Deciphering the Cognitive Genesis of Early Humans: Techno-Typological Insights from Microlithic Assemblages of the Lower Jhaun River during the Late Pleistocene to Early Holocene Epoch

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Abstract

The present study endeavors to undertake a systematic and critical examination of the recently identified Microlithic sites situated along the Lower reaches of the Jhaun River, located within the Bargarh district of Odisha. As a significant tributary of the Mahanadi River system, the Jhaun River appears to have functioned as a vital geomorphological and ecological conduit, facilitating continuous human occupation and cultural development. This occupation seemingly traversed a broad chronological and cultural spectrum extending from the Paleolithic to the Mesolithic epochs. Within the scope of an extensive archaeological reconnaissance, five major Microlithic locales have been documented, each strategically distributed across the surveyed terrain. These sites yield a prolific assemblage of lithic artefacts, offering substantive insight into the adaptive and technological strategies employed by Late Pleistocene hominin to Early Holocene populations. The artefactual repertoire recovered from the Lower Jhaun riverine corridor provides invaluable empirical data concerning settlement dynamics, mobility patterns, and subsistence behavior among Prehistoric communities. Such findings underscore the ecological significance of this landscape as a potential locus for both seasonal and semi-permanent habitation. The ongoing analytical framework encompasses detailed stratigraphic, typological, and spatial studies of the Microlithic deposits, aiming to reconstruct the cultural and cognitive processes underlying early human technological evolution. Ultimately, this research contributes to a broader interpretive paradigm of Prehistoric occupation and lithic innovation in Eastern and Central India.

Keywords: Bargarh, Lower Jhaun, Microlithic, Mesolithic, Techno-Typological Analysis

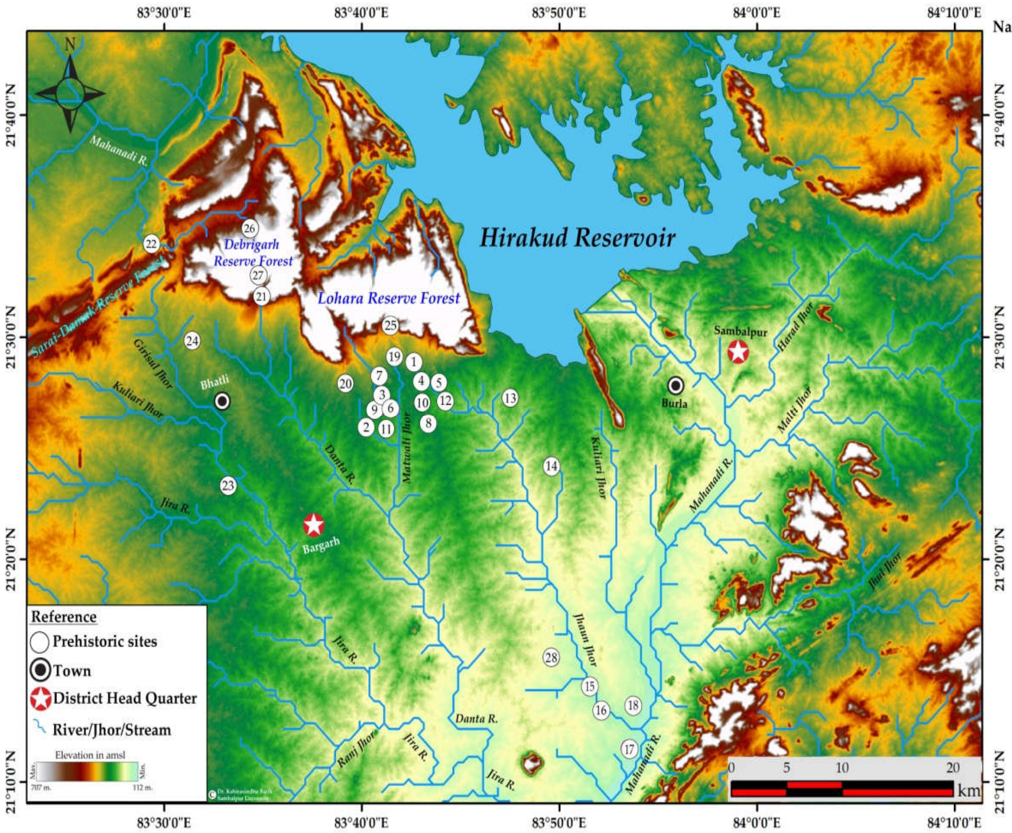
1. Introduction

The systematic reconnaissance of both primary and subsidiary drainage systems within the Bargarh Upland has resulted in the identification of an impressive corpus of Prehistoric sites, encompassing cultural phases from the Paleolithic through the Mesolithic periods. Collectively, these discoveries have begun to illuminate the material and cultural dimensions of early human existence in this region dimensions that had hitherto remained obscure (Behera et al. 2015, Behera & Thakur 2015, Deep 2016, Rana 2018, Barik & Sabale 2021, Behera & Barik 2022, Barik, 2022, Barik et al. 2023, Behera & Barik 2023, Pradhan & Rana 2025).

Despite persistent lacunae in the archaeological record pertaining to quotidian life during these epochs, the perceptive scholarship of archaeologists and historiographers has enabled a credible reconstruction of early hominin life ways through empirical site-based analyses. Over successive millennia, the evolutionary trajectory of human subsistence strategies from foraging and hunting to the initial stages of food procurement has been elucidated through meticulous typological and functional analyses of Prehistoric lithic industries (Rana & Acharya 2019).

Persistent and methodologically rigorous archaeological investigations within the Bargarh region have progressively elucidated a complex cultural stratigraphy encompassing the Acheulian, Middle Paleolithic, Microlithic, and Neolithic cultural complexes. Within contemporary archaeological discourse, the term Microlithic conventionally denotes Mesolithic techno-complexes distinguished by meticulously crafted diminutive implements typically under 40 mm in length and less than 4 mm in thickness (Orliac 1997). The extensive deployment of these microliths, often hafted into organic substrates such as bone, antler, or wood, epitomizes the refined cognitive aptitude and technological ingenuity of Mesolithic populations.

The archaeologically fecund landscape of Bargarh thus emerges as a palimpsest of Prehistoric human enterprise, tracing a continuum from the earliest lithic traditions of the Stone Age to the more sophisticated technological expressions of the Late Pleistocene and early Holocene. Over the preceding triennium, the present authors have undertaken systematic field investigations to delineate the cultural Prehistory of this region, with a particular emphasis on the fluvial geomorphology of the Lower Jhaun River basin. Within this dynamic palaeo landscape, five principal sites Attabira, Manpur, Pandkipali, Deshbhatli, and Baipur have been identified as pivotal nodes of Prehistoric habitation. The lithic assemblages recovered from these locales furnish invaluable insights into the adaptive strategies, techno-economic organization, and socio-cultural trajectories of early human groups inhabiting this hitherto understudied micro-region of Eastern India (**Fig. 1)**.



Name of the Archaeological sites

1	Junani Loc-1
2	Junani Loc-2
3	Junani Loc-3
4	Junani Loc-4
5	Junani Loc-5
6	Junani Loc-6
7	Junani Loc-7
8	Aamjhar
9	Runipali
10	Belbahali
11	Kantal
12	Batimunda
13	Amlipali
14	Attabira
15	Pandkipali
16	Manpur
17	Baipur
18	Deshbhatli
19	Gadgaddalla
20	Ghanghati
21	Aapkhol
22	Nalichuan
23	Halanda
24	Gangei
25	Junani
26	Barabakhara
27	Debrigarh
28	Bindhyabasini

Fig. 1. DEM Map of the Study Area

2. Synopsis of Precedent Archaeological Inquiries

Archaeological inquiry across Odisha, initiated nearly a century ago, has incrementally illuminated a constellation of Prehistoric sites distributed along riverine terraces, upland corridors, piedmont slopes, and cave complexes. Yet, vast segments of this terrain remain archaeologically uninvestigated, thereby sustaining profound epistemological lacunae in the reconstruction of the region's anthropogenic antiquity (Mendaly 2019). Intermittent explorations across the state have, however, revealed vestiges of Microlithic cultural transformations manifest across a spectrum of geomorphic milieus.

In the specific context of the Bargarh Upland, the initial reconnaissance of Microlithic sites along the Jira River was undertaken by Mishra (Mishra 1998), who documented assemblages in its lower reaches proximate to Bargarh town. This pioneering effort was subsequently augmented by K. Seth's downstream investigations extending to the Mahanadi confluence, wherein seven sites bearing Microlithic artefacts were recorded in Lower Jira valley (Seth 1995). Parallel inquiries were conducted by S. Panda in the Ong Valley (Panda, 1996), S. Mishra in the upper Jira segment (Mishra 1998), and J. Naik in the lower Bheden valley (Naik 2005). Between 2011 and 2015, P.K. Behera and Neena Thakur executed extensive survey operations across the

Bargarh district, culminating in the identification of numerous hitherto unrecorded archaeological loci (Thakur 2015). Complementary contributions emanated from the Girsul Valley by S. Mendaly (Mendaly 2012) and the lower Jira catchment (Deep 2020), particularly emphasizing lithic resource exploitation in the Ranj and Danta sectors by S. Deep (Deep 2016).

The present research extends this intellectual continuum through systematic exploration and analytical assessment of artefactual materials retrieved from the lower Jhaun River corridor. These lithic inventories have undergone a meticulous technological and typological evaluation, subsequently juxtaposed with cognate assemblages from other Microlithic bearing localities within the Bargarh Upland. This comparative framework facilitates a nuanced contextualization of the material culture within the broader of late Pleistocene to Early Holocene techno-complex and its adaptive interplay with the regional geomorphic and ecological substratum **(Fig. 2)**.

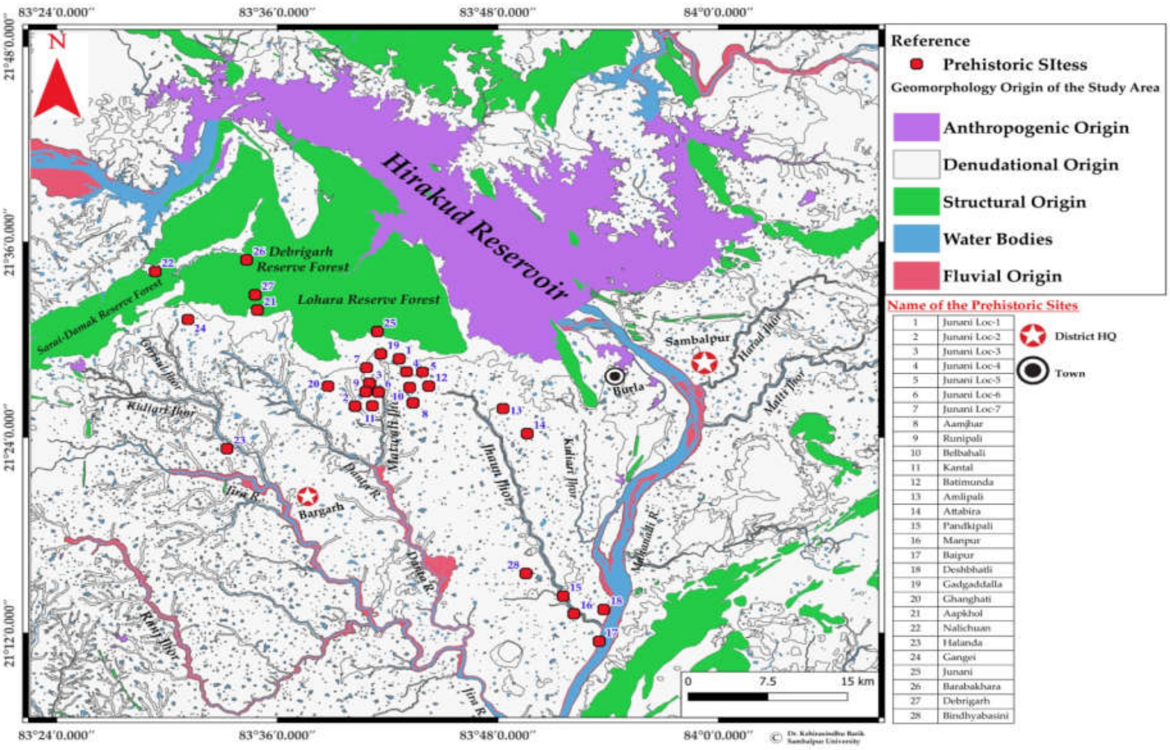


Fig. 2. Geomorphological Map of the Study Area

3. Research Objectives:

The present study is guided by the following objectives:

1. To map the archaeological sites of the Lower Jhaun River basin and document their spatial distribution.

2. To assess the present environmental conditions of the study area in relation to the establishment and sustainability of hominin occupation.

3. To analyze the nature of material culture pertaining to prehistoric tool-making through systematic site contextualization.
4. To conduct a techno-typological analysis of the Microlithic assemblage recovered from the study area.
5. To reconstruct the cultural landscape, mobility patterns, and chronological framework of prehistoric communities in the Lower Jhaun River region during the Late Pleistocene to Early Holocene Epoch.

4. Methodological Paradigm and Research Instruments

4.1 Spatial Domain of the Present Research

The present archaeological investigation aspires to undertake a rigorous, multidimensional exploration of the geomorphological and cultural landscape delineated by the expansive and diminutive tributaries of the Jhaun River. Originating from the Barapahad Hills, these sinuous watercourses pursue a meandering trajectory until their confluence with National Highway 6 (NH6), traversing an altitudinal gradient fluctuating between 150 and 200 meters above mean sea level. Revered as a vital hydrographic artery, the Jhaun River has indelibly shaped the spatial configuration and cultural evolution of the Paleolithic habitation zones across the Bargarh region, ensuring both ecological sustenance and anthropological continuity **(Fig. 3)**.

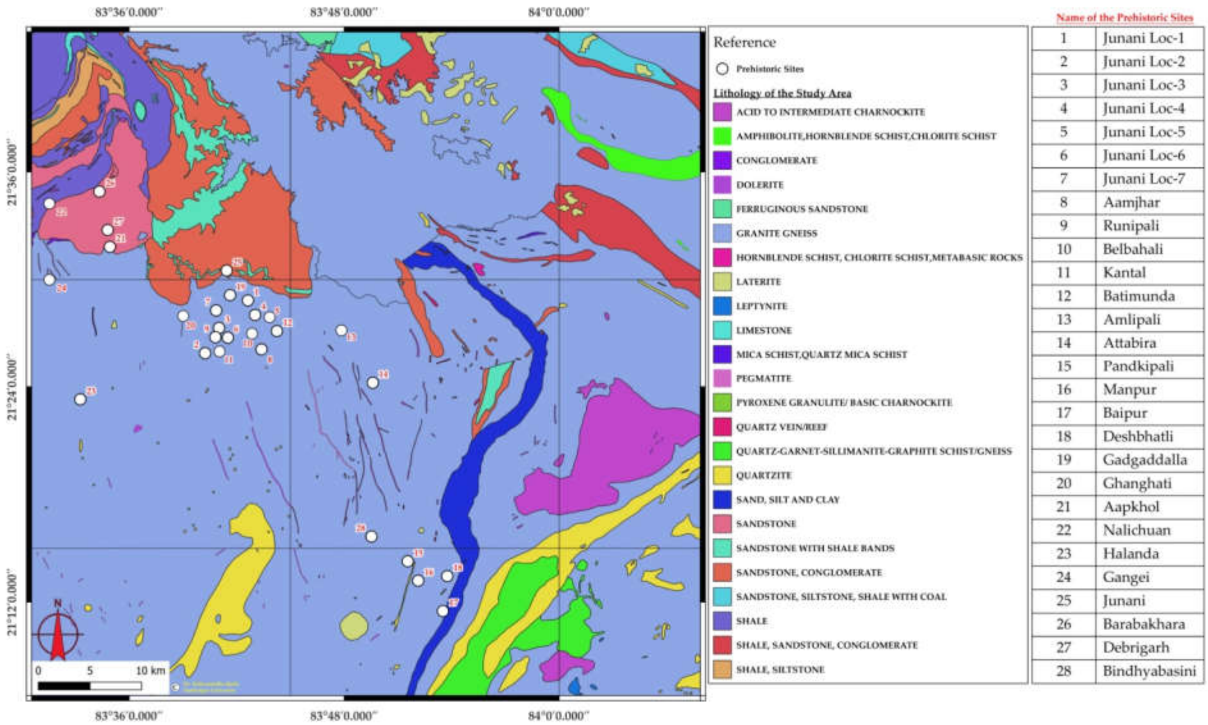


Fig. 3. Lithology Map of the Study Area

From its nascent spring in the Barapahad range, the river meanders through an intricate mosaic of locales Junani, Belbahali, Kaantal, Aamjhar, Batimunda, and Attabira before intersecting NH6 and ultimately merging with the Mahanadi River (Rana 2018). The foothill tracts of this hydrological corridor are studded with Prehistoric settlements of significant archaeological consequence. Among these, Attabira, Manpur, Pandkipali, Deshbhatli, and Baipur stand as noteworthy loci, lying within the jurisdictional peripheries of Attabira and Bheden blocks. Encompassing these domains, the Bargarh Upland, nurtured by the perennial flow of the Jhaun, has historically furnished the hydrographic stability indispensable for the continuity and resilience of early human occupation.

4.2 Topographical and Geomorphological Attributes

Situated within the South-Western Hill Tract of the Odisha Highlands, the Bargarh District manifests a complex physiographic configuration an eloquent interplay between its undulating uplands and fertile alluvial expanses. Dominating its geomorphology is the Bargarh Plain, an extensive alluvial formation dissected by a reticulate network of minor fluvial systems such as the Danta, Ong, and Jira Rivers. To the north, the district is securely buttressed by the Barapahad Hill Range, while the southwestern periphery merges into the Ong River Valley. The eastern frontier, in contrast, is defined by the Mahanadi Basin, a locus of sustained agrarian fertility owing to its rich alluvial substratum and perennial hydrological affluence.

Geomorphologically, Bargarh is divisible into two principal macro-units- the undulating uplands, largely occupying the southern and southwestern sectors, and the dissected plains, which dominate the northern and western quadrants. The central physiographic corridor emerges as a gently undulating terrain, encompassing expansive tracts of cultivable land and maintaining an elevation continuum between 285 meters and 120 meters above mean sea level.

As an integral constituent of the Indian Peninsular Plateau, the district's physiography is punctuated by a constellation of residual hills and low-altitude ranges notably the Gandhamardan, Barapahad, and Jhanjpahad interwoven with ancillary forested tracts that lend ecological depth and geomorphic diversity to the region. Of particular prominence is the Barapahad Range, extending over approximately 777 square kilometers, culminating at Debrigarh, the district's highest elevation point at 2,267 feet (691.1 meters). This summit, distinguished by its plateau-like morphology, is abundantly endowed with hydrological and ecological resources, rendering it an ideal locus for eco-touristic and health-oriented development **(Fig. 4).**

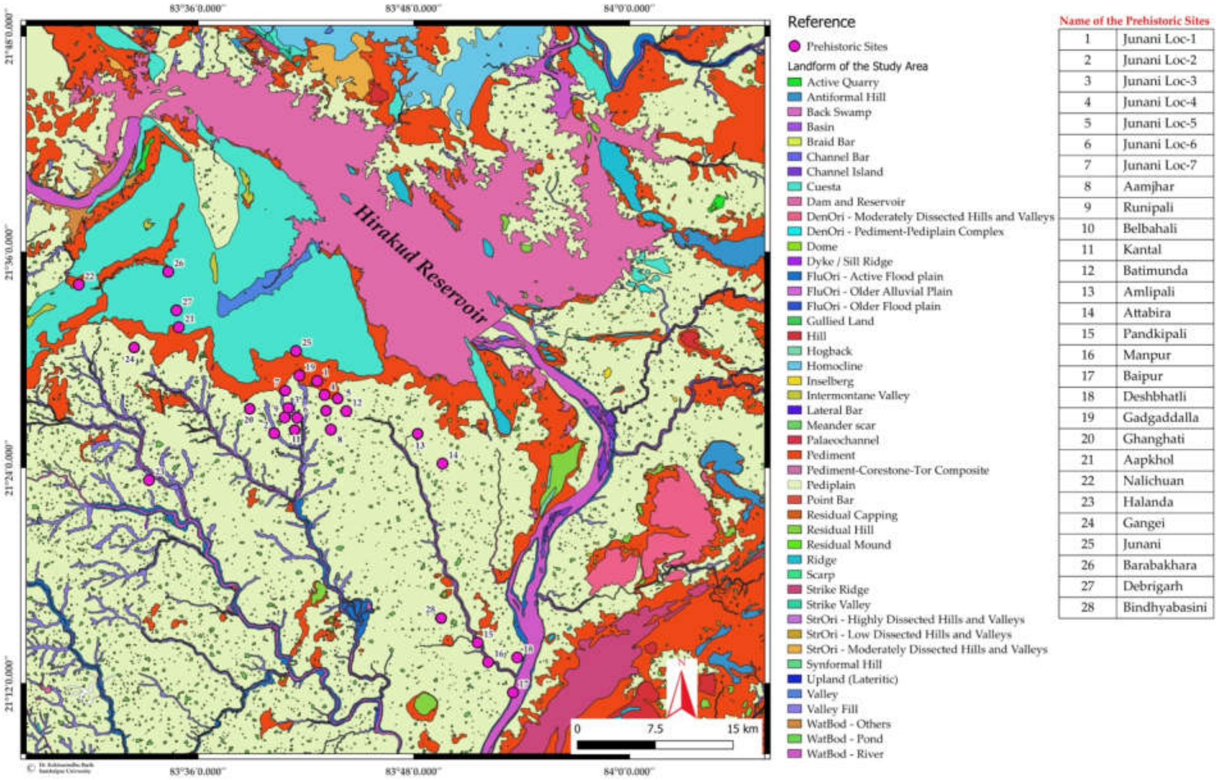


Fig. 4. Landform Geology of the Study Area

The ecological equilibrium and biological endemism sustained within these uplands underscore their role as a crucial bio-geographical enclave, not merely in shaping the environmental matrix of Bargarh but also in facilitating the Prehistoric human adaptive strategies that once flourished along the Jhaun River Basin (Rana 2018).

5. Composition of stone tools

The Mesolithic cultural manifestations of Odisha may be broadly classified into two principal categories open-air sites and rock-shelter habitations. From a geomorphological perspective, these locales further resolve into distinct physiographic contexts namely, riverine valley systems, hilltop or slope-oriented occupations, and elevated hillock formations (Deep 2016).

Comprehensive archaeological reconnaissance undertaken in the Lower Jhaun River, in conjunction with adjoining area, has culminated in the discovery of Five stratigraphically and spatially significant microlithic sites Attabira, Manpur, Pandkipali, Runipali, Deshbhatli and Baipur each contributing to the reconstruction of a coherent regional chronological framework **(Fig. 5 and Table 1)**.

Fig. 5. General view of Deshbhatli site

Sl. No	Name of the sites	Core	%	Flake	%	Blade	%	Bladelet	%	Hammer Stone	%	Chip / Chunk	%	Total	Percentage
1	Attabira	90	28.48	166	52.53	14	4.43	27	8.54	---	---	19	6.01	316	19.96
2	Manpur	39	17.97	118	54.37	21	9.67	17	7.83	---	---	22	10.13	217	13.70
3	Pandkipali	51	25.37	93	46.26	14	6.96	24	11.94	---	---	19	9.45	201	12.69
4	Deshbhatli	52	20	154	59.23	15	5.76	18	6.92	---	---	21	8.07	260	16.42
5	Baipur	115	19.52	264	44.82	82	13.92	90	15.28	2	0.33	36	6.11	589	37.20
Total	5 sites	347	21.92	795	50.22	146	9.22	176	11.11	2	0.12	117	7.39	1583	99.97

Table 1. Lithic Assemblage of the Study Area

The cumulative assemblage from these sites encompasses 1583 lithic artifacts, representing a robust corpus of technological variability. The typological spectrum comprises Cores (N is 347), Flakes (N is 795), Blades (N is 146), Bladelets (N is 176), Hammer stones (N is 2) and Chips/Chunks (N is 117) (**Fig. 6)**.

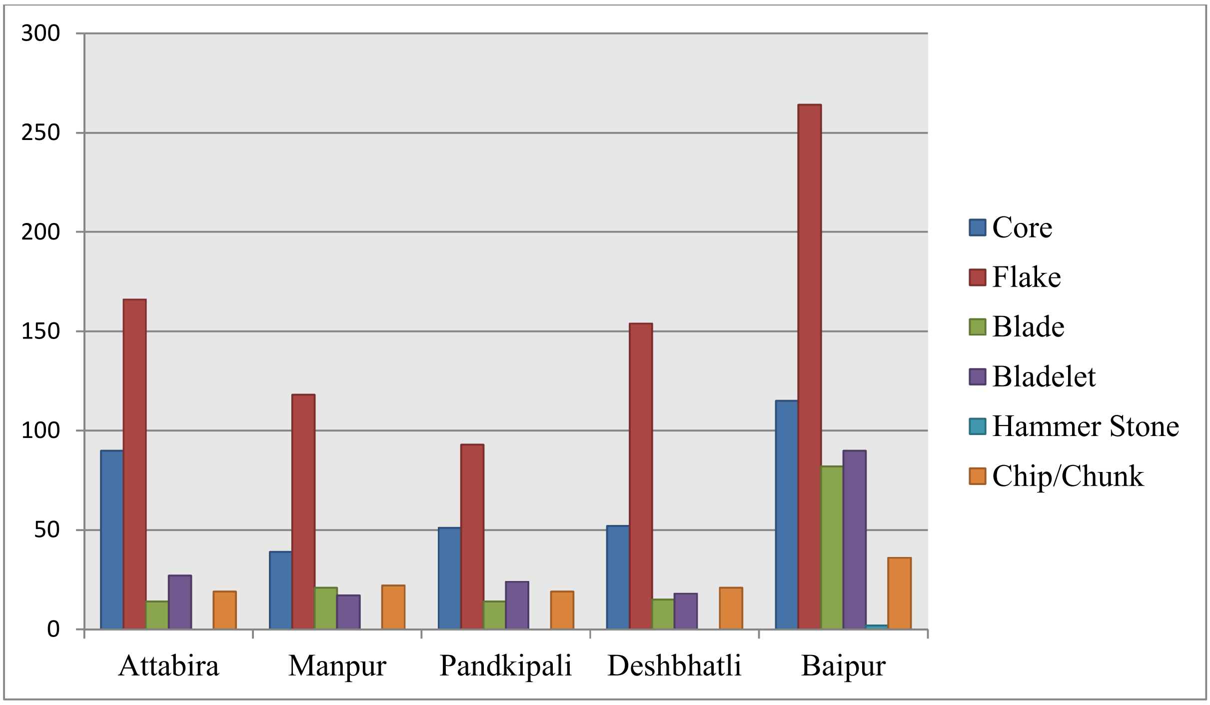


Fig. 6. Lithic Assemblage of the Study Area

Among these, Flakes overwhelmingly dominate the assemblage, reflecting their technological primacy within the lithic reduction strategies of the Mesolithic inhabitants. Such predominance implies a deliberate technological orientation towards flexible Flake-based production systems, facilitating adaptive tool design and functional diversity in subsistence practices.

6. Raw Materials and Their Use

Archaeological materials whether organic or inorganic derive intrinsically from naturally occurring geological sources, devoid of artificial synthesis (Herz & Garrison 1988). The raw lithic resources identified across the surveyed sites have been heuristically classified into five gradational textural categories, very fine, fine, coarse, very coarse, and indeterminate.

The Barapahad hill complex functioned as the principal lithic procurement zone, serving as a quarrying nucleus for Prehistoric populations. It is plausible that these groups exercised selective exploitation of specific litho-types, a process that both mirrored and fostered cognitive and technological sophistication during the course of their cultural evolution (Rana 2018).

The regional geomorphological substratum reveals a sequential lithostratigraphic progression encompassing Archean formations, succeeded by Dharwarian, Cuddapah, Lower Gondwana, Tertiary, and ultimately Quaternary deposits. The landscape is punctuated by extensive Quartzite and silicified rock outcrops, complemented by doleritic dykes, Quartz veins, and Chert beds (Singh 1971). These lithological constituents provided a technologically versatile medium for tool production extending from the Pleistocene into the early Holocene **(Table 2).**

Raw Material type	Core	%	Flake	%	Blade	%	Bladelet	%	Hammer Stone	%	Chip/ Chunk	%	Total in nos.	Percentage
Chert	196	20.69	477	50.36	76	8.02	81	8.55	---	---	117	12.35	947	59.82
Quartz	34	24.63	93	67.39	1	0.72	10	7.24	---	---	---	---	138	8.71
Quartzite	27	22.5	83	69.16	8	6.66	---	---	2	1.66	---	---	120	7.58
Agate	65	24.43	122	45.86	51	19.17	28	10.52	---	---	---	---	266	16.80
Chalcedony	25	22.32	20	17.85	10	8.92	57	50.89	---	---	---	---	112	7.07
Grand Total	347	21.92	795	50.22	146	9.22	176	11.11	2	0.12	117	11.18	1583	99.98

Table 2. Raw Materials of the Study Area

Among the diverse raw materials, Chert emerges as the preferred litho-type, distinguished by its abundant local availability, fine-grained texture, and superior conchoidal fracturing properties attributes that rendered it exceptionally amenable to controlled knapping techniques. The strategic selection of Chert underscores a refined understanding of lithic mechanics and reflects an adaptive response to the evolving subsistence and ecological dynamics at the threshold of the late Pleistocene and Holocene epoch **(Fig. 7 and Fig. 8).**

Fig. 7. Microlith on Section Attabira Site and **Fig. 8.** Lithic Scatter Artefact of Deshbhatli Site

Quantitative analysis of the lithic inventory from the Lower Jhaun River basin indicates a distinct material preference: Chert 59.82% (N is 947) constitutes the majority, followed by Quartz 8.71% (N is 138), Quartzite 7.58% (N is 120), Agate 16.80% (N is 266), and Chalcedony 7.07% (N is 112).

A graphical visualization particularly through a pie chart representation effectively elucidates the proportional distribution and material selection pattern, thereby accentuating the technological choices and resource optimization strategies employed by Mesolithic populations within this culturally and geologically dynamic landscape (**Fig. 9).**

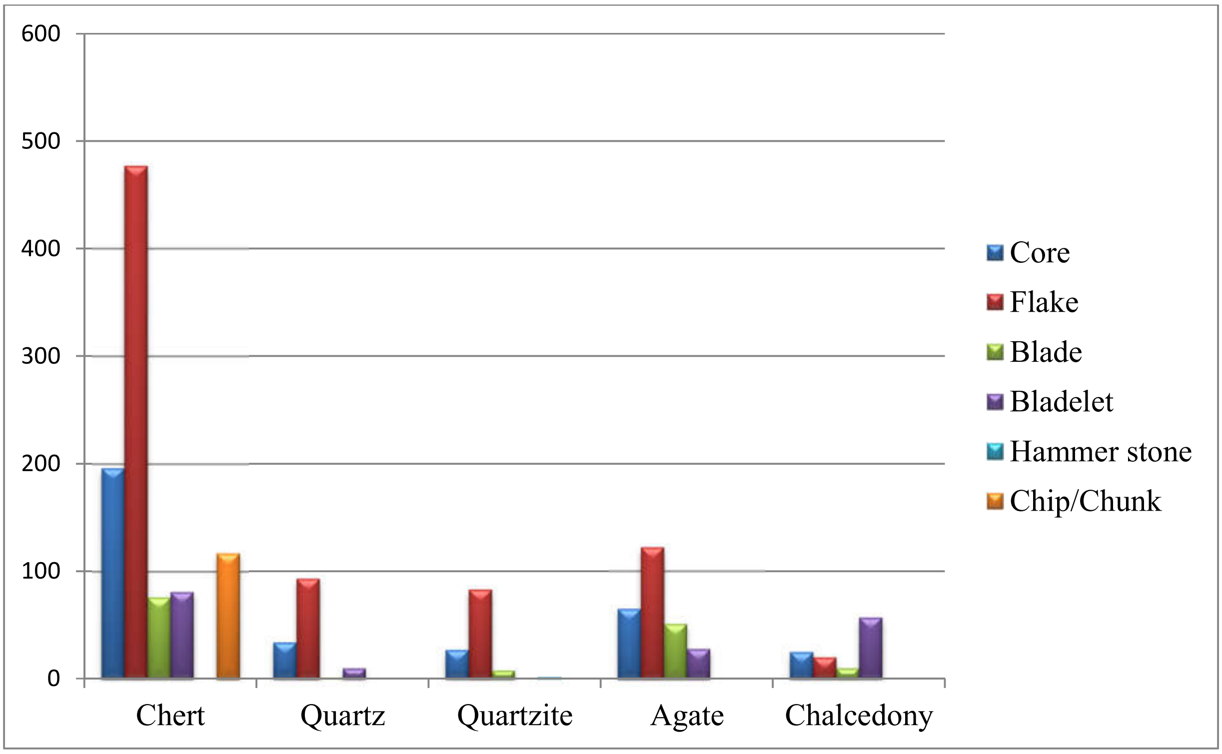


Fig. 9. Raw Materials of the Study Area

7. Lithic Inventory of the Study Region

The lithic corpus of the study area reveals a discernible evolutionary trajectory, transitioning from rudimentary Core biface and chopper-chopping implements to a more refined, Flake-based technological paradigm, epitomized by the application of the Levallois technique. Within the framework of lithic technological discourse, diagnostic tool categories including choppers, chopping implements, and side scrapers have been systematically documented, reflecting both functional specialization and technological sophistication.

8. Outcome

The technological continuum evident within the assemblage underscores a marked shift from a Core biface/chopper-chopping tradition towards a predominantly Flake-oriented lithic industry, structured around the methodological principles of the Levallois technique. Examination of the tool assemblage reveals diagnostic categories such as choppers, chopping tools, and side scrapers, which collectively indicate a nuanced and dynamic lithic system. The assemblage thus captures the transitional silhouette from Core biface instruments to a sophisticated Flake-based industry, demonstrating the interplay of technological innovation and functional optimization in Prehistoric lithic production.

9. Techno-lithic Genesis and Morpho-structural Taxonomy of the Artefacts

9.1 Core

Cores, representing the primary lithological substrates typically flint nodules or slabs are taxonomically classified according to their morphological characteristics and the technological schema of detached products, including Blades, Bladelets, and Flakes. As the principal progenitors of lithic debitage, Cores exhibit diverse morphological configurations, reflecting the culmination of reduction sequences characterized by systematic detachment, tool production, and eventual resource exhaustion (Mendaly 2019) **(Table 3).**

Site Name	Chert	%	Quartz	%	Quartzite	%	Agate	%	Chalcedony	%	Total	%
Attabira	61	67.77	9	10	---	---	20	22.22	---	---	90	25.93
Manpur	19	48.71	7	17.94	4	10.25	9	23.07	---	---	39	11.23
Pandkipali	29	56.86	4	7.84	6	11.76	8	15.68	4	7.84	51	14.69
Deshbhatli	45	86.53	2	3.84	1	1.92	2	3.84	2	3.84	52	14.98
Baipur	42	36.52	12	10.43	16	13.91	26	22.60	19	16.52	115	33.14
Total	196	56.48	34	9.79	27	7.78	65	18.73	25	7.20	347	99.97

Table 3. Analysis of the Core Group of the Study Area

The archaeological survey enumerated 347 Core implements within the study region. Typological variants include Flake Cores, Blade Cores, Blade-Bladelet Cores, and Flake-Blade Cores. The lithic matrix comprises materials such as Quartzite, Quartz, Chert, Agate, and Chalcedony, indicative of selective procurement strategies and material versatility (**Fig. 10 and Fig. 11**).

Fig.10. Core tool of Baipur Site

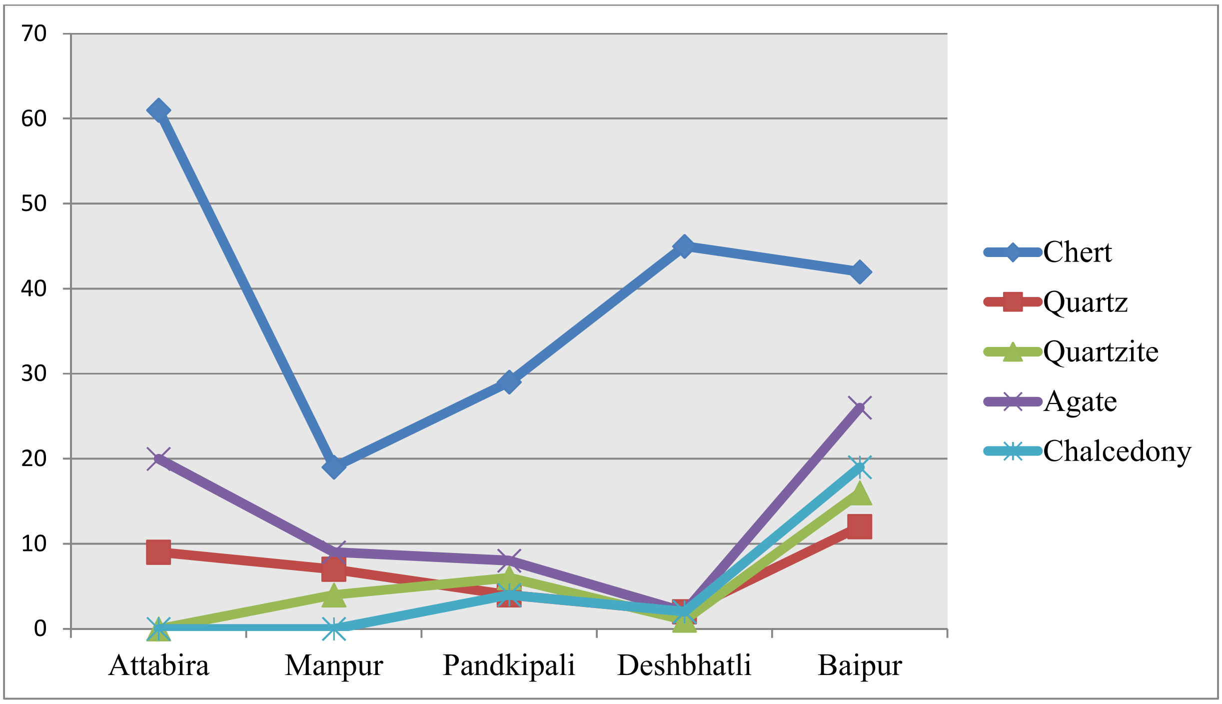


Fig. 11. Pie charts of the percentage of raw materials (Core)

9.2 Flake

Flakes constitute a central element of Middle Paleolithic lithic technology and are integral to the techno-functional evolution of Prehistoric tool typologies. This phase is characterized by temporal and spatial consistency, reflecting a coherent operational framework of lithic manufacture, with Flakes occupying a primary functional domain **(Fig. 12)**.

Typologically, a Flake is defined as a lithic artifact whose length does not exceed twice its breadth, displaying variable dorsal morphologies and edge configurations. Flakes often exhibit parallel or divergent lateral margins and are frequently subjected to secondary retouching to enhance functional efficacy. The typological repertoire derived from Core reduction includes scrapers, awls, projectile points, and Blades, all meticulously modified to meet specific utilitarian demands **(Table 4).**

Site Name	Chert	%	Quartz	%	Quartzite	%	Agate	%	Chalcedony	%	Total	%
Attabira	108	65.06	12	7.22	10	6.02	36	21.68	---	---	166	20.88
Manpur	77	65.25	13	11.01	12	10.16	16	13.55	---	---	118	14.84
Pandkipali	55	59.13	8	8.60	11	11.82	16	17.20	3	3.22	93	11.69
Deshbhatli	116	75.32	22	14.28	12	7.79	3	1.94	1	0.64	154	19.37
Baipur	121	45.83	38	14.39	38	14.39	51	19.31	16	6.06	264	33.20
Total	477	60	93	11.69	83	10.44	122	15.34	20	2.51	795	99.98

Table 4. Assessment of Flake Tools from the Study Area

Fig. 12. Flake tools of Baipur Site

The present investigation documents a total of 795 Flake artifacts, predominantly recovered from the Jhaun River basin and the lower escarpments of Barapahad. The lithic raw materials identified within the assemblage encompass Quartzite, Quartz, Chert, Chalcedony, and Agate, reflecting both local availability and selective procurement strategies **(Fig. 13)**.

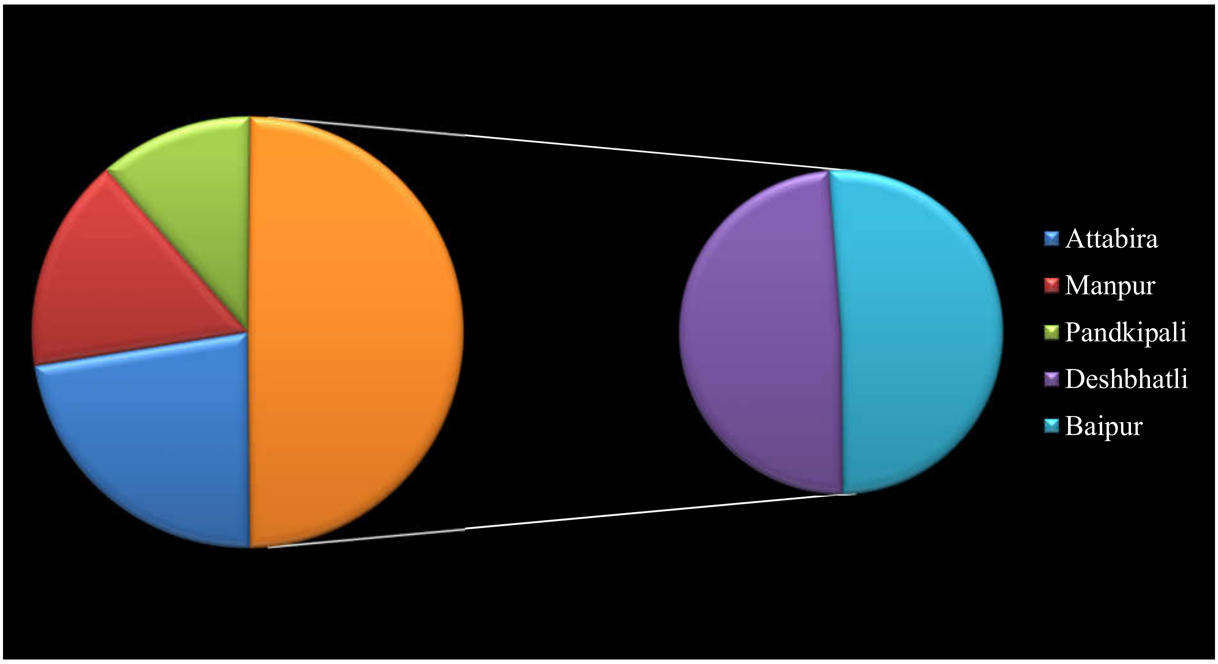


Fig. 13. Pie charts of the percentage of raw materials (Flake)

9.3 Blade

Following the typological framework established by Tixier (Tixier 1963), a Blade is archaeologically characterized as an elongated, slender lithic fragment with acutely sharpened edges, produced via deliberate detachment from a prepared Core, typically employing percussion techniques. The dimensional criterion stipulates that the length must be at least twice the width. Functionally, Blades may serve directly as cutting implements or act as blanks for subsequent refinement into bifacial tools such as knives, burins, or perforators. Diagnostic attributes include minimal dorsal cortex coverage and the presence of one or more longitudinal dorsal ridges aligned parallel to the axis of percussion (Mendaly 2019) **(Table 5).**

Site Name	Chert	%	Quartz	%	Quartzite	%	Agate	%	Chalcedony	%	Total	%
Attabira	6	42.85	1	7.14	2	14.28	5	35.71	---	---	14	9.58
Manpur	14	66.66	---	---	---	---	3	14.28	4	19.04	21	14.38
Pandkipali	12	85.71	---	---	---	---	2	14.28	---	---	14	9.58
Deshbhatli	15	100	---	---	---	---	---	---	---	---	15	10.27
Baipur	29	35.36	---	---	6	7.31	41	50	6	7.31	82	56.16
Total	76	52.05	1	0.68	8	5.47	51	34.93	10	6.84	146	99.97

Table 5. Study of Blade tools from the Study Area

Morphologically, Blades display parallel lateral margins and consistent dorsal scar patterns, indicative of skilled knapping **(Fig. 14 and Fig. 15)**.

Fig. 14. Blade Tools of Baipur Site

Archaeological exploration within the Barapahad hills and Jhaun River valley, particularly at site N-146, has yielded a substantial Blade complex assemblage. Preliminary raw material assessment indicates that the Blades were predominantly knapped from locally sourced Chert, with specimens exhibiting minimal weathering and a remarkable degree of preservation. The majority of artifacts are fashioned from black, green, and brown Chert, typologically defined by their acute edges and morphological precision, underscoring their utility in diverse functional contexts, particularly cutting and slicing operations.

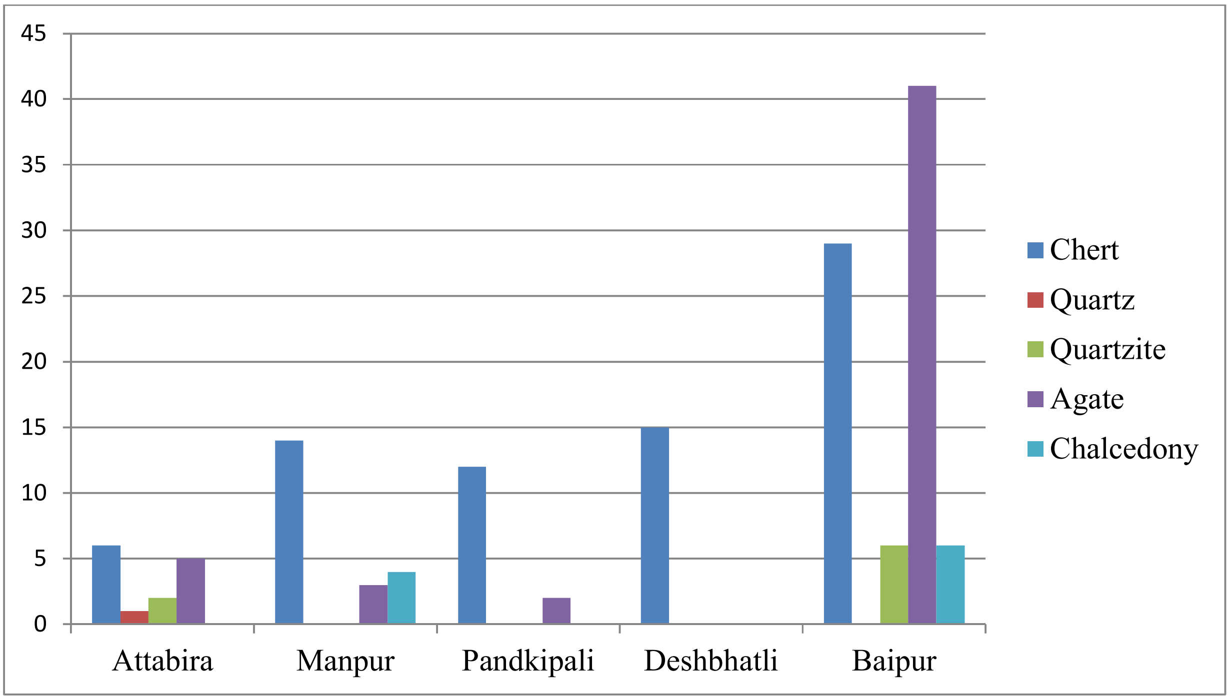


Fig. 15. Pie charts of the percentage of raw materials (Blade)

9.4 Bladelets

Bladelets, defined as diminutive derivatives of Blades, measure under 50 mm in length and not exceeding 12 mm in width (Mendaly 2019), typically ranging between 15–45 mm in length and 5–11 mm in width. These narrow lithics are detached from conical or wedge-shaped micro-Cores using advanced techniques such as punch-striking and pressure-flaking **(Table 6).**

Site Name	Chert	%	Quartz	%	Agate	%	Chalcedony	%	Total	%
Attabira	10	37.03	---	---	4	14.81	13	48.14	27	15.34
Manpur	13	76.47	---	---	1	5.88	3	17.64	17	9.65
Pandkipali	9	37.5	---	---	4	16.66	11	45.83	24	13.63
Deshbhatli	18	100	---	---	---	---	---	---	18	10.22
Baipur	31	34.44	10	11.11	19	21.11	30	33.33	90	51.13
Total	81	46.02	10	5.68	28	15.90	57	32.38	176	99.97

Table 6. Study of Bladelet tools from the Study Area

Bladelets were frequently retouched into microlithic implements, forming critical components of composite tools **(Fig. 16 and Fig. 17).**

Fig. 16. Bladelet tools of Baipur Site

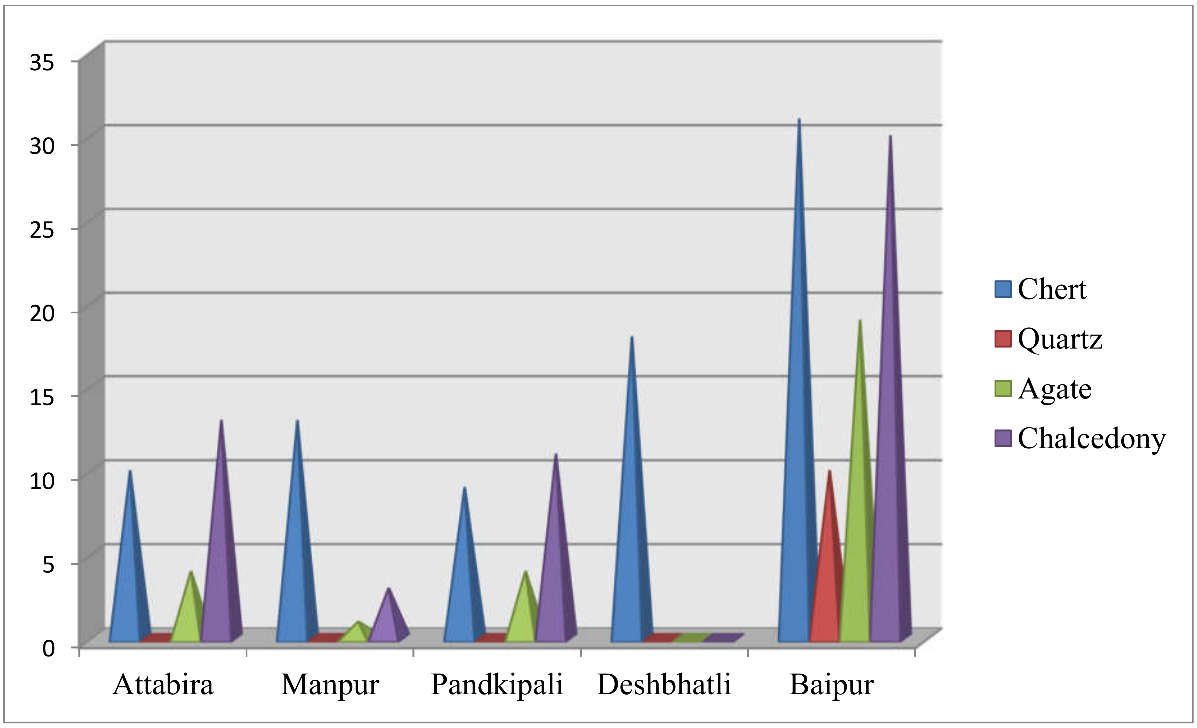


Fig. 17. Pie charts of the percentage of raw materials (Bladelet)

The survey documented 176 Bladelets, predominantly manufactured from Chert and Chalcedony, reflecting sophisticated lithic reduction strategies.

9.5 Hammer Stones

Hammer stones, serving as percussive implements, are composed of mechanically resilient lithologies including dolerite, Quartzite, and other coarse-grained rocks. These tools were strategically selected for their capacity to withstand repetitive impact, facilitating the detachment of substantial Flakes or Cores. As observed by M'Guire (M'guire 1891, Mendaly and Hussain 2015), Prehistoric populations demonstrated nuanced understanding of lithic material properties, optimizing tool selection for specific functional requirements. Within the current investigation, the site of Baipur yielded the sole documented hammer stone, highlighting its likely role in primary reduction processes rather than as finished tools.

9.6 Chips and Chunks

Byproducts of lithic reduction, categorized as chips and chunks, constitute a significant portion of the assemblage. Chips, typically under 15 mm, are often considered unusable due to irregular morphology, while chunks, though larger, also lack diagnostic features indicative of tool function. Collectively termed debitage, these fragments attest to active tool production processes. Fieldwork along the Jhaun River and the lower Barapahad slopes documented 102 such fragments, corroborating the interpretation of the site as a lithic workshop or production locus (Mendaly & Hussain 2015).

10. Techno – Typological Analysis

This displays a table titled Techno – Typological Analysis of the Study area that categorizes various tool types based on debitage types like Core, Flake, Blade, and Bladelet, showing their respective totals and percentages **(Table 7).**

Sl. No	Tool type	Debitage Type				Total	Percentage
		Core	Flake	Blade	Bladelet		
1	Alternately Retouched Flake	---	9	---	---	9	4
2	Awl	---	8	---	---	8	3.55
3	Backed Bladelet	---	---	---	7	7	3.11
4	Borer	---	7	4	---	11	4.88
5	Concave Side Scrapper	6	---	---	---	6	2.66
6	Convex Backed Blade/Point	---	---	5	6	11	4.88
7	Convex End Scrapper	---	6	---	---	6	2.66
8	Convex Side Scrapper	---	5	4	---	9	4
9	Denticulate	---	6	4	---	10	4.44
10	Denticulate + Transverse Burin	---	7	---	---	7	3.11
11	End Scrapper	---	8	3	---	11	4.88
12	Levallois Core	6	---	---	---	6	2.66
13	Levallois Flake	---	11	---	---	11	4.88
14	Levallois Point	---	6	---	---	6	2.66
15	Lunate	---	---	---	6	6	2.66
16	Marginally Retouched	---	8	---	---	8	3.55
17	Micro Burin	---	9	---	---	9	4
18	Micro Denticulate	---	---	---	8	8	3.55

19	Notch	---	10	4	---	14	6.22
20	Notch + Denticulate	---	6	---	---	6	2.66
21	Offset Burin	---	9	---	---	9	4
22	Partially Retouched	---	6	5	3	14	6.22
23	Retouched Point	---	---	6	---	6	2.66
24	Side Scrapper	---	9	---	---	9	4
25	Transverse Burin	---	7	---	---	7	3.11
26	Transverse Scrapper	---	6	---	---	6	2.66
27	Trapeze	---	---	---	5	5	2.22
	Grand Total	12	143	35	35	225	99.88

Table 7. Techno – Typological Analysis of the Study area

Specifically, the table lists twenty-seven tool types with their distribution across these debitage categories. The tool types include Alternately Retouched Flake (9 total, 4%), Awl (8 total, 3.55%), Backed Bladelet (7 total, 3.11%), Borer (11 total, 4.88%), Concave Side Scraper (6 total, 2.66%), Convex Backed Blade/Point (11 total, 4.88%), Convex End Scraper (6 total, 2.66%), Convex Side Scraper (9 total, 4%), Denticulate (10 total, 4.44%), Denticulate + Transverse Burin (7 total, 3.11%), End Scraper (11 total, 4.88%), and Levallois Core (6 total, 2.66%).

This has been showing with various categories related to stone tools or lithic analysis. The table has columns for different counts and a percentage column labeled with "99.88" as the grand total percentage. The categories listed include Levallois Flake, Levallois Point, Lunate, Marginally Retouched, Micro Burin, Micro Denticulate, Notch, Notch + Denticulate, Offset Burin, Partially Retouched, Retouched Point, Side Scraper, Transverse Burin, Transverse Scraper, and Trapeze. Each category has counts in four columns with a fifth column showing percentages like 4.88, 2.66, 2.66, 3.55, 4, 3.55, 6.22, 2.66, 4, 6.22, 2.66, 4, 3.11, 2.66 and 2.22 percentage for respective categories.

11. Discussion

The identification of five Microlithic sites along the Lower Jhaun River represents a pivotal contribution to our understanding of Prehistoric human settlement in the Bargarh district of Odisha. The spatial concentration of these sites along a principal tributary of the Mahanadi River suggests that early hominin groups deliberately selected ecologically advantageous locales to facilitate habitation, resource exploitation, and perhaps seasonal mobility. The Jhaun river valley, functioning as a natural corridor, appears to have enabled either continuous occupation or recurrent episodic use across multiple cultural phases, spanning from the Paleolithic to the Neolithic. This riverine alignment echoes broader archaeological paradigms in which proximity to freshwater sources critically influenced Prehistoric settlement strategies.

The lithic assemblages, characterized by diagnostic microliths including Blades, scrapers, and points, underscore a technologically sophisticated lithic tradition. Such artefacts imply a subsistence economy likely predicated on hunting and foraging, reflecting both technological continuity and adaptive ingenuity. Their presence across open-air contexts, particularly along the riverine terraces of the Jhaun, indicates nuanced patterns of landscape utilization, potentially correlated with diverse functional or seasonal activities.

Importantly, these newly documented sites address a longstanding lacuna in the Prehistoric archaeological mapping of Western Odisha, a region hitherto underrepresented in studies of Microlithic culture. The findings extend the documented geographical range of Eastern Indian Microlithic communities and enrich our comprehension of regional variability in tool typology and settlement behavior. Comparative analyses with neighboring cultural spheres, such as the Chhattisgarh plateau and the Central Indian region, may elucidate broader trajectories of cultural interaction, diffusion, or independent parallel development.

Future investigations, incorporating systematic excavation and multidisciplinary approaches including paleoenvironmental reconstruction promise to illuminate the dynamic interplay between ecological factors and human adaptive strategies in this region, offering deeper insights into the resilience and ingenuity of Prehistoric populations.

12. Conclusion

The revelation of Mesolithic habitations scattered across diverse regions of the Indian subcontinent profoundly enriches our understanding of the evolutionary trajectory of early human civilizations. The emergence of microlithic technology, documented as early as 48,000 years Before Present (BP) at Mehtakheri, Madhya Pradesh (Misra 2002), 35,000 BP at Jwalapuram, Andhra Pradesh (Clarkson et al. 2009), and further substantiated at Inamgaon, Maharashtra, within the temporal bracket of 25,000–28,000 BP (Murty 1979), underscores a widespread and enduring pan-Indian diffusion of this lithic tradition. Complementary discoveries at Kana (46,000 BP) and Mahadebbera (37,000–28,000 BP) in the Purulia district of West Bengal (Basak et al. 2014) further corroborate the extensive geographic and chronological dissemination of microlithic industries. Morphological variations within lithic assemblages signify recurrent and sustained Prehistoric occupation across these landscapes, highlighting adaptive strategies and technological sophistication. The OSL dating of upper level of second unit of Totajunga site of Bargarh upland suggest that the hominine occupation was established before 12.8± 2.8 years ago (Behera & Thakur 2015). The artifacts from the Lower Jhaun River demonstrate technological affinities with lithics from the Bargarh Upland and adjoining terrains suggesting a broader cultural and technological coherence (Behera & Thakur 2015, Deep 2016, Pradhan & Rana 2025, Pradhan et.al 2025).

The principal aim of this study was to delineate the cultural and technological configuration of the microlithic epoch within the environs of the Jhaun River and the Barapahad hills of Bargarh district. The lithic corpus, comprising diverse Core types, Blades, Bladelets, and geometric implements, firmly situates these sites within the pan-Indian microlithic cultural framework. Spatial analysis reveals a pronounced proliferation of sites, frequently positioned along riverine corridors and the basal slopes of orographic features. Stratified pediment zones, often exposed through fluvial erosion, have proven invaluable in the recovery of microlithic assemblages, offering critical insights into site formation processes.

Ecologically, the region likely offered a congenial environment for Prehistoric foragers, facilitating seasonal mobility and resource exploitation. Mesolithic populations appear to have pursued a peripatetic subsistence strategy, navigating the landscape for lithic raw materials, hunting, and plant foraging, gradually evolving towards more structured patterns of mobility and resource management. While numerous sites have been identified, the majority remain situated within secondary depositional contexts, underscoring the necessity of systematic excavation to establish definitive chronological markers. Despite typological heterogeneity among artifacts, a remarkable stylistic and technological congruence is observable, reflecting shared adaptive and cultural practices. Future archaeological endeavors should prioritize the identification of stratified primary-context sites, the establishment of a precise chronological framework, and a nuanced reconstruction of the subsistence strategies and mobility paradigms of Late Pleistocene to Early Holocene foraging communities inhabiting this region.

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