieved from <https://doi.org/10.12766/jna.2019S.11>
- Thapar, B. (1978). Early Farming Communities in India. *Journal of Human Evolution*, 7, 11-22.
- Tiwari, R., Srivastava, R., & Singh, K. (2001-02). Excavations at Lahuradewa, District Sant Nagar, Uttar Pradesh. *Puratattva*, 32, 54-62.
- Trigger, B. (1965). *History and Settlement in Lower Nubia*. New Haven: Yale University Publication in Anthropology.
- Trigger, B. (1967). Settlement Archaeology: its Goals and Promises. *American Antiquity*, 32, 149-160.
- Trigger, B. (1989). *A History of Archaeological Thought*. Cambridge: Cambridge University Press.
- Tzudir, T., Jamir, T., & Sharma, S. (2019). Analysis of iron ore, iron slag and soils of termite nest from Wui village, Nagaland, India. *Current Science*, 116(2), 311-319.
- Vahia, M., Kumar, P., Bhogale, A., Kothari, D., Chopra, S., Shinde, V., . . . Shastri, R. (2016). Radiocarbon dating of charcoal samples from Rakhigarhi using AMS. *Current Science*, 111, 27-28.
- Vasks, A. (2003). The Symbolism of Stone Work-Axes Based on Material from the Daugava Basin. *Archaeologia Lituana*, 4, 27-32.
- Velde, B., & Druc, I. (1995). *Archaeological Ceramic Materials: Origin and Utilization*. Berlin: Springer, Natural Science in Archaeological Series.
- Velraj, G., Tamilarasu, S., & Ramya, R. (2015). FTIR, XRD and SEM-EDS studies of archaeological pottery samples from recently excavated site in Tamil Nadu, India. *Materials Today: Proceedings*, 2, 934-942.
- Venkatachalapthy, R., Sridharan, T., Dhanapandian, S., & Manoharan, C. (2002). Determination of firing temperature of ancient potteries by means of infrared and Mossbauer studies. *Spectroscopy Letters*, 35(6), 769-779.

- Villa, P. (1983). *Terra Amata and the Middle Pleistocene Archaeological Record of Southern France*. Berkeley: University of California Press.
- Vranova, V., Theodore, D. M., & Klelement, R. (2015). Soil Scientific research methods used in archaeology - promising soil biochemistry: a mini-review. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 63(4), 1417-1426.
- Waters, M. (1992). *Principles of Geoarchaeology: A North American Perspective*. Tucson: University of Arizona Press.
- Willey, G. (1953). Prehistoric Settlement Patterns in the Virú Valley, Peru. *Bureau of American Ethnology Bulletin*, 155.
- Willey, G. R. (1956). Introduction. (G. R. Willey, Ed.) *Prehistoric Settlement Patterns in the New World*(23), 1-2.
- Wood, W., & Johnson, D. (1978). A survey of disturbance process in archaeological site formation. *Advances in Archaeological Method and Theory*, 1, 315-381.
- Worman, E. (1949). The Neolithic Problem in the Prehistory of India. *Journal of Washington*, 39(6), 181-201.
- Wright, H. (1969). The Administration of Rural Production in an Early Mesopotamia Town. *Museum Anthropology, Anthropology Paper 23, University of Michigan*.
- Yerkes, R., & Kardulias, P. (1993). Recent developments in the analysis of lithic artifacts. *Journal of Archaeological Research*, 1, 89-119.
- Zhengdu. (2002). Prospects of studies on man-land relationship in the 21st century. *Geographical Research*, 21(1), 9-13.
- Zussman, J. (1977). *Physical methods in determinative Mineralogy* (2 ed.). London: Academic Press.



Appendices

Plates



Plate 1. 1: Dense deposit of potsherd and sporadic occurrences of celts in Marakdola



Plate 1. 2: Massive sediment deposit in Bagibari village



Plate 1. 3 Agricultural land created by removing the upper layer of the terrace at the foothill of Silchang village



Plate 1. 4: Archaeological records reported from the agricultural land at Silchang

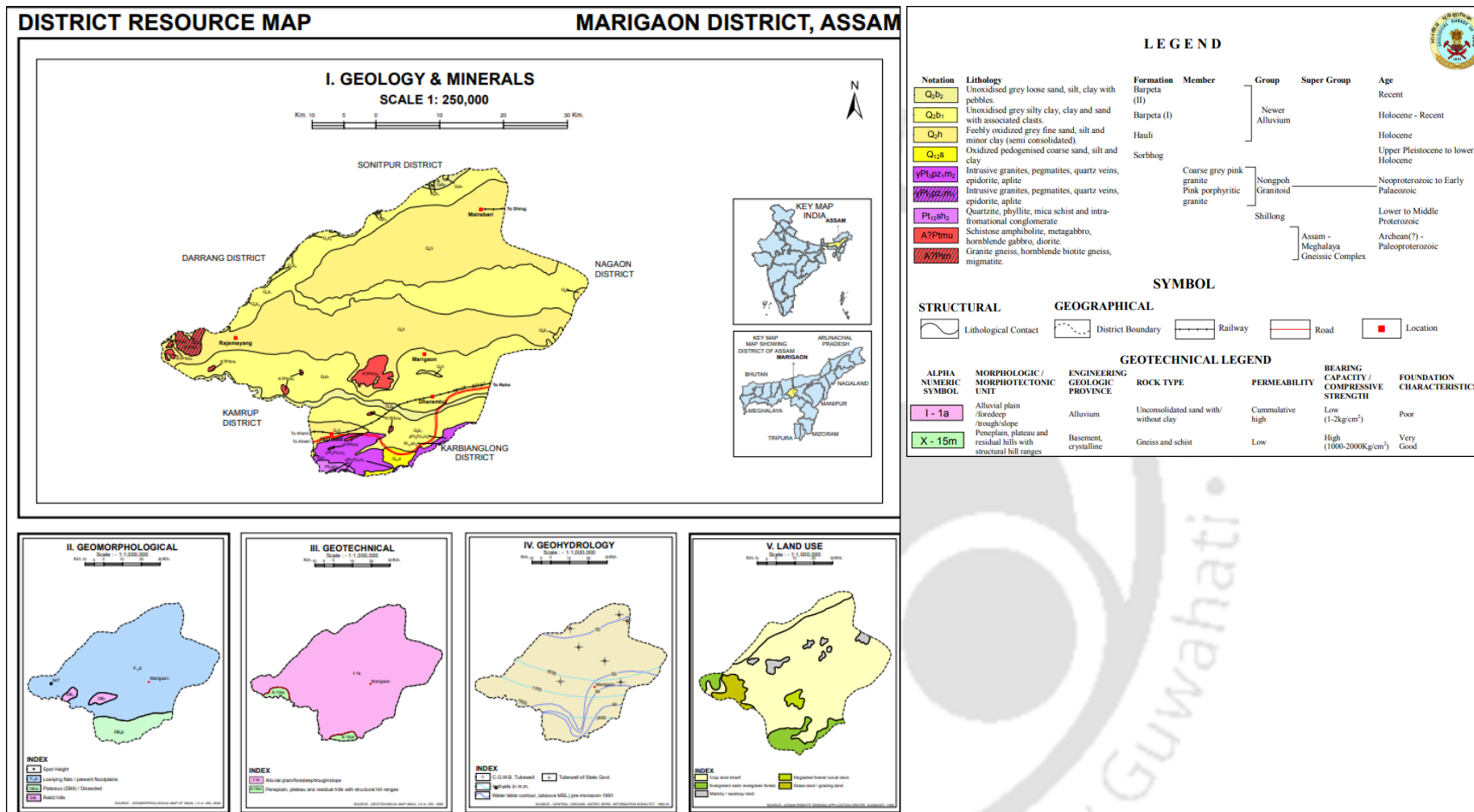


Plate 1. 6: District Resource Map of Marigaon district, Assam (source Geological Survey of India)

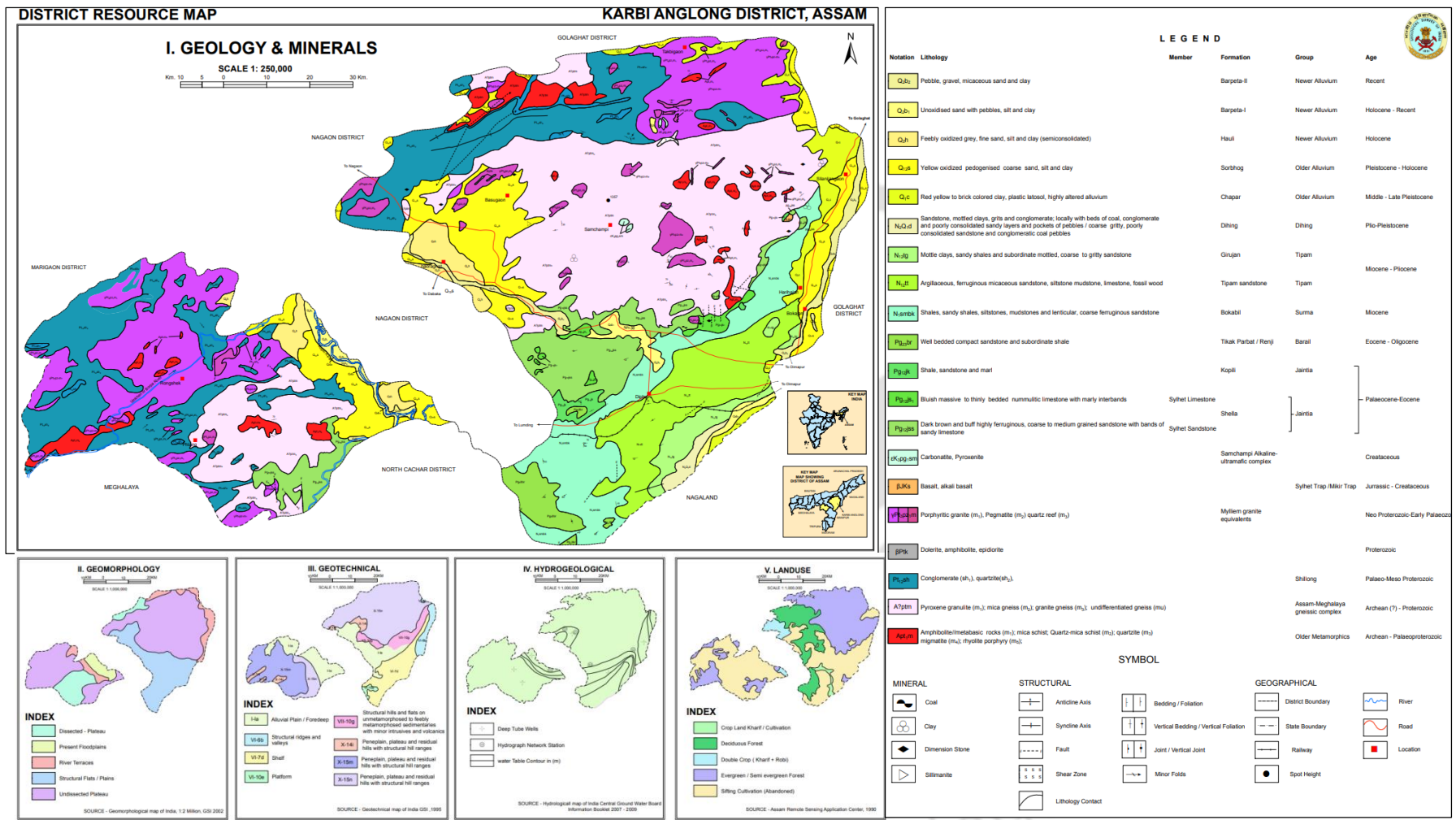


Plate 1. 7: District Resource Map of Karbi Anglong district, Assam (source Geological Survey of India)

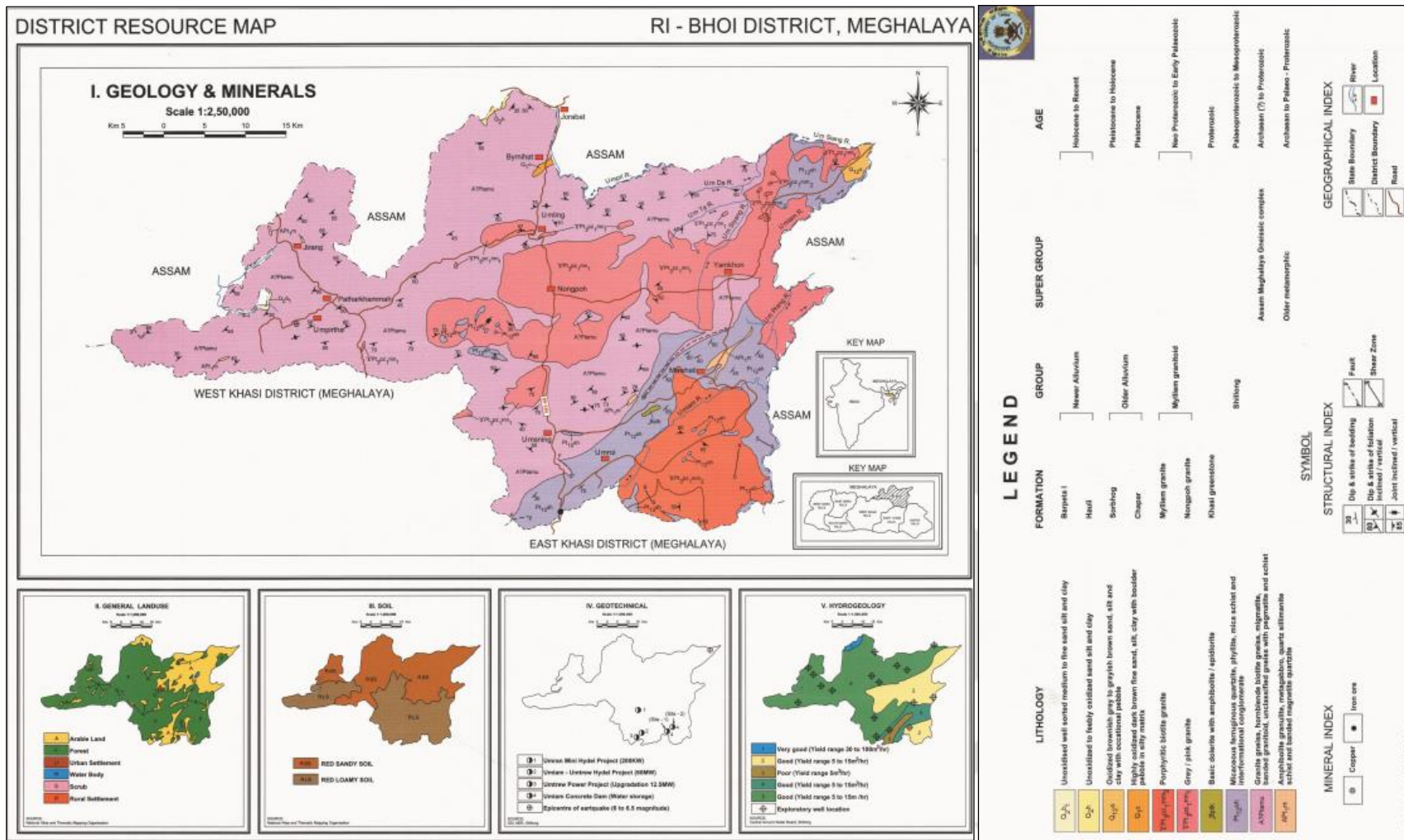


Plate 1. 8: District Resource Map of Ri-Bhoi district, Meghalaya (source Geological Survey of India)

Plate 2. 1: Test pit at Marakdola village



Plate 2. 2: Charcoal sample at Marakdola test pit



Plate 2. 3: Megalith monuments at Chenimur village L1 (left) and Teteliguri village (right)



Plate 2. 4: Megalith monuments at Sukuripara village (left) and Barkuchi village (right)



Plate 2. 5: Dolmen (left) and menhirs (right) at Batakuchi village



Plate 2. 6: Megalith monuments at Taloni village (left) and Khamar village (right)



Plate 2. 7: Megalith monuments at Bogpur (left) and Tegheria (right)



Plate 2. 8: Megalith monuments at Dakhin Topatoli (left) and Diksak (right)



Plate 2. 9: Scattered megalith monuments at Lymphuid village



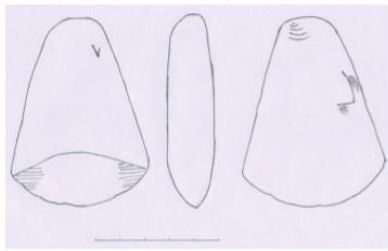
Plate 2. 10: Megalith monuments at Kraikijam village



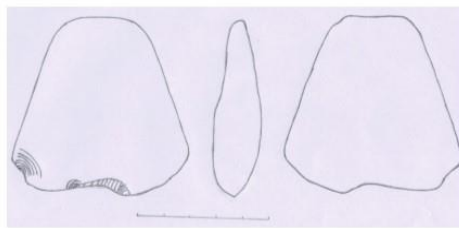
Plate 2. 11: Megaliths and potsherds reported from the Umswai region



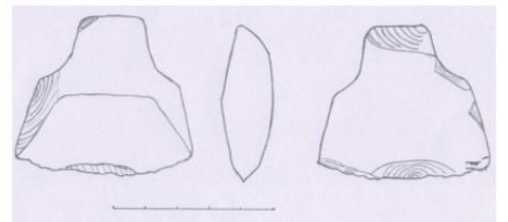
Plate 3. 1: Illustration of stone celts from Bagibari (BGI) and Amkhang (AKG)



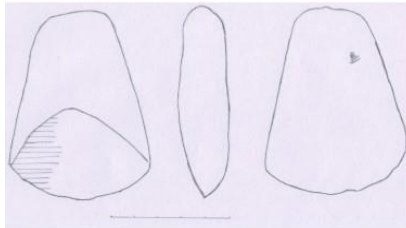
BGI t1



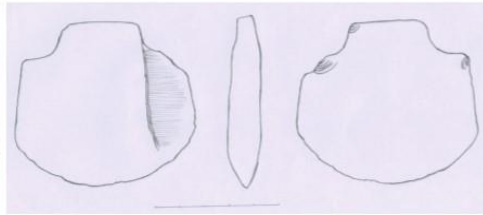
BGI t2



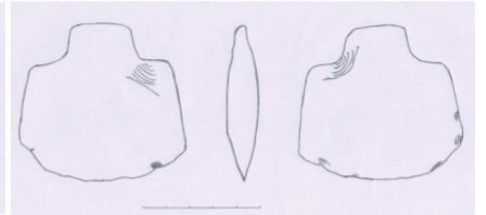
BGI t3



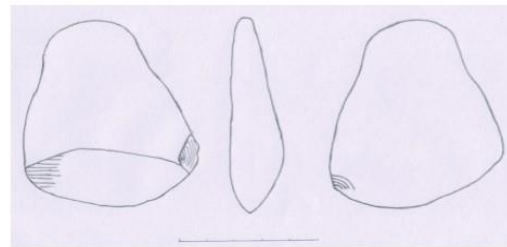
BGI t4



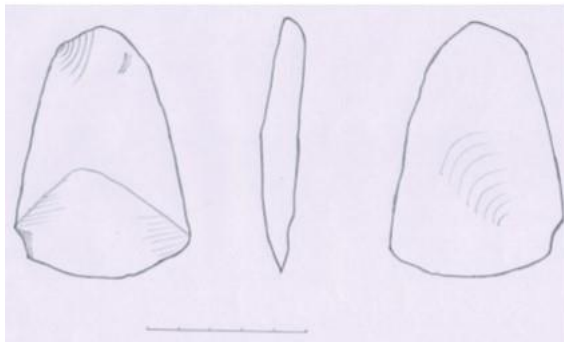
BGI t5



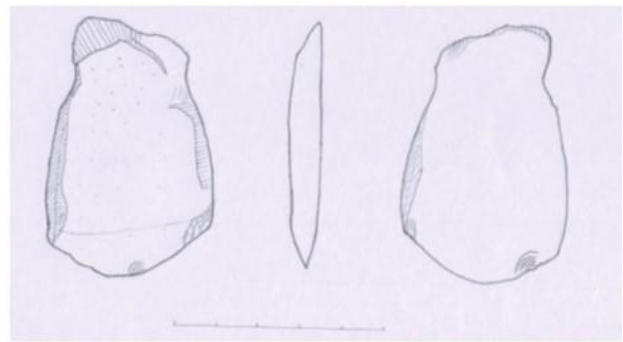
BGI t6



BGI t7

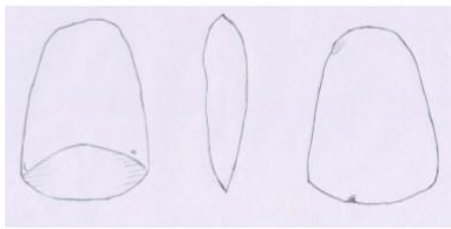


AKG t1

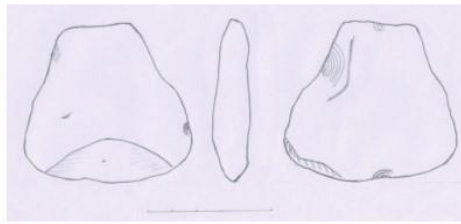


AKG t2

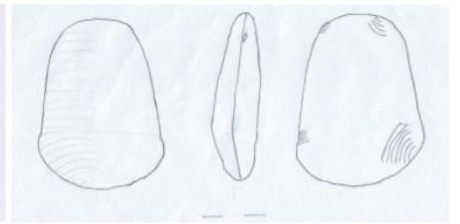
Plate 3. 2: Illustration of stone celts from Marakdola (MRK) and Kraikijam (KJM)



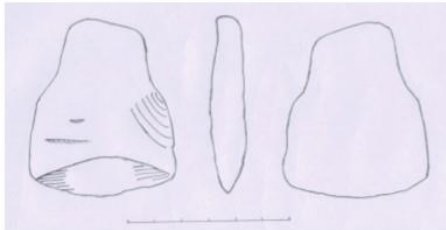
MRK t 1



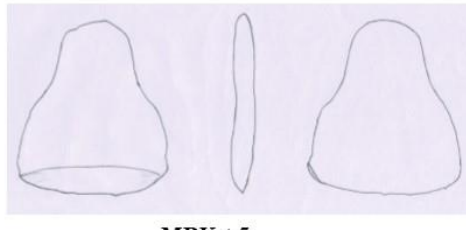
MRK t 2



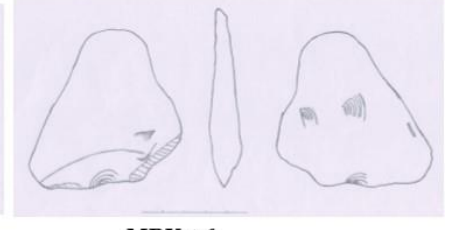
MRK t 3



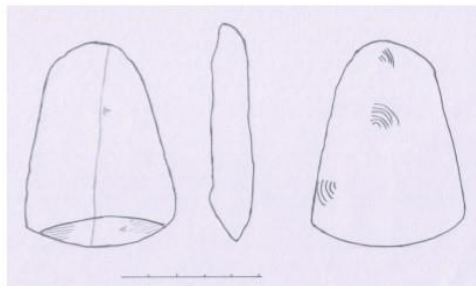
MRK t 4



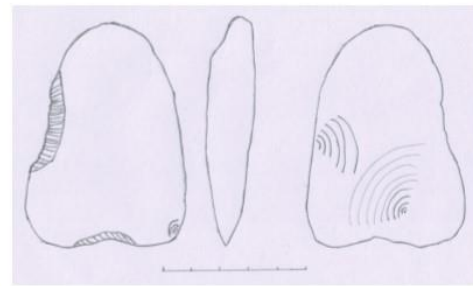
MRK t 5



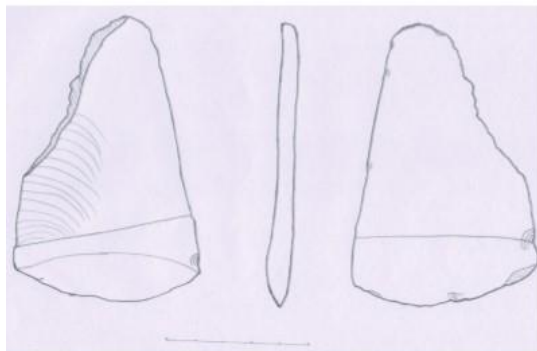
MRK t 6



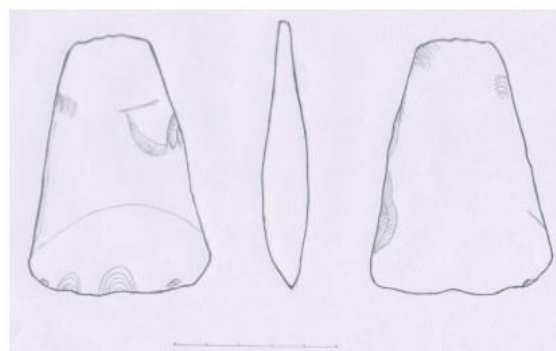
MRK t 7



MRK t 8

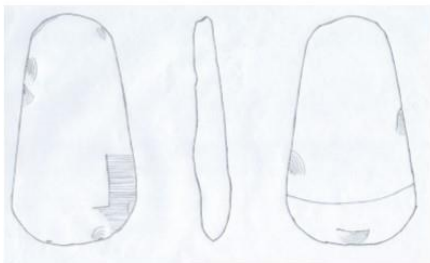


KJM t 1

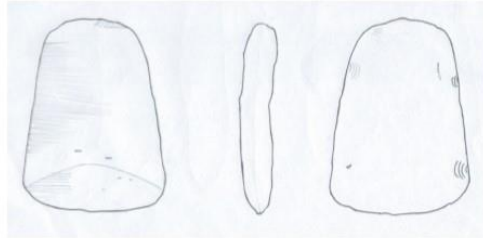


KJM t 2

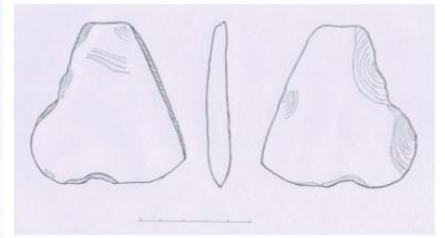
Plate 3. 3: Illustration of stone celts from Shankargog (SKG), Shikdamakha (SDM), Kalbari (KLB), and Lymphuid (LPD)



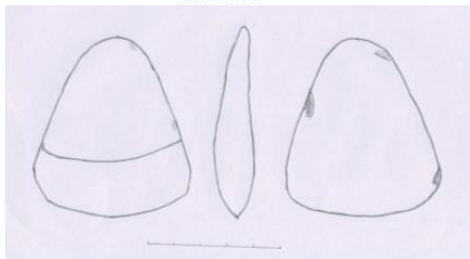
SKG t1



SKG t2



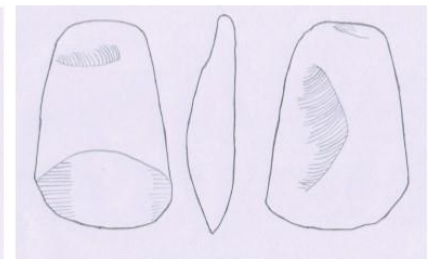
SKG t3



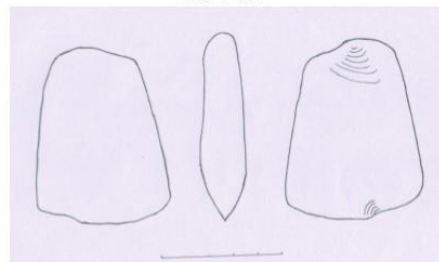
SKG t4



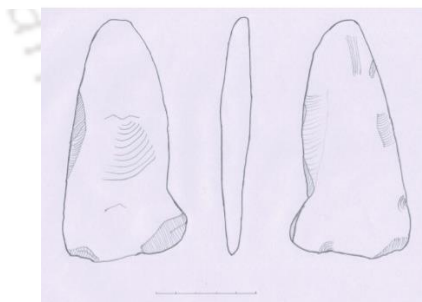
SKG t5



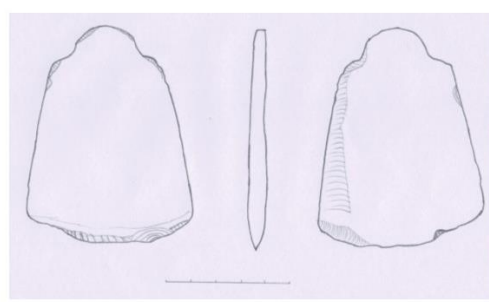
SKG t6



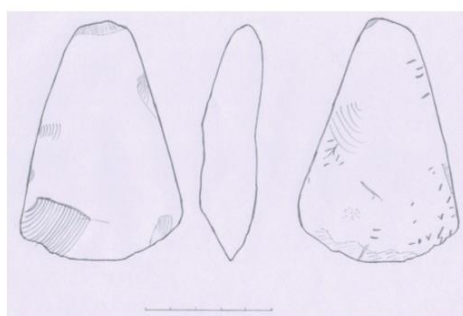
SKG t7



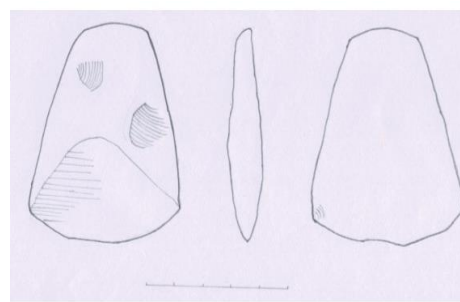
SDM t1



SDM t2

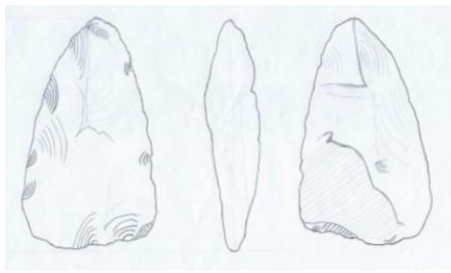


KLB t1

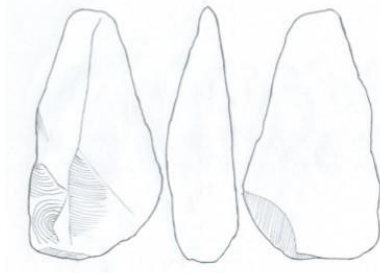


LPD t1

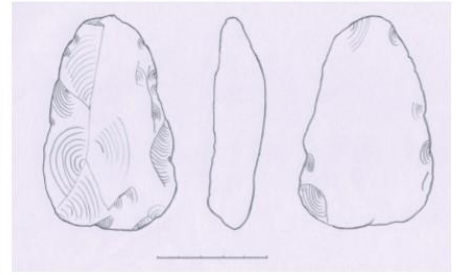
Plate 3. 4: Illustration of stone celts from Silchang (SLG)



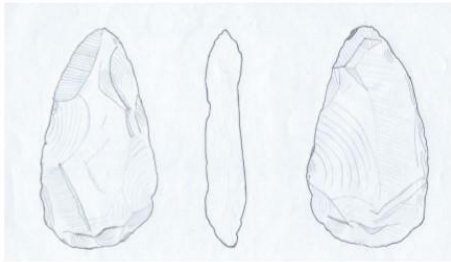
SLG t1



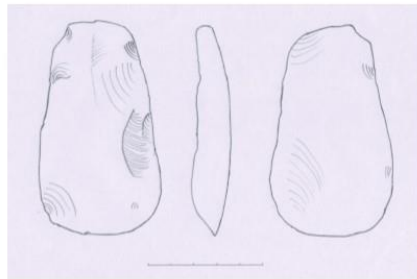
SLG t2



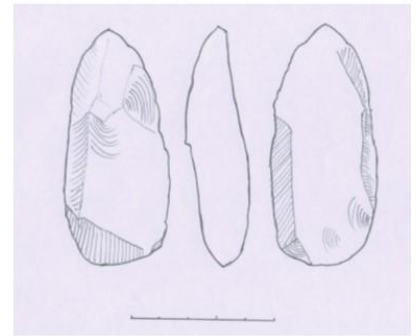
SLG t3



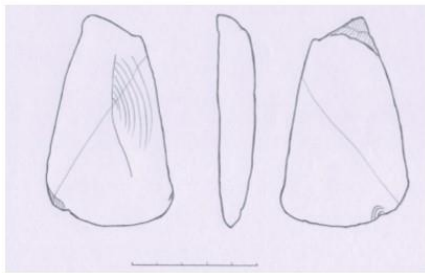
SLG t4



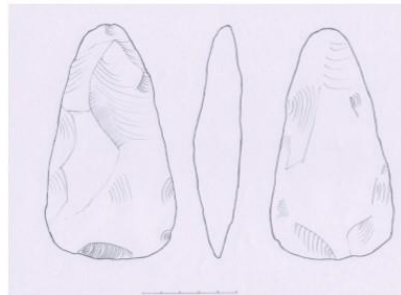
SLG t5



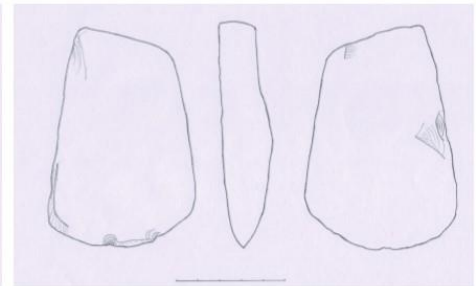
SLG t6



SLG t7



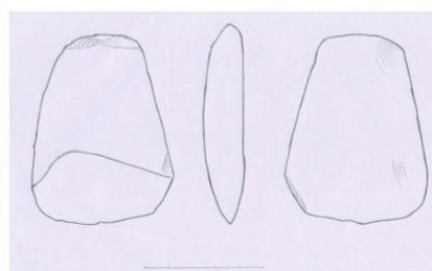
SLG t8



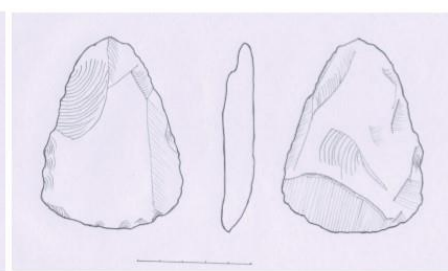
SLG t9



SLG t10



SLG t11



SLG t12



Plate 3. 5: Stone celts reported from MRK, BGI, SDM, KJM, AKG, KLB, and LPD

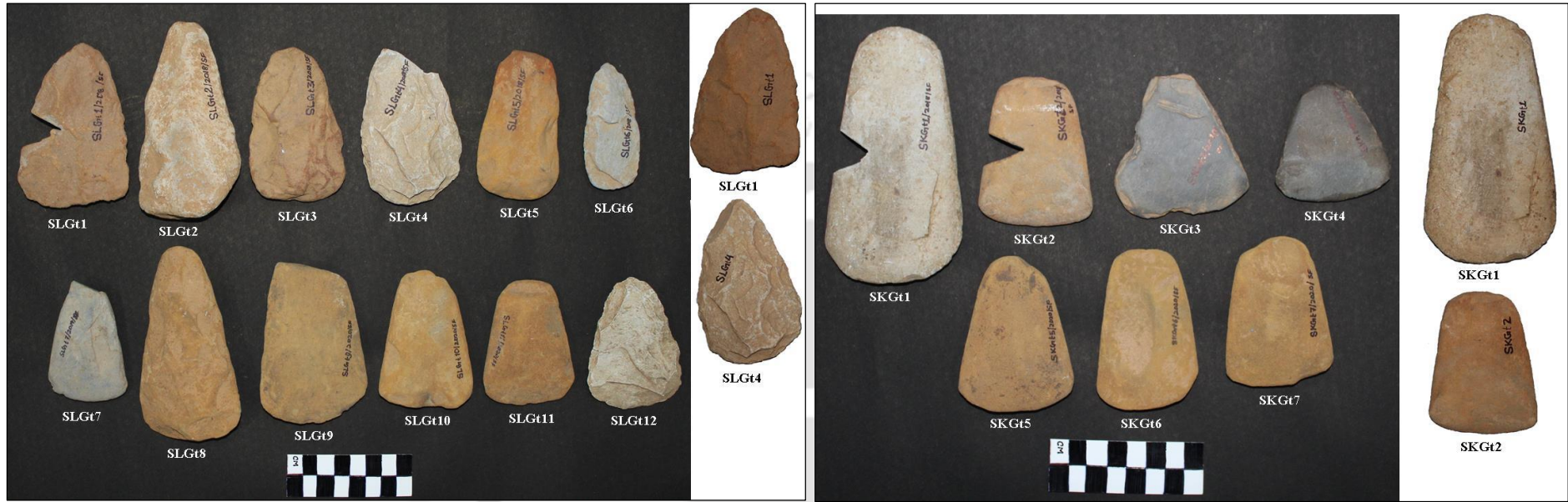
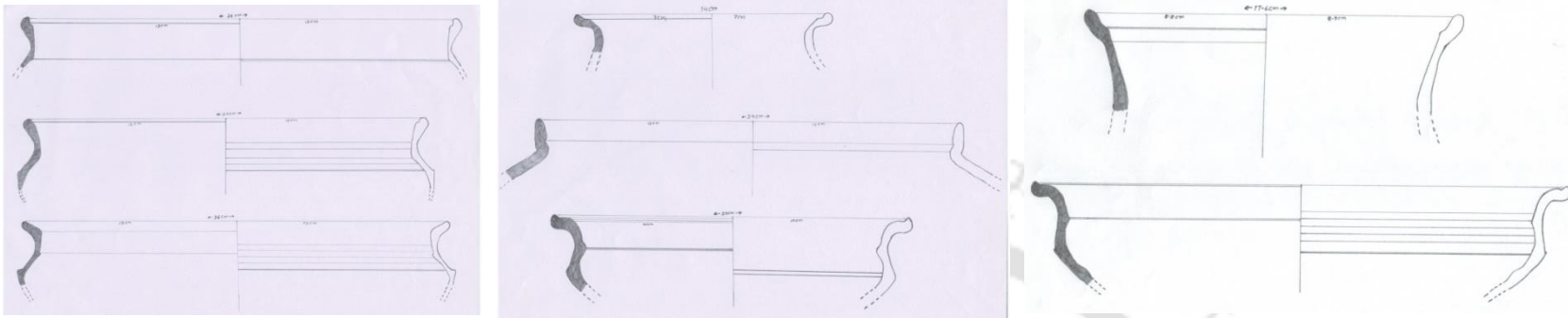
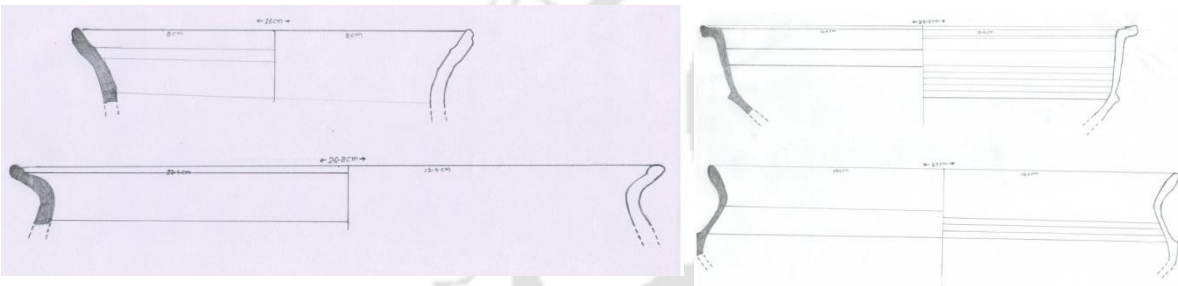


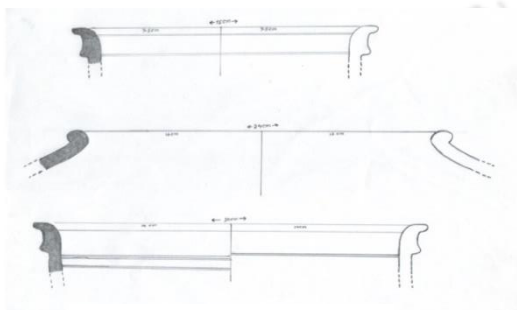
Plate 3. 6: Stone celts reported from SLG and SKG



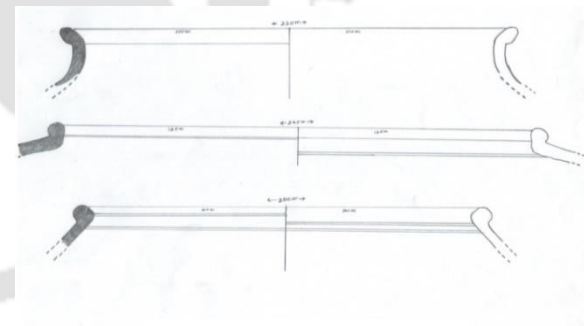
Bagibari (BGI)



Marakdola (MRK)



Shankargog (SKG)



Silchang (SLG)

Plate 3. 7: Potsherd shape reconstruction from rim sherds

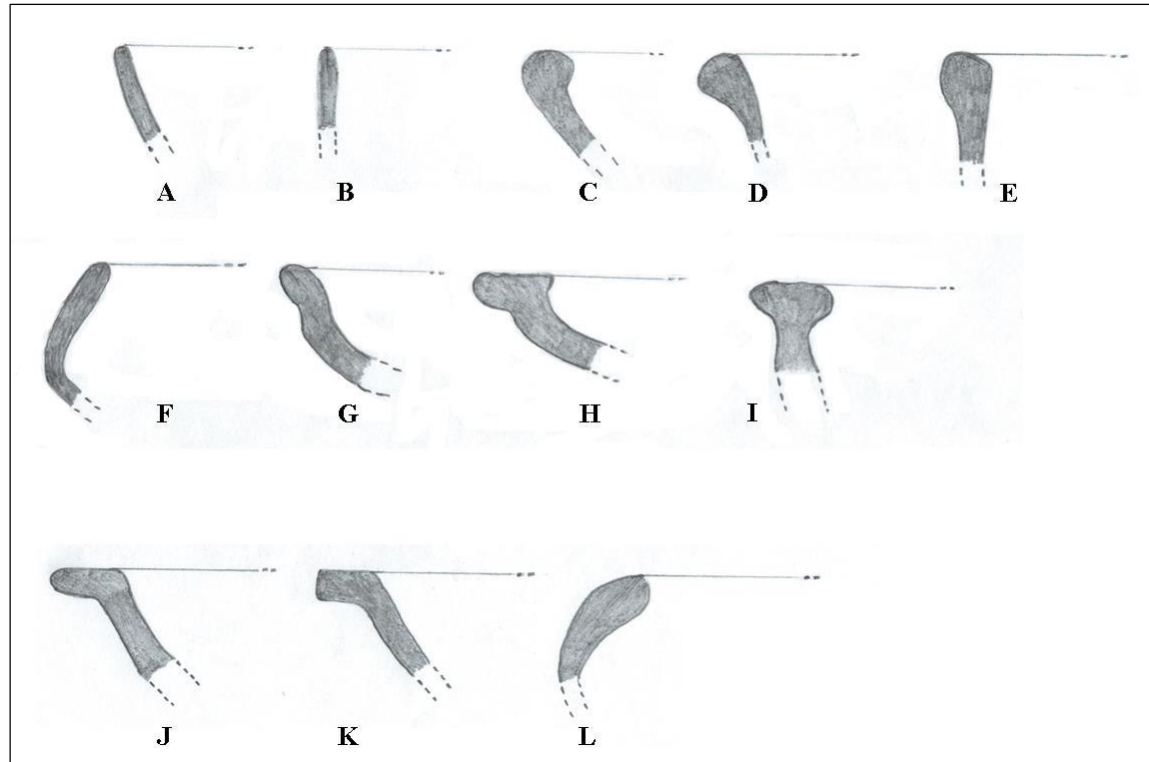


Plate 3. 8: Rim Stances type – Plain (A – sloping, B – vertical); Articulated (C – thickened internally, D – thickened externally, E – symmetrical thickening, F – inverted plain, G – everted plain); Everted (H); T-shaped (I); Horizontal rim stance (J); Horizontally and vertically flattened rim (K); and Incurving rim (L).

Plate 3. 9: Potsherd reported from Marakdola (MRK)



Plate 3. 10: Potsherd reported from Bagibari (BGI)



Plate 3. 11: Potsherd reported from Shankargog (SKG)



Plate 3. 12: Potsherd reported from Silchang (SLG)



Plate 3. 13: Bolia, a tool made of clay to give shape to the pots and also used to make the surface smooth



Plate 3. 14: Miscellaneous Ceramics Objects



Plate 3. 15: Impressions on the potsherds



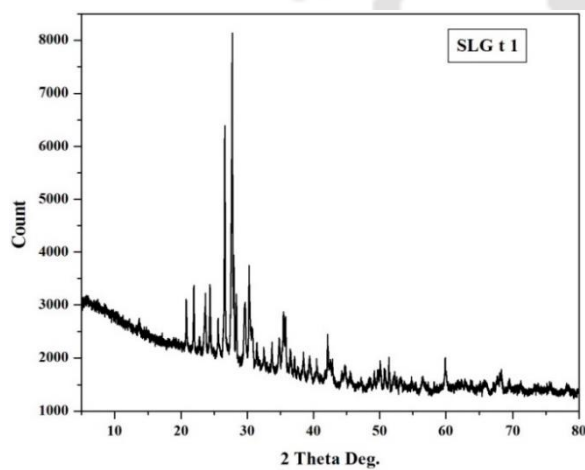
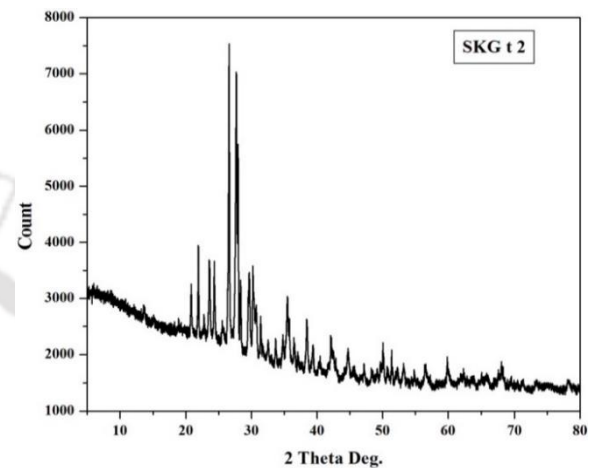
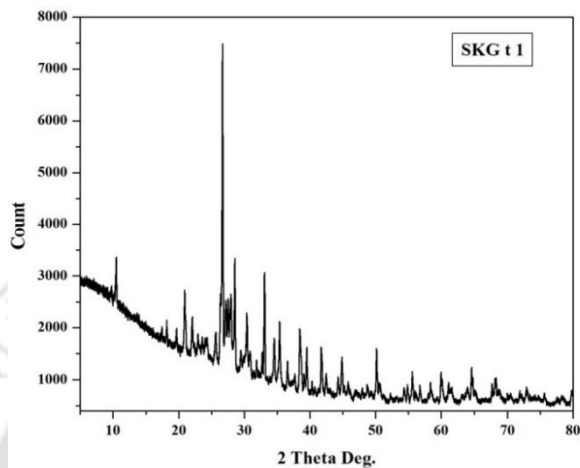
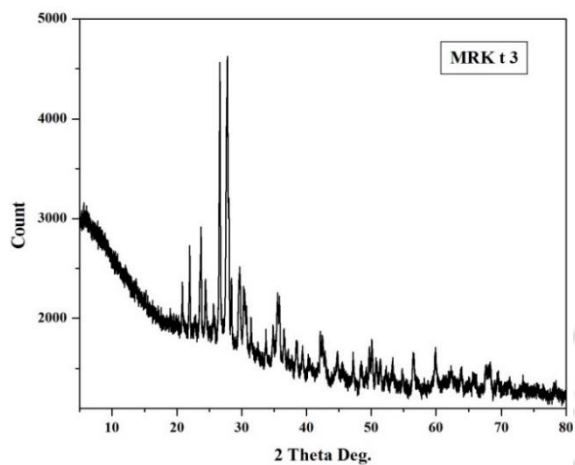


Plate 4. 1: XRD pattern of Stone Celt samples

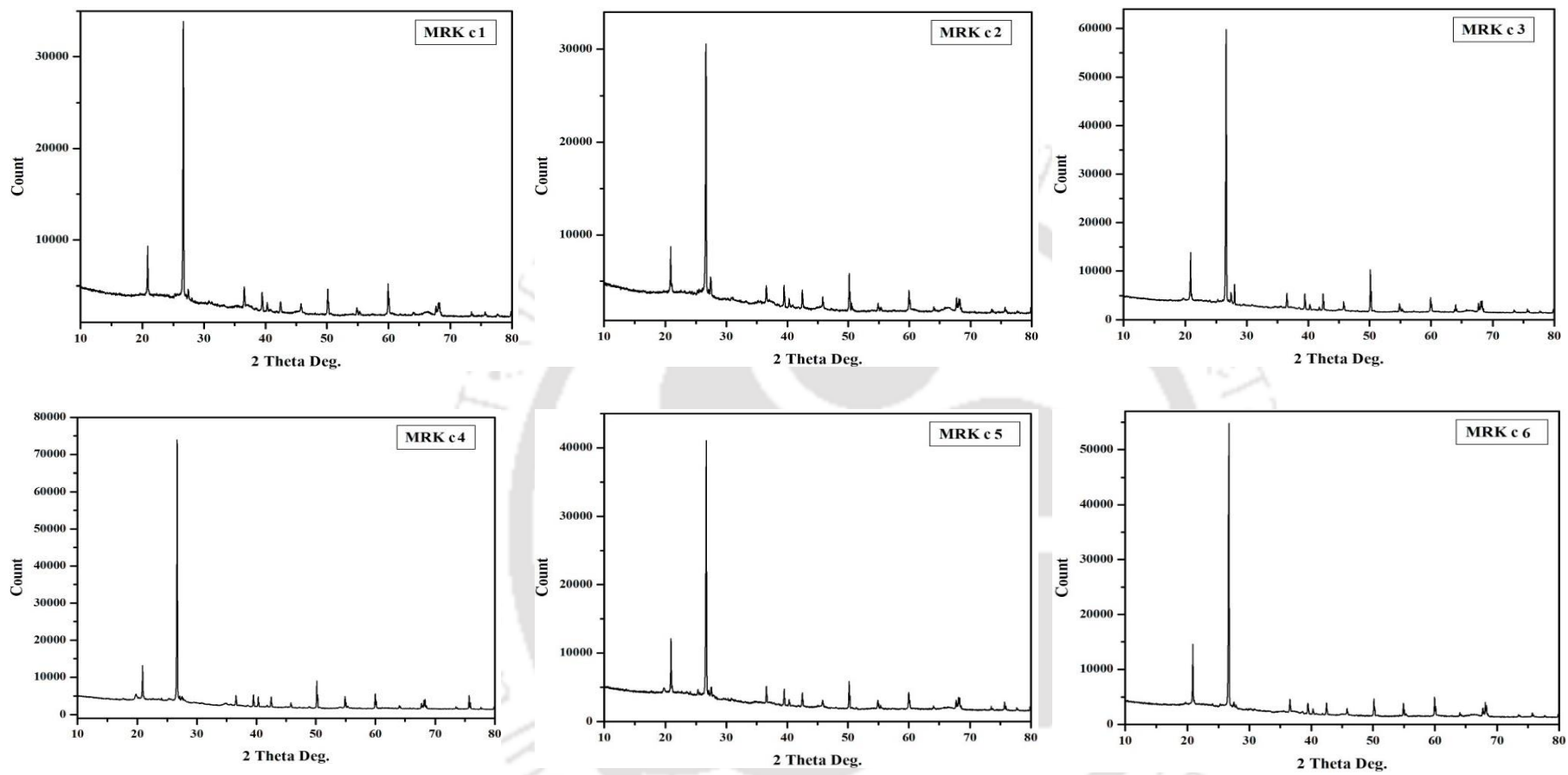


Plate 4. 2: XRD pattern of MRKc1, 2, 3, 4, 5, and 6

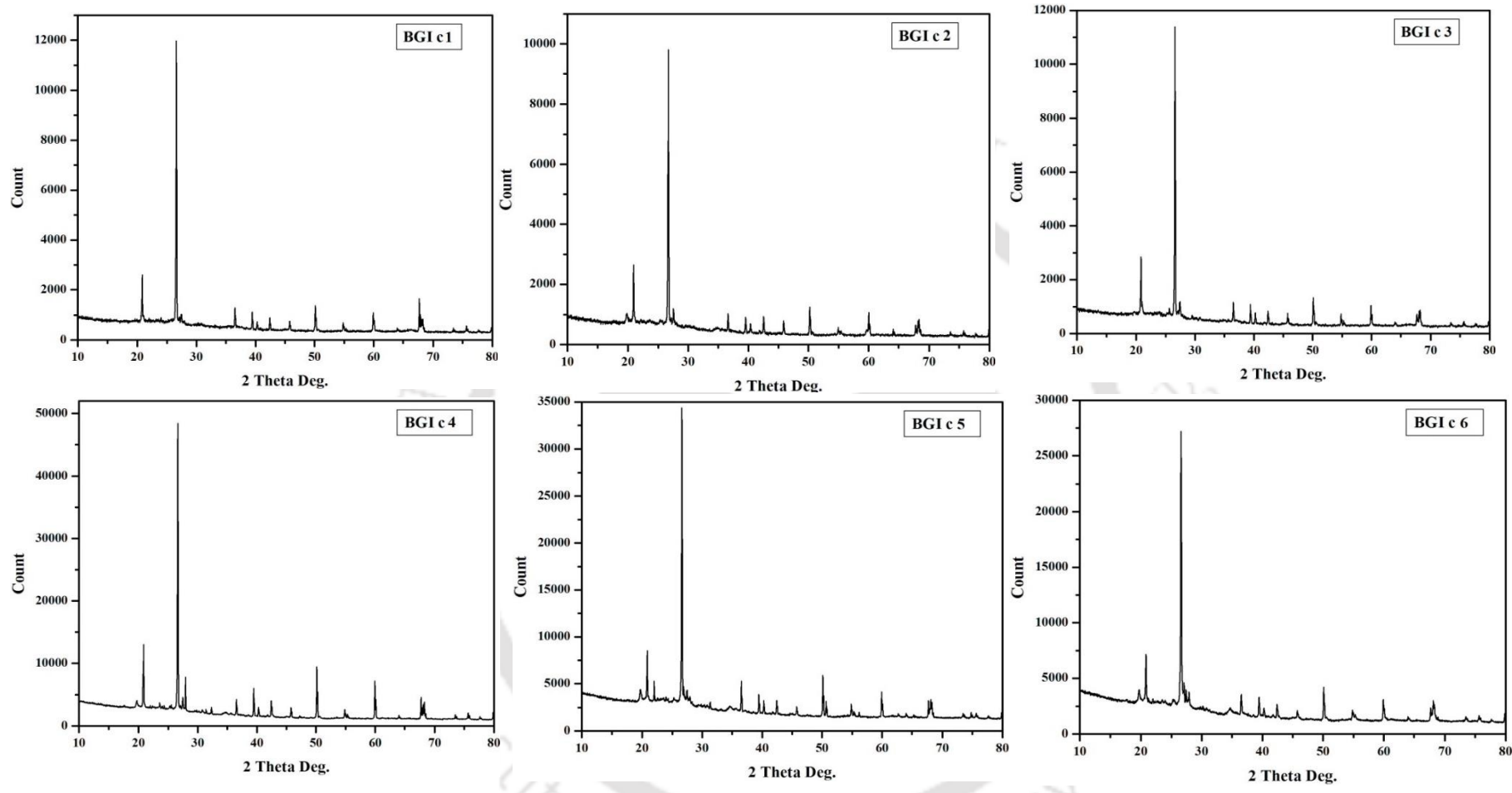


Plate 4. 3: XRD pattern of BGIc1 to BGIc6

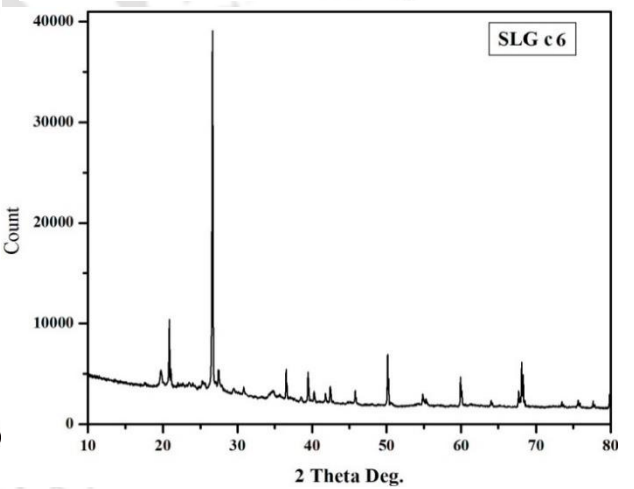
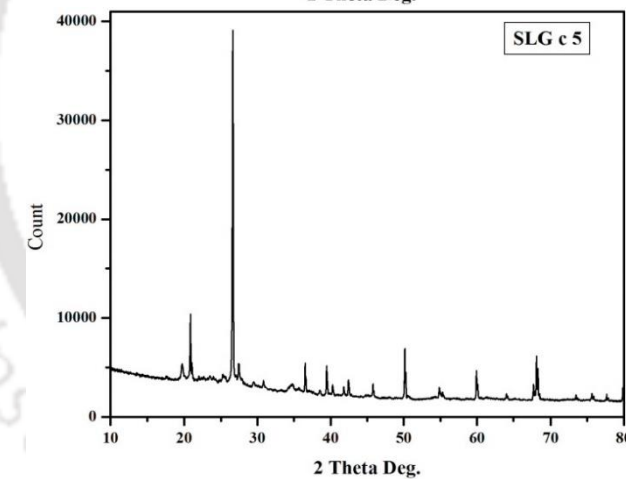
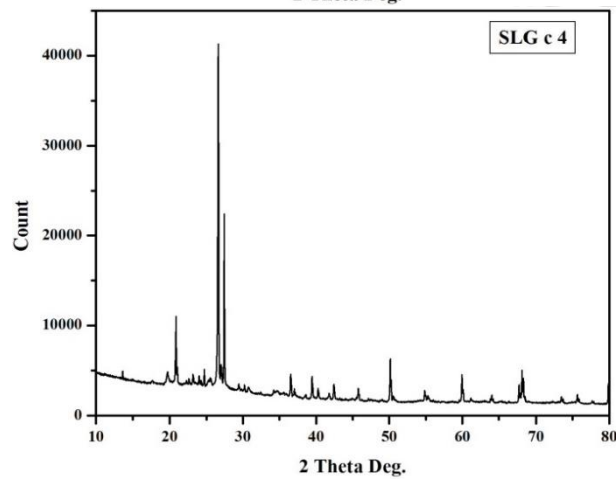
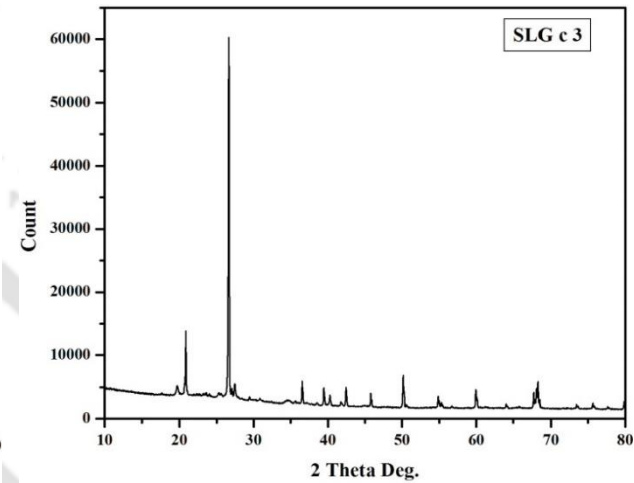
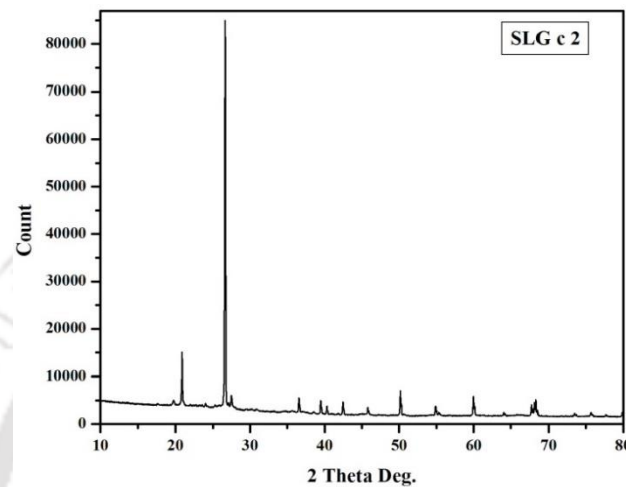
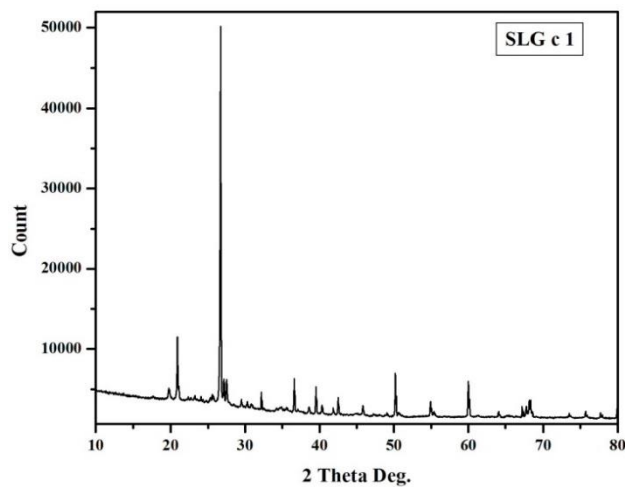


Plate 4. 4: XRD pattern of SLGc1 to SLGc6

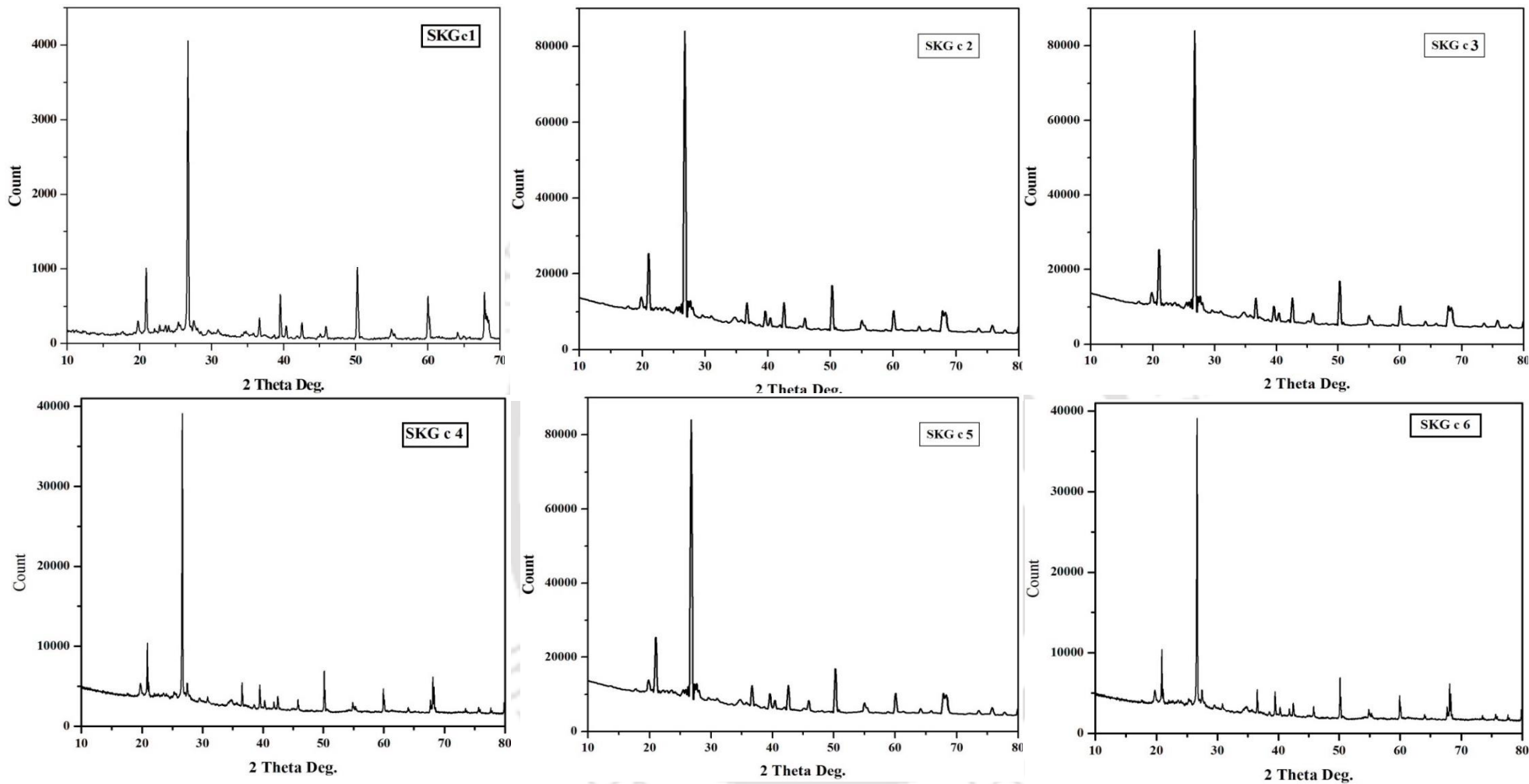


Plate 4. 5: XRD pattern of SKGc1 to SKGc6

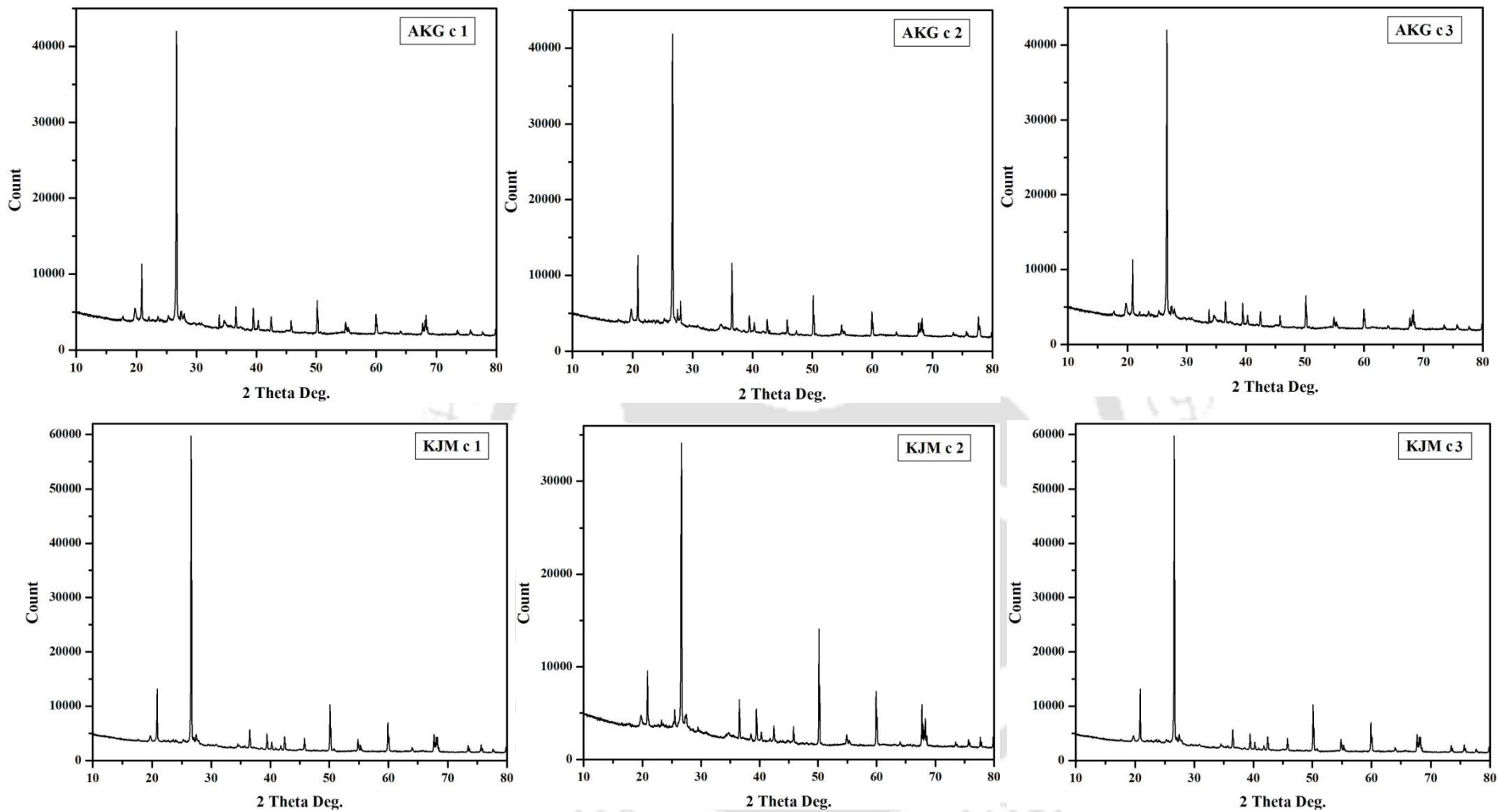


Plate 4. 6: XRD pattern of AKGc1 to AKGc3 and KJM c1 to KJM c3

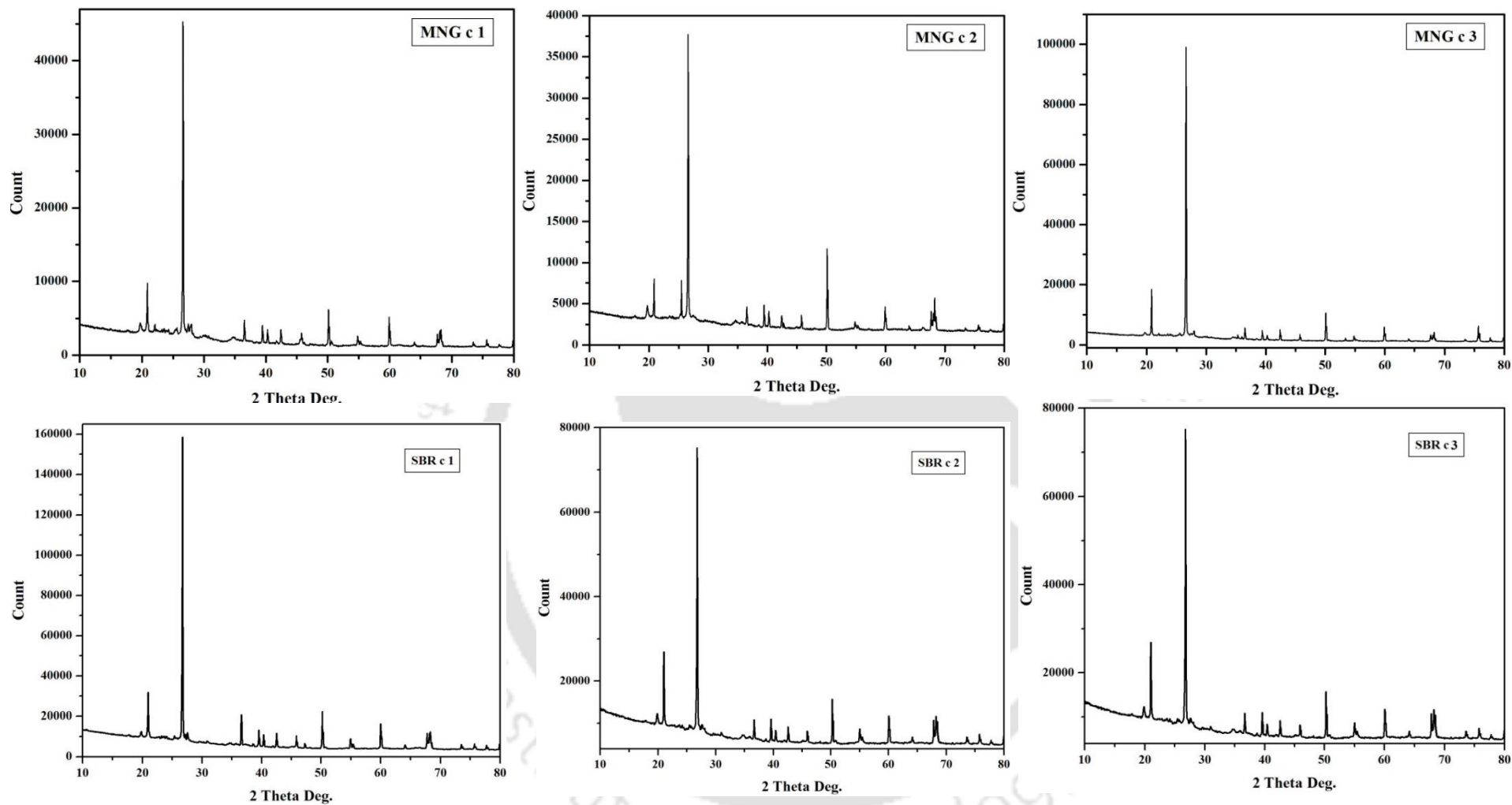


Plate 4. 7: XRD pattern of MNGc1 to MNGc3 and SBRc1 to SBRc3

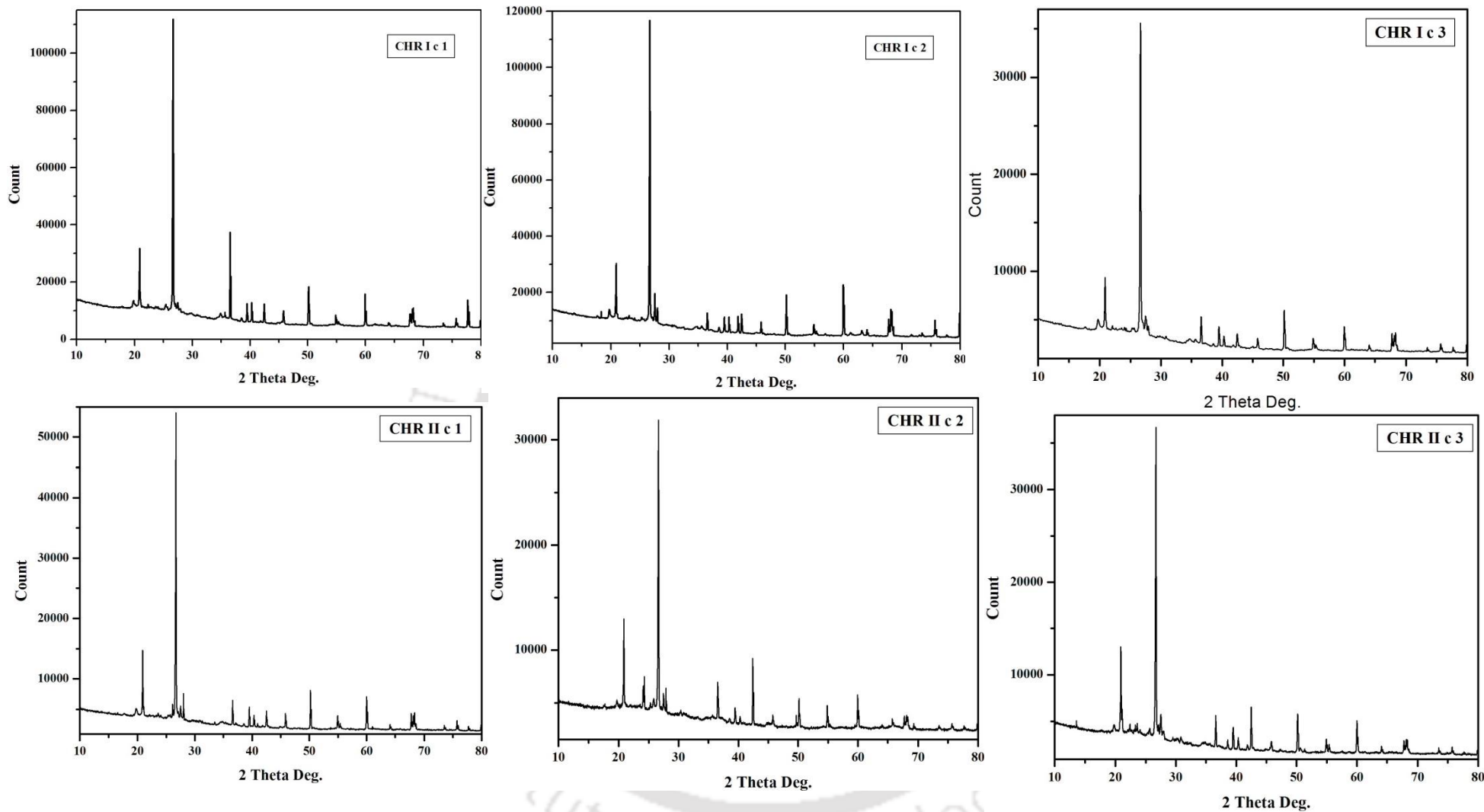


Plate 4. 8: XRD pattern of CHR I c 1 to CHR I c 3 and CHR II c 1 to CHR II c 3

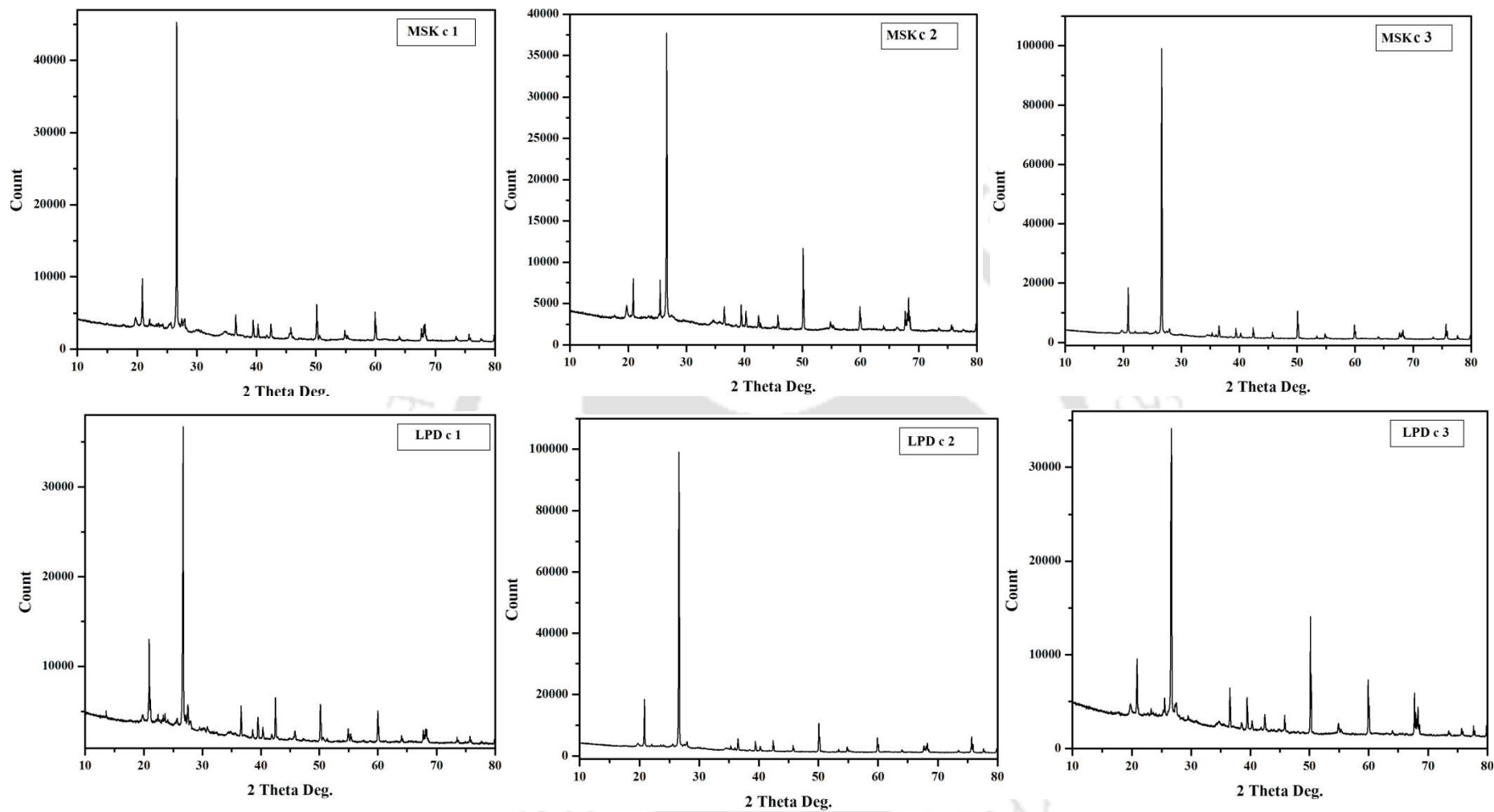


Plate 4. 9: XRD pattern of MSKc1 to MSKc3 and LPDc1 to LPDc3

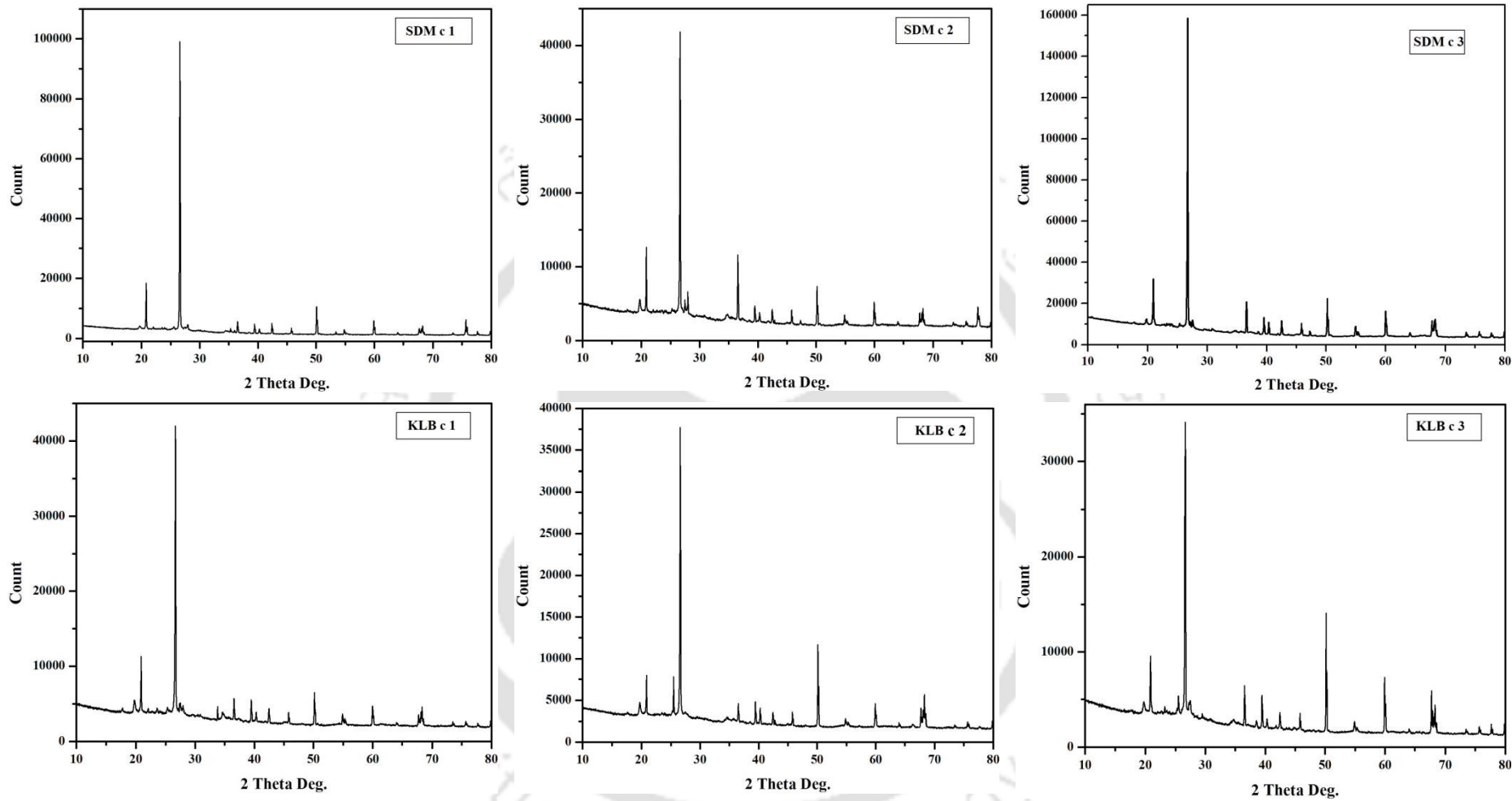


Plate 4. 10: XRD pattern of SDMc1 to SDMc3 and KLBC1 to KLBC3

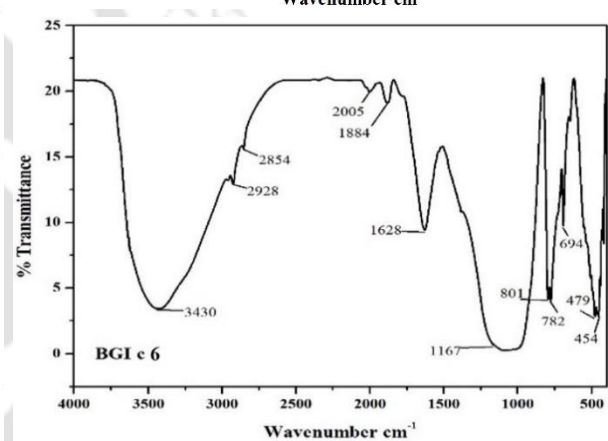
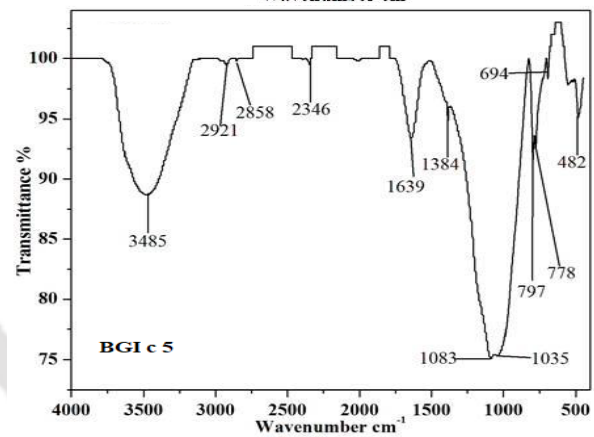
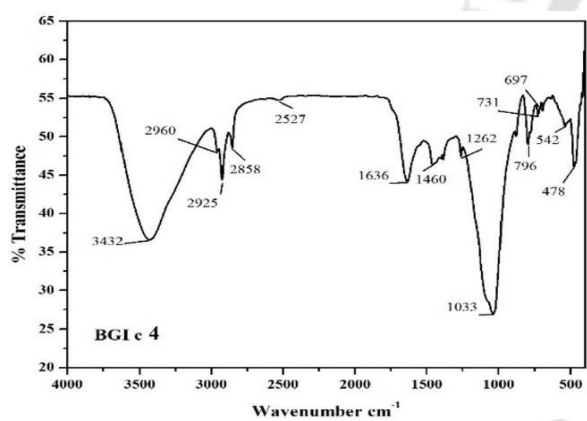
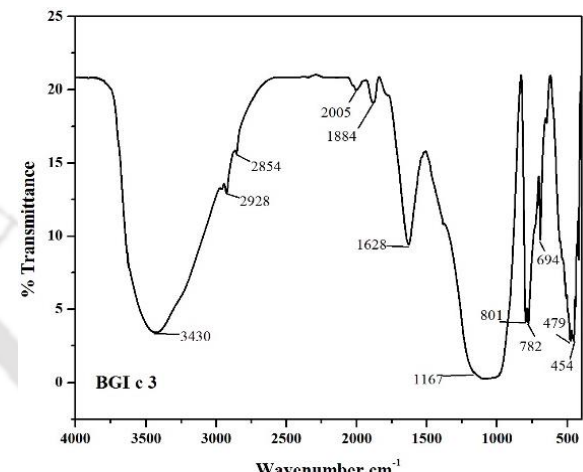
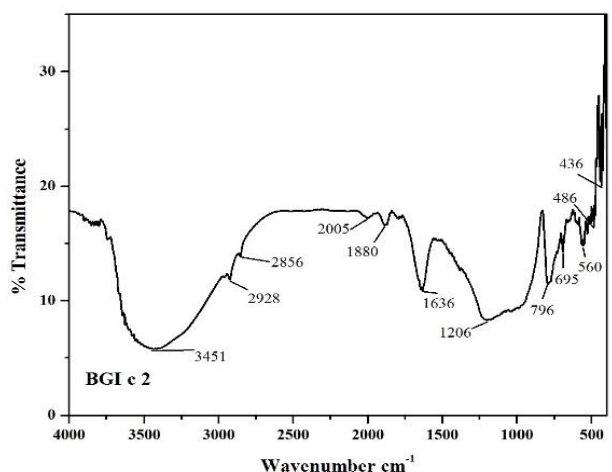
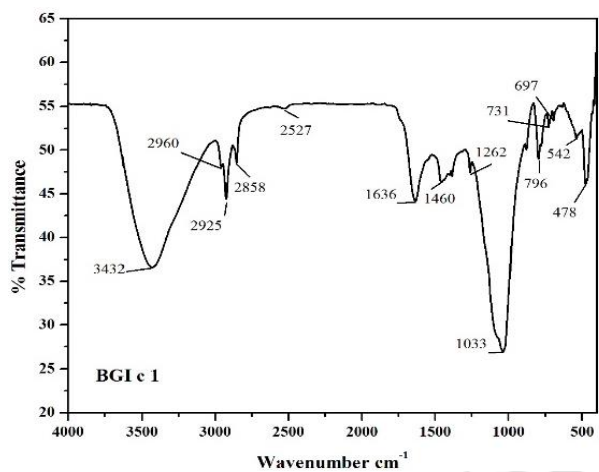


Plate 4. 11: FTIR spectra of BGIc1 – BGIc6

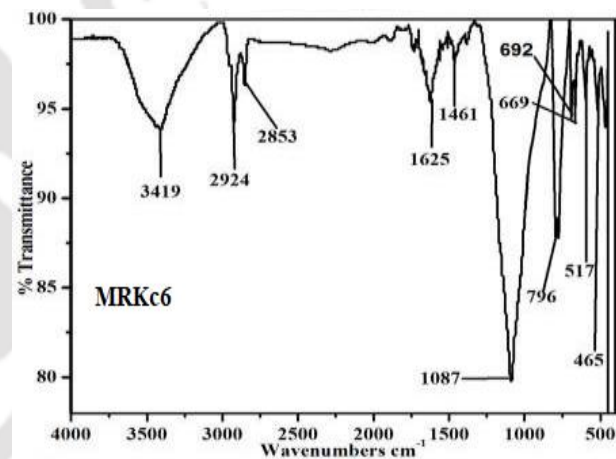
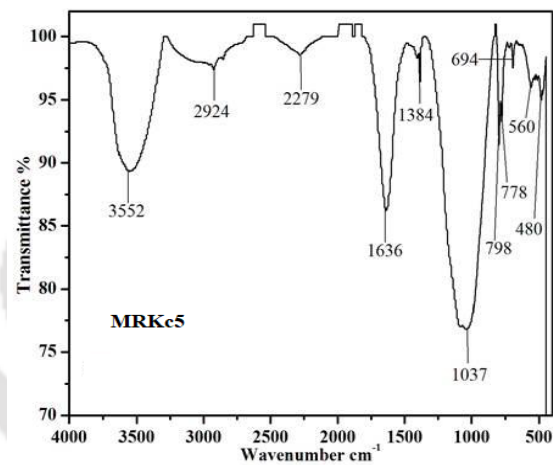
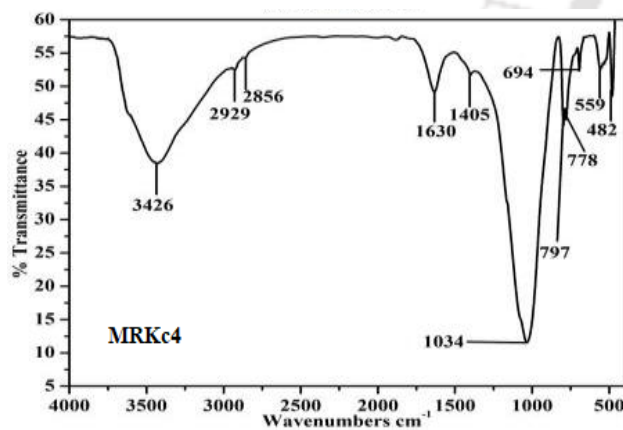
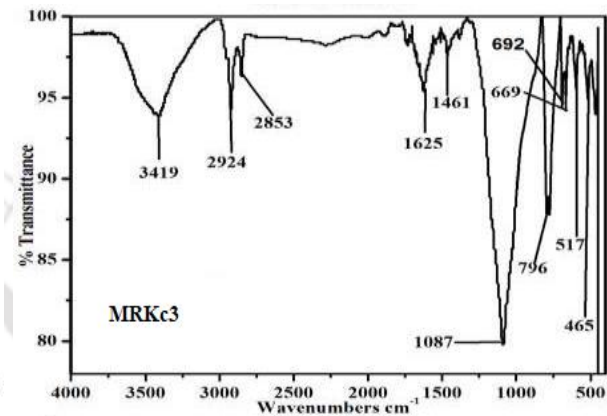
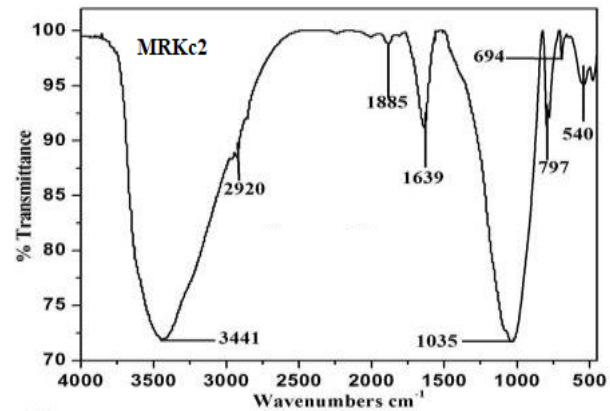
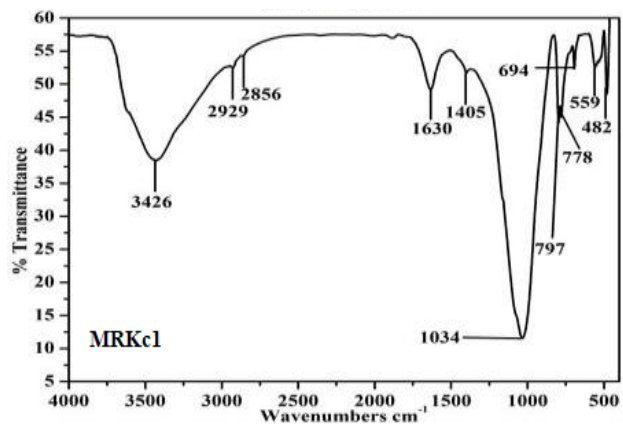


Plate 4. 12: FTIR spectra of MRKc1 – MRKc6

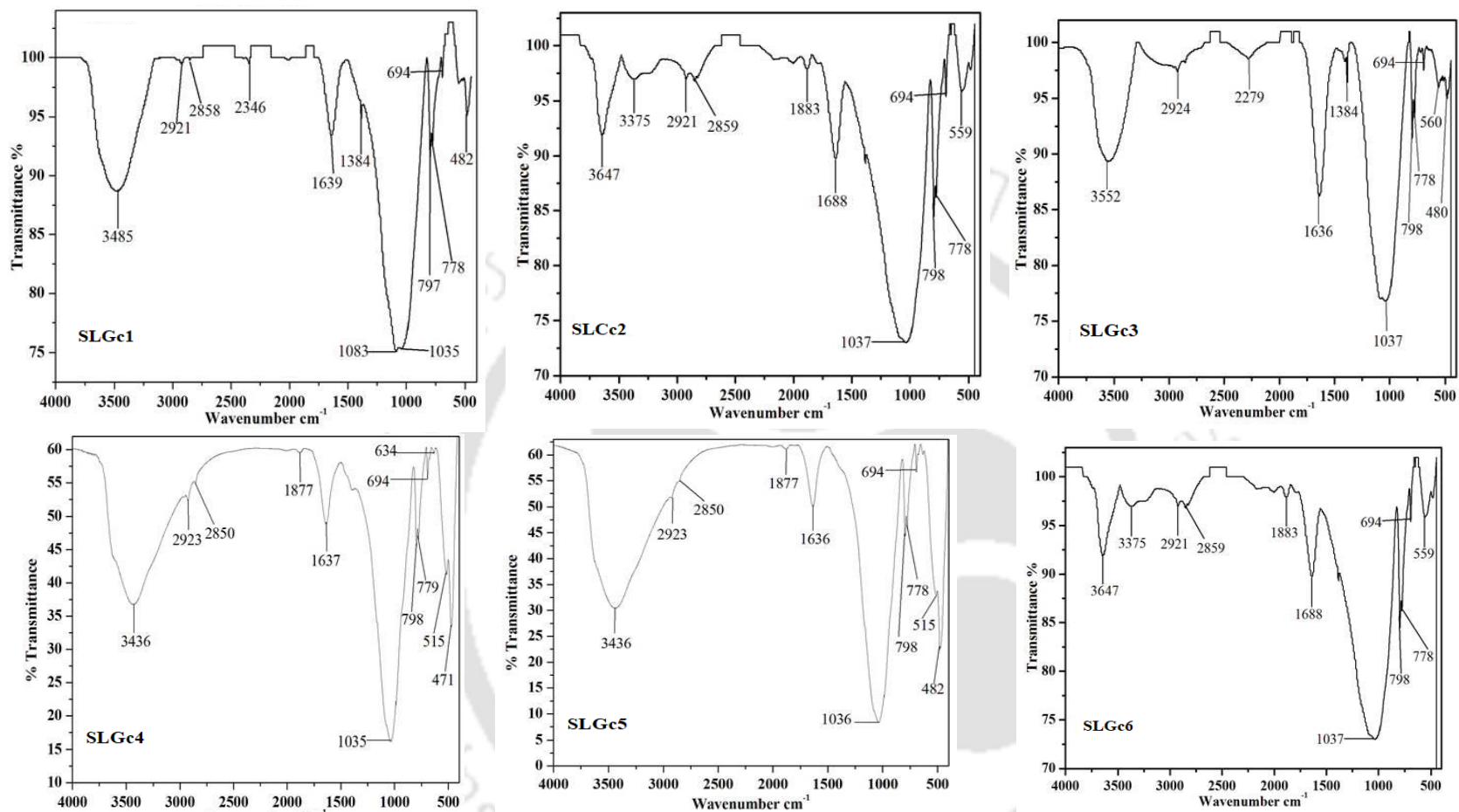


Plate 4. 13: FTIR spectra of SLGc1 – SLGc6

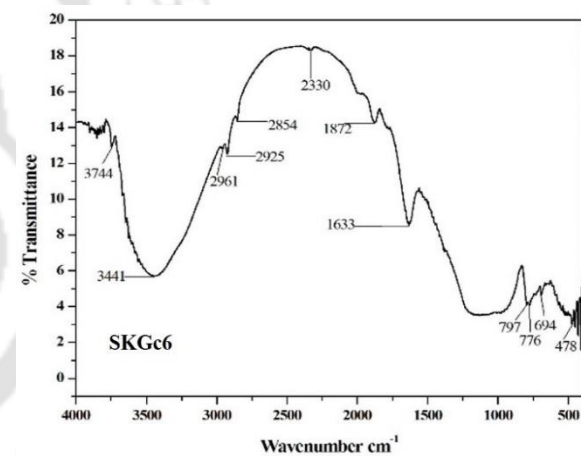
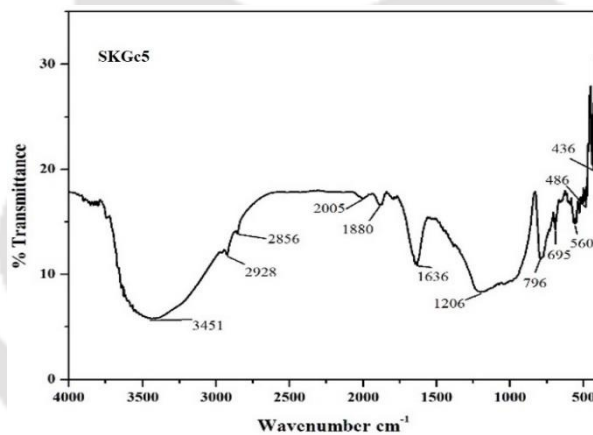
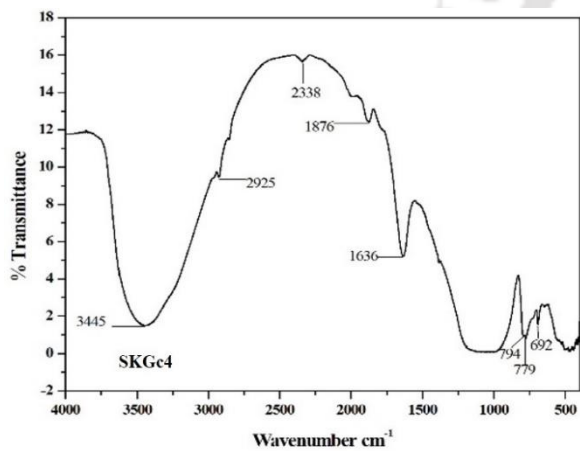
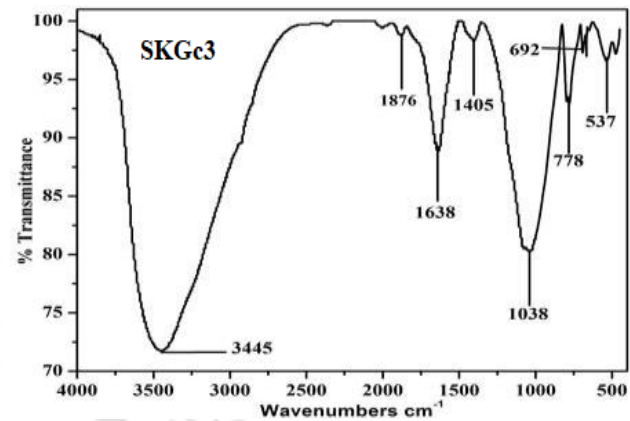
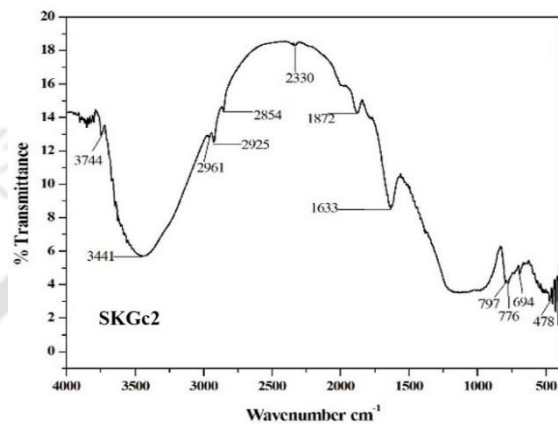
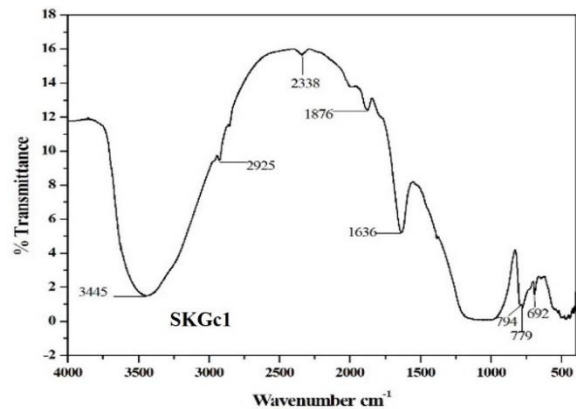


Plate 4. 14: FTIR spectra of SKGc1 – SKGc6

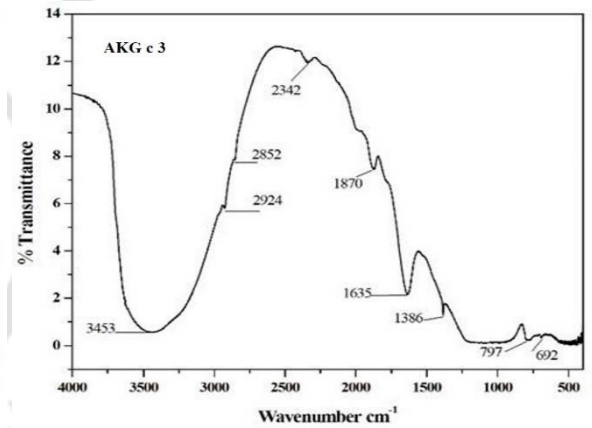
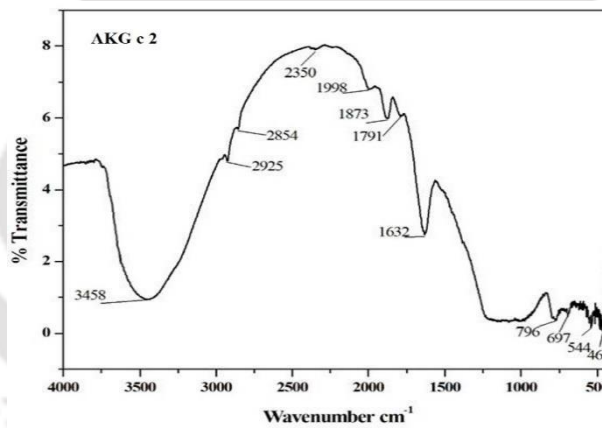
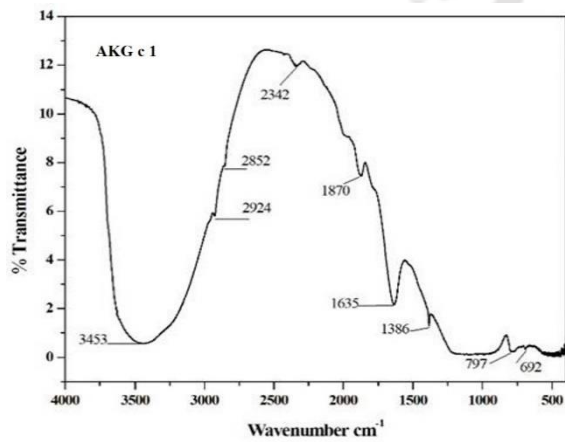
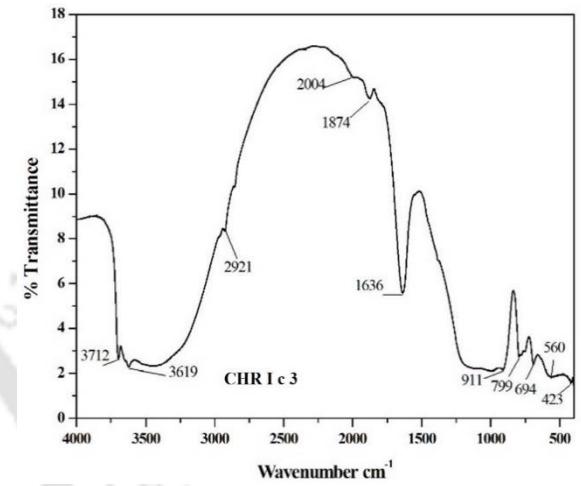
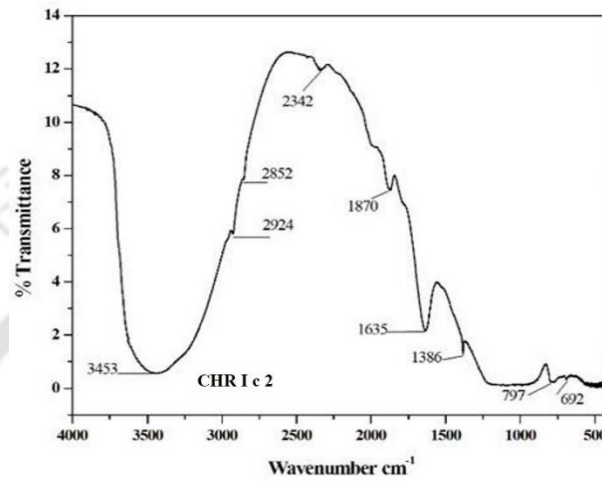
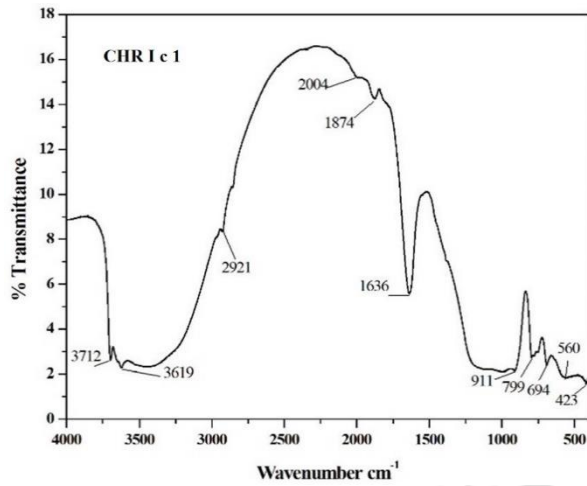


Plate 4. 15: FTIR spectra of CHR I c 1 – CHR I c 3 and AKG c 1 – AKG c 3

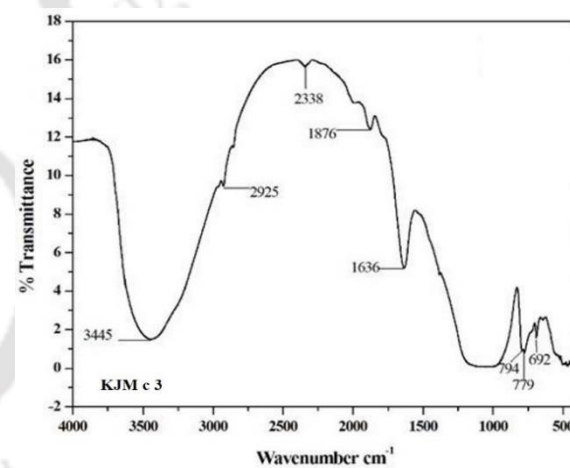
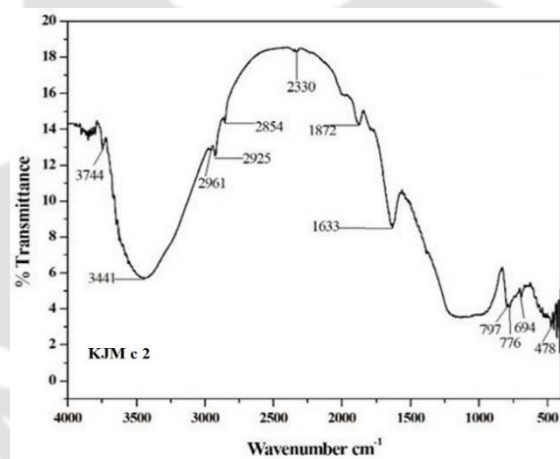
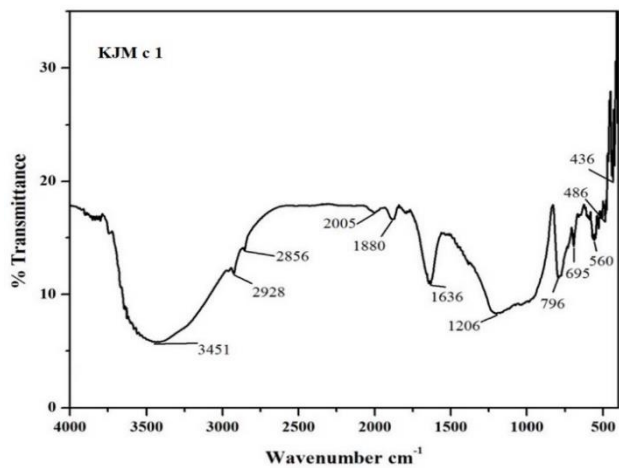
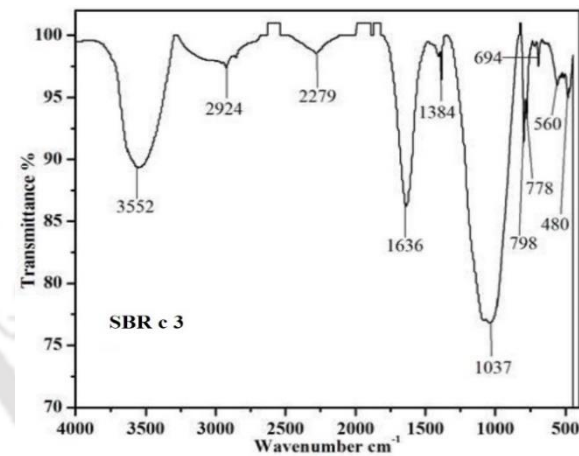
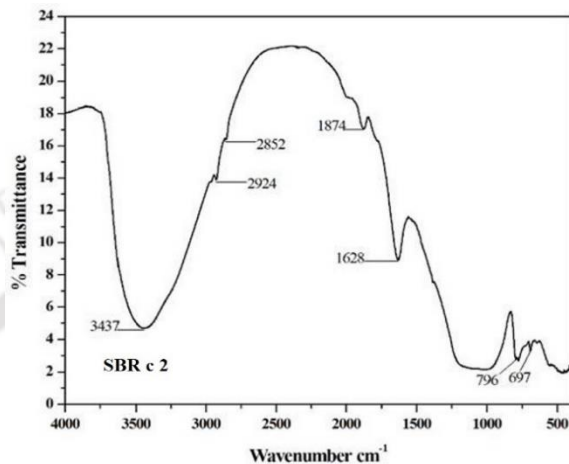
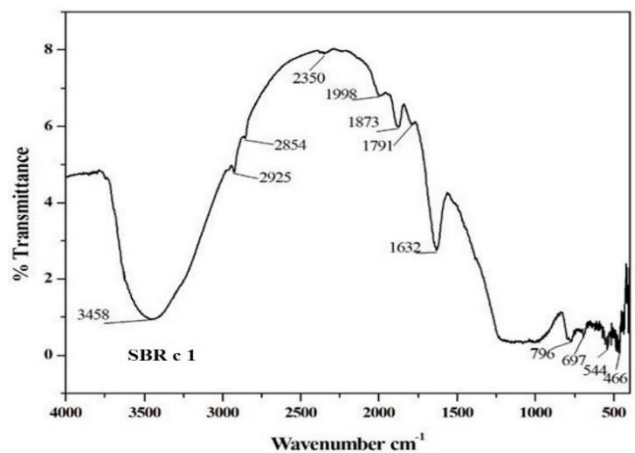


Plate 4. 16: FTIR spectra of SBRc1 – SBRc3 and KJM c1 – KJM3

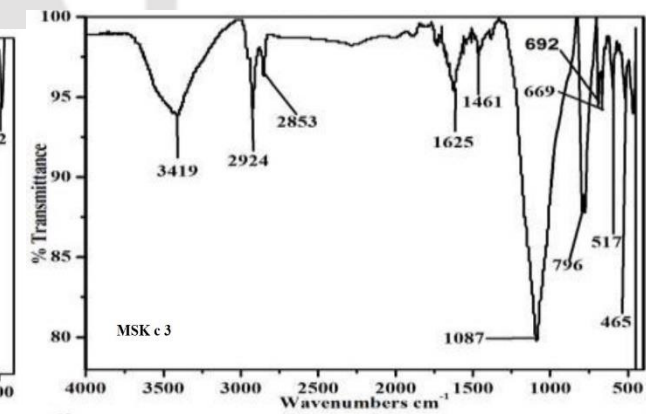
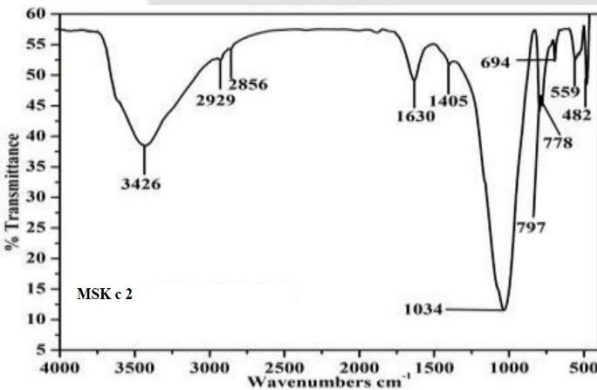
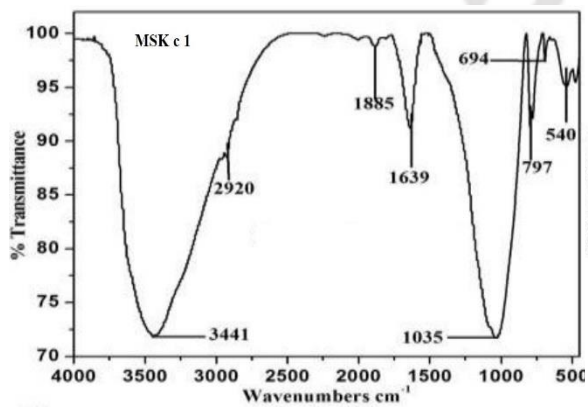
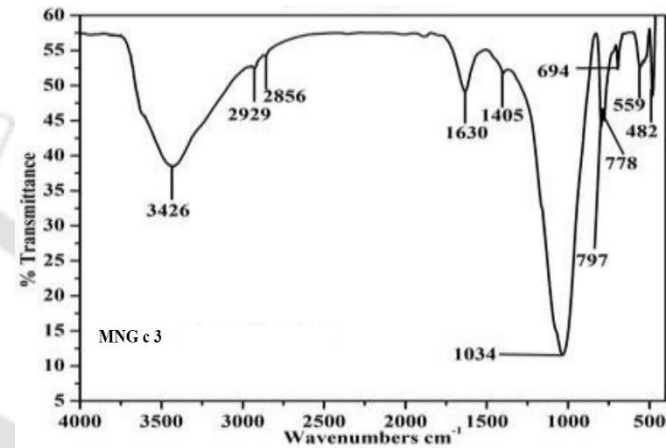
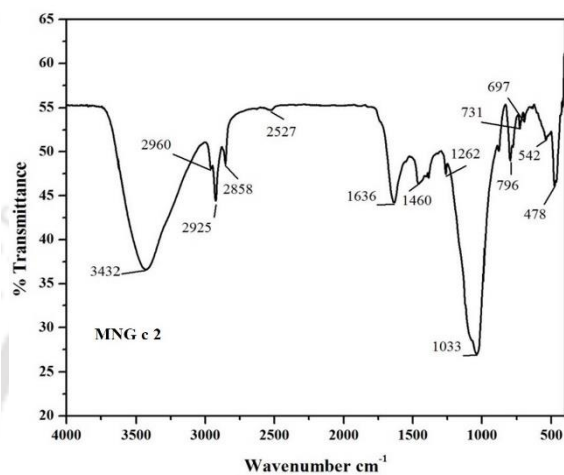
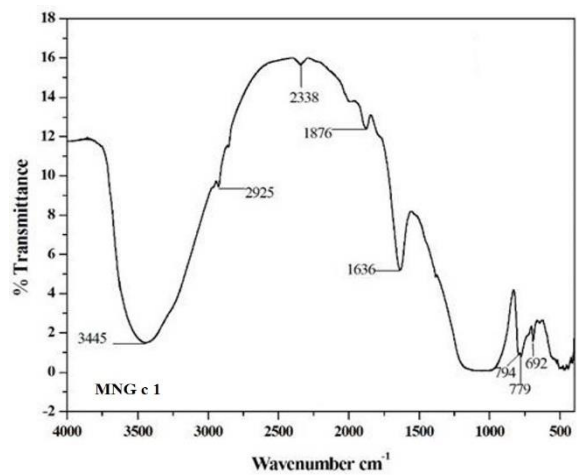


Plate 4. 17: FTIR spectra of MNGc1 – MNGc3 and MSKc1 – MSKc3

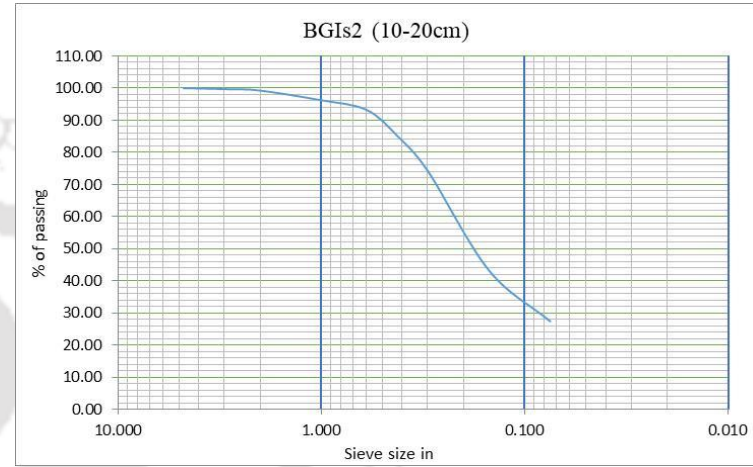
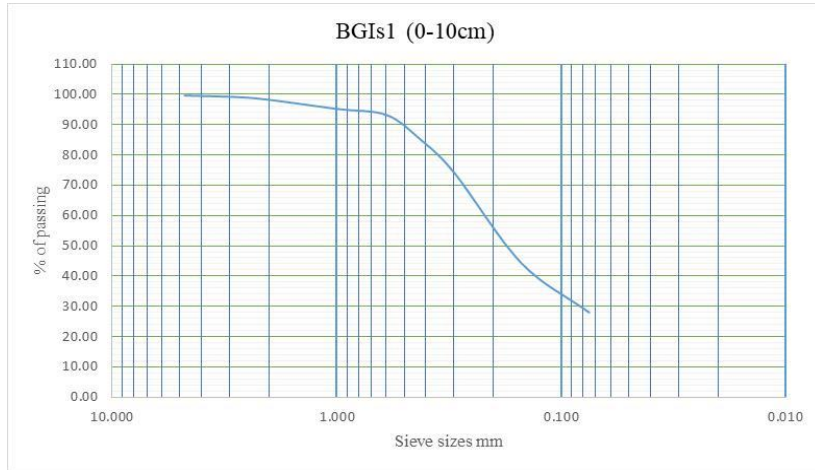


Plate 4. 18: Grain size distribution curve of BGIs1 to BGIs3

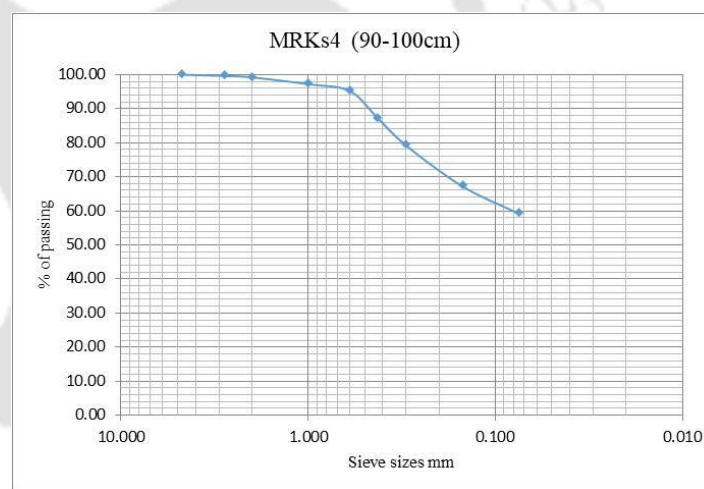
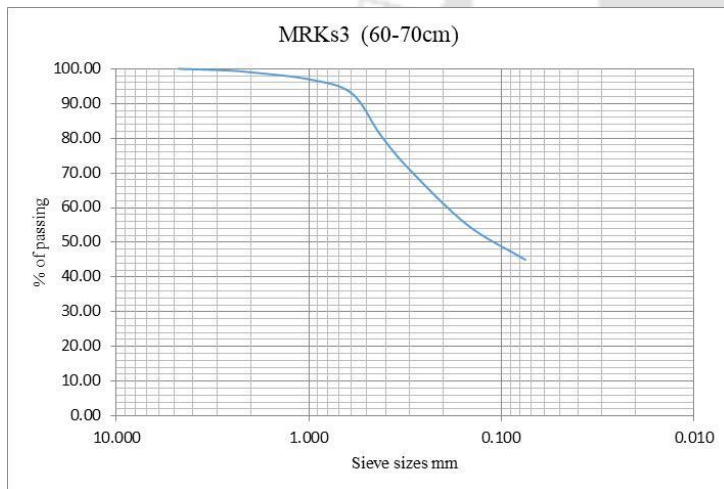
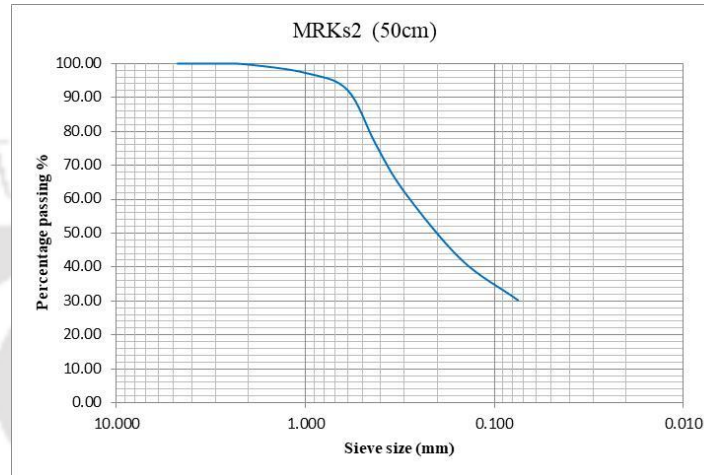
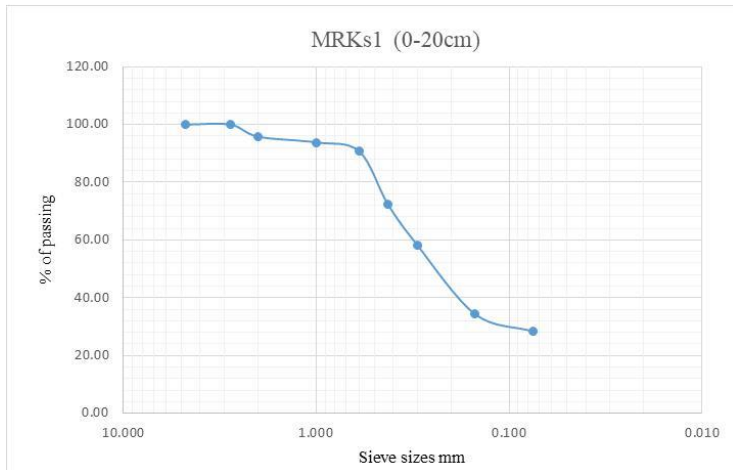


Plate 4. 19: Grain size distribution curve of MRKs1 to MRKs4

Jitendra Kumar

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List of Publications

1. Kumar, J., & Sharma, S. (2019). Slope Instability and Rearrangement of Sealed Sites: A Study in Digaru-Kolong River Valley. *Puratattava: Journal of the Indian Archaeological Society*, 48, 199-209.
2. Kumar, J., & Sharma, S. (2018). Reconnaissance in Search of Sarutaru. *Pratna Samiksha: A Journal of Archaeology*. Centre for Archaeological Studies and Training Eastern India, Kolkata, 9, 1-14.

Collaborations

1. Accelerator Mass Spectrometry (AMS) analysis at Inter-University Accelerator Centre, New Delhi.
 - a. January 08, 2021
BTR No. & Activity: 69110, AMS
Principle Investigator: Prof. Sukanya Sharma
Title: AMS dating of the Archaeological sites of Digaru – Kolong River.
Number of samples sanctioned: 10 Samples (¹⁴C)
 - b. August 01, 2019
BTR No. & Activity: 66105, AMS
Principle Investigator: Prof. Sukanya Sharma
Title: AMS dating of the archaeological sites of Digaru-Kolong river valley, Assam
Number of samples sanctioned: 07 Samples (¹⁴C)

Conferences and Workshops

1. Presented a paper titled “**Slope instability and Rearrangement of Sealed Sites: A Study in Digaru-Kolong River Valley**” in the two days National Seminar on *Relevance of Archaeology in 21ST Century India*, organized by National Institute of Advanced Studies (NIAS), Bengaluru, 24th to 25th July 2018.
2. Presented a paper titled “**An Analytical and Comparative Study of the Terracotta Plaques from the Cotton College site in the collection of Assam State Museum**” in the three days Silver Jubilee Celebration and National Seminar on *Art of Eastern India and Art of Masks: In Social, Cultural and Religious Contexts*, organized by Indian Art History Congress, Guwahati, 22nd to 24th December 2017.
3. Presented a paper titled “**Reconnaissance in Search of Sarutaru**” in the three days National Seminar on Archaeology, History, Art, Museums, and Folklores of the North-East India, organized by Indian Archaeological Society, New Delhi, in collaboration with Rajiv Gandhi University and National Museum Institute, New Delhi, 20th to 22nd April 2017.
4. Presented a paper titled “**Neolithic Cultural Materials from Khasi Hills of Central Meghalaya Plateau**” in the three days International annual conference for the 22nd Himalayan Language Symposium held at the Indian Institute of Technology Guwahati, Assam, India, organized by the Department of Humanities & Social Sciences, Centre for Linguistic Science & Technology, IIT Guwahati, 8th to 10th June 2016.
5. Attended an online course on “**Rock Art of Southeast Asia and the World**” organized by Seameo Regional Centre for Archaeology and Fine Arts, Thailand, from 2nd May to 24th June 2022.
6. Attended Online Workshop on “**Classification in Archaeology**” organized by Artifactual Archaeological Sciences Society, Prayagraj, India, from 5th February to 26th March 2022.
7. Attended a Webinar on “**DELNET Resources & Services**” organized by Nava Nalanda Mahavihara, Nalanda, and DELNET Library Network, on 21st April 2022.
8. Attended three days National Conference on **Buddhism** organized by the Indian Society for Buddhist Studies at Nava Nalanda Mahavihara, Nalanda, Bihar, from 1st to 3rd October 2021.
9. Attended two days National Seminar on “**Relevance of Buddhism and Sanatana Dharam in North East India**” organized by Maharaja Bir Bikram University, Agartala, Tripura, from 30th to 31st October 2021.
10. Attended an online course on “**The Geological Evolution of India: From 3.2 Billion Years to Yesterday**” organized by INSTUCEN Trust, Mumbai, from 29th June to 9th

July 2020.

11. Attended an online course on **“Human Evolution and Prehistory”** organized by INSTUCEN Trust, Mumbai, from 20th April to 3rd May 2020.
12. Attended a Special Course on **“Indian Stone Age in Global Perspective”** organized by *Jnana Pravaha*, Varanasi, from 10th to 19th December 2019.
13. Attended a National Seminar and Workshop on **“Relevance of Archaeology in 21st Century India”** organized by the National Institute of Advanced Studies (NIAS), Bengaluru, on 26th July 2018.
14. Attended a National Seminar on **“Archaeology, History, Art, Museums, and Folklores of the North-East India”** organized by Indian Archaeological Society, New Delhi, in collaboration with Rajiv Gandhi University and National Museum Institute, New Delhi, on 20th to 22nd April 2017.
15. Attended a Workshop on **“Contributions of Earth Sciences to Archaeology”** organized by the Department of Archaeology, Cotton College State University, Guwahati, Assam, on 4th January 2017.
16. Attended a Symposium on **Himalayan Language Symposium** held at the Indian Institute of Technology Guwahati, Assam, India, organized by the Department of Humanities & Social Sciences, Centre for Linguistic Science & Technology, IIT Guwahati, on 8 to 10 June 2016.
17. Attended a Workshop on **“Research Methodology”** organized by the Department of Humanities and Social Science, Indian Institute of Technology Guwahati, from 14th March to 23rd March 2016.
18. Attended an ICPR Sponsored Teachers Meet on **“The Crisis of Multiple Identities in Contemporary World”** organized by ICPR and the Indian Institute of Technology Guwahati, from 15th to 17th February 2016.