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TECHNOLOGICAL CHARACTERISTICS OF CORE COMPONENTS IN THE LITHIC ASSEMBLAGES OF BARGARH UPLAND

Sudam Deep

Abstract: Analysis of lithic components of an archaeological site is carried out basically to determine the typological and technological attributes of artefacts. From these attributes we can infer the economic behaviour of prehistoric man. Within the assemblages recovered from a prehistoric site, core components form an important artifact category. These are particular kinds of lithic artefacts which usually generate flakes, blades or bladelets that can be further retouched to use as tools. Archaeologists consider analysis of core artefacts as significant to evaluate the range of roles that such artefacts may have played in the past cultural setting. To have a better understanding over the strategy of raw materials procurement, tool production techniques, stages of shaping, retouching, discard and other economic behaviour of prehistoric man, it is imperative to study the typo-technological features of cores components of lithic assemblages as it gives us clues to sketch human mind. Certainly there is variation in types and raw materials but each specimen represents the cultural characteristics of the maker. The present paper deals with the technological aspects of core components of recently discovered microlithic settlements of Bargarh upland in western part of Odisha.

Keywords: Core, Flake, Chert, Bargarh upland, Microlith, Retouching.

Introduction

In the prehistoric studies, scholars usually accept that there is relationship between settlement pattern and the organization of lithic technology. Research on these aspects reveals that various factors are responsible for affecting this lithic tool production technology (Shott, 1986; Shiffer and Skibo, 1987). One of the important factors is the availability of raw materials and its quality from which the artefacts are produced. Some researchers also argue that stone tool production by prehistoric man is correlated with their mobility pattern too (Andrefsky, 1991; Kelley, 1988). So, the quality and availability of raw materials as well as their mobility pattern over a particular landscape determined the tool production technology. Some scholars believe that the prehistoric mobile community used these raw materials of landscape more efficiently and effectively (Torrence, 1983; Foley and Lahr, 2015) for manufacturing of tools. The stone tool makers had access to a variety of raw materials of different size which proves that tool production was certainly a conscious effort made by them. During the late Pleistocene and early Holocene period, man adopted various methods of stone tool production by employing different techniques. There was large scale manufacturing of microlithic artefacts in this time and produced varieties of sophisticated tools. Obviously there was

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variation from one site to another in terms of tools selected for retouch, core reduction techniques and raw materials selection (Sheet, 1975; Kuhn, 1994). These hunter-gatherers societies produced different blanks from the raw materials, and further modify it to make it a tool of their choice. In this context, cores are artifacts with a great potential from which we can infer the technology employed during its production. Cores are basically acts as a source of flakes as it has negative flake scars from prior removals. According to Kuhn (1992), a core is a shaped piece yielding flakes of potentially usable size and shape, and which lacks evidence for shaping of edge unrelated to removal of usable flakes. Therefore, while analysing the lithic artefacts of site, we need to be more careful for understanding technology of core component because it gives us clues pertaining to the provisioning process i.e selection of raw material and transport. The important aspect of obtaining raw material is the movement of prehistoric communities from one place to another which is also an influential factor of affecting lithic production technology (Parry and Kelly, 1987). The ways in which human groups choose and use raw material are associated with their efforts of either short distance or long distance traveling as well as use of space. Thus, the study of procurement, production and abandonment of lithic raw materials contribute to our knowledge about mobile societies of the past and their tool production technology (Bicho, 2002). In this context, the western part of Odisha allured the attention of so many scholars for last few decades. They have brought many such stone age site to the limelight with rich cultural antiquities. In the major river valleys of this region such as Tel valley (Tripathy, 1972), Bagh and Maharani (Ota, 1986), Indravati basin (Nanda, 1984), Brahmani valley (Behera, 1989), Mahanadi valley (Behera, 2006), Jira valley (Mishra, 1998), Ong valley (Panda, 1996), Jonk valley (Padhan, 2013), Suktel (Gadtia, 2000) valley etc large number of lithic artefacts including heavy duty tools have been reported. Prehistoric sites of these river valleys also yield core as a major component of its lithic assemblage. Keeping the significance of core as an artefact, a special emphasis was given to analyse the core components of microlithic sites reported from Bargarh upland. In the lithic compositions, core is an important component and dominating in almost all sites of the study area. Core artefacts of this region are quite peculiar in typological and technological point of view. Hence different parameters were taken to analyse these artefacts to infer human behavior in the past. Therefore, in this paper attempt has been made to understand the technological characteristics of the core artefacts reported from various microlithic settlements of river Jira, Ranj and Danta in the Bargarh upland. The author tries to understand the technological aspects of core artefacts by taking various parameters.

Study Area and Geographic setting

The Bargarh district lies between 20^0 43' to 21^0 41' North latitude and 82^0 39' to 83^0 58' East longitude. It is located in the western part of Odisha sharing its border with the state of Chhattisgarh. The present research work was conducted in the upland area of Bargarh (Fig-1), which has occupied over 2690 km^2 surface area. This upland area has erosional surface with the general relief varying between 140m and 250m above mean sea level. The Bargarh upland is bounded on the west and north-west by hill ranges of eastern Sarangagarh and Raipur districts of Chhattisgarh. In the northern site the Barapahar hill range is situated while in the eastern site the upland area of Sambalpur is located. In the south east and southern part, the districts of Sonepur and Bolangir have shared their borders. The area is represented by three natural divisions such as-a) the catchments of the river Jira and its tributaries, b) the continuous hill range of Saraidamak on the west and north-west which merges into the Barapahar hill in the north, and c) small isolated hills varying in height from 255m to 312m within the upland. The upland mainly comprises of meta-sedimentary rocks, *viz*. coarse, earthy, felspathic, and other varieties of quartzite, conglomerate, shale and calcareous shale, belonging to the Chhattisgarh Super group (Das *et al,* 2001). Older meta-sedimentary rocks occur as enclaves within the granitic rocks, which are intruded at places by dolerite dykes and quartz reef/veins. The upland is not a leveled tract, but an expanse of undulating country sloping down from the Saraidamak-Debrigarh-Lohara massif in the north-west and north to the Mahanadi valley in the east and south-east.

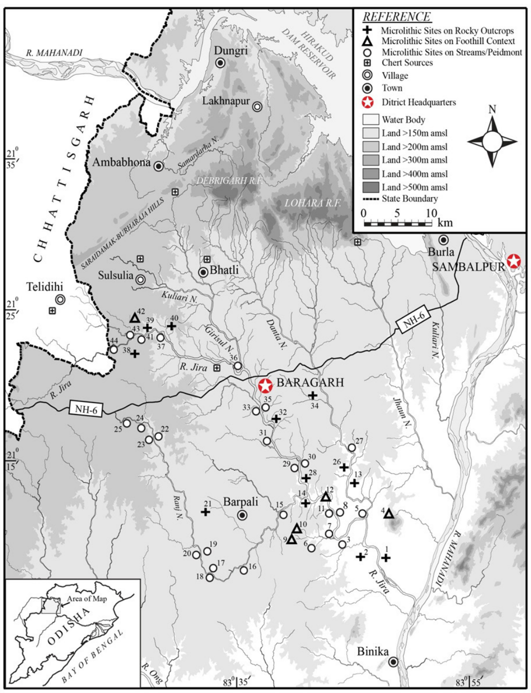

Figure-1: Map of Bargarh Upland Showing the sites context

Five types of soils like Red forest soil, Brown forest soil, Sandy soil, Clay-loamy and clay soil and Black cotton soil are usually found in the upland region (Sahoo, 2007). Among all the soils category, the clay soil has high percentage of calcium and rich in organic matter. The climate of this area is characterized by long warm summers and cold winters. The climate of this area support mostly dry-mixed-deciduous type of forest, closely resembling that of the semi-arid and sub-tropical zone. Large varieties of wild animals like Elephants, Bison Sambar, Nilgai, spotted dear, barking dear, Chousinga (Four-horned antelope), mouse dear, wild bear, etc. are common in the forest of this region. The area is drained by the river Jira and its various tributaries. It originates from near the border of Bargarh and Chhattisgarh, and after traversing for about 80 km in the district Bargarh in a south-easterly direction it joins the right bank of the Mahanadi at Brahmani-Turum. Other tributaries of Jira are the Danta and the Ranj, which join Jira in the left and right bank respectively. The Ranj river constitutes one of the major tributaries of the river Jira which is originated from an open scrub near the village Birhipali and joins in its right bank near the village Samlaipadar. Another tributary Danta has its origin from southern peach of Debrigarh reserve forest and joins the left bank of river Jira near Bheden. During the exploration, the catchment areas of all the three river banks were surveyed, which resulted in the discovery of as many as 28 microlithic settlements with rich lithic artefacts.

Research Objectives

The upland area of Bargarh district is geographically a distinct area. Many small rivulets have its origin from Barapahar range located in the northern part of the district. These rivers bank and other adjoining area are very significant in archaeological point of view. Hence the research conducted in this region aims to trace the prehistoric sites as well as to understand the distribution pattern of the prehistoric settlement in this region to develop a regional archaeological picture. Besides, another objective is to understand the context and nature of prehistoric sites along with its stratigraphy to comprehend the early human behavior. In this paper a detailed morpho-metric and technological study of the artefacts, recovered from the prehistoric sites of this region have been made to determine the interregional variability.

Materials and Methods

Investigation in the upland areas of Bargarh particularly along the river banks of Jira, Danta and Ranj brought to light a number of prehistoric settlements. All the localities are rich in microlithic assemblages which have been found scattered on the surface of the site. As many as 28 microlith bearing settlements have been identified in this upland area in various geographic contexts. The adjacent area of river bank, rocky outcrops, rocky knobs, foothills, and pediment areas were surved properly to locate the microlithic industries. Lithic materials from various sites were collected systematically for better understanding of the nature and composition of lithic materials. A total of 9024 microlithic artefacts comprising Core, Flake, Blade, Bladelet, chips/chunks etc. were collected from all sites. The core artefact within the assemblage is 2146 in number and occupied second position after flake components. A series of attributes were recorded for each microlith to gain further understanding into the typological and technological details of each piece. These attributes include physical condition of artefacts, breakage pattern, the preserved component of the tool, raw material type, maximum length, width, and thickness etc. While analyzing the core artefacts platform types, platform preparation, blank form; core types and raw materials used etc were taken into consideration. For measuring the length, the proximal end to the distal end of an artefact was calculated. Maximum width of artefact is taken perpendicular to length and the maximum thickness is considered.

Core types in the Assemblage composition

A core is a mass of homogeneous lithic material and from its surface a number of flakes are removed. The basic purpose of a core is to produce flakes and blades which can then be used for the production of various tools (Andrefsky, 1998:12). Sometimes the core itself is used as tool for various purposes. Scholar like Peter Hiscock (2007) argues that large numbers of small and step terminated scars on core indicates the item is a tool, whereas few large and feather terminated scars on it seems to have been a producer of flakes. It cannot be denied that cores are used for removal of flakes as well as used as a tool by the prehistoric communities. Some scholars like Mulvaney (1969:140) is of opinion that core tools are utilised for scrapping, pounding and chopping purpose. Thus core as an artefact has become very important stone tools during entire Stone Age. In the present work, it has been noticed that large number of core artefacts are present in all prehistoric sites. However, the materials collected from the prehistoric settlements of Bargarh upland are classified into categories on the basis of some observable features of the objects. Classifying lithic artefacts is considered as one step in the overall analysis of lithic artefacts in relation to patterns of human behaviour (McPherron, 2000). Therefore, various parameters were taken to analyse the core components. Within the lithic assemblages, it has been observed that the presence of negative scars is a basic characteristic of core artefacts. A total of 2146 core components were taken into analysis to understand its techno-typological features. During the analysis of core artefacts as many as six types of core are noticed in the assemblages. Such as the flake core, blade core, bladelet core, flake/blade core, blade/bladelet core and core rest. These types have been made only on the basis of the flake, blade or bladelet blanks removed from the surface of a core. Cores of the study area are basically made of river pebble and hill slope nodules in the studied assemblages.

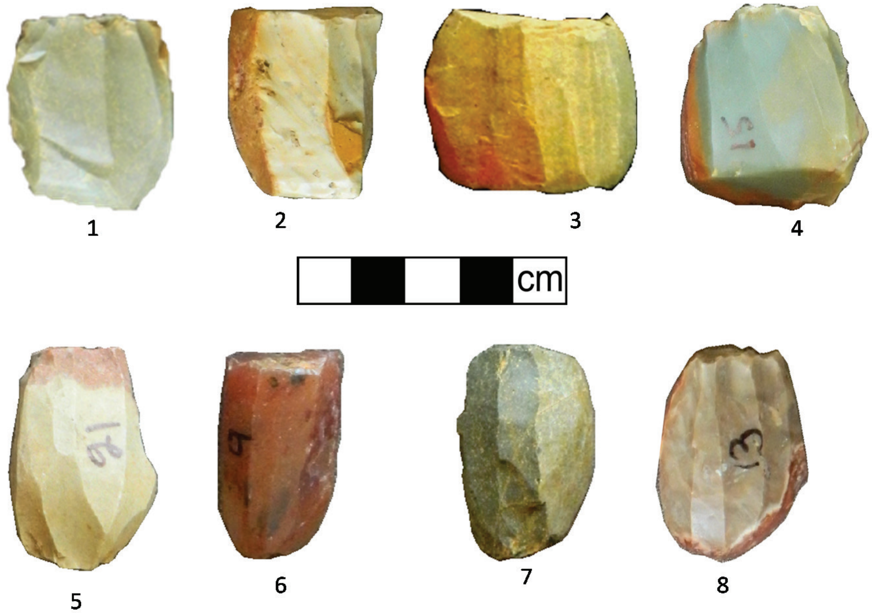

Fig-2. Blade Core (1-4) and Bladelet Core (5-6)

The typological analysis demonstrates that flake cores are dominant in all the sites which are 55.03% (1181nos). Most of the cores are bearing the negative scars of flakes being removed from different directions. The flake cores are followed by bladelet core (19.43%) which (417 nos) are usually common in almost all prehistoric sites of this upland. From this variety of core only bladelets have been detached and often of cylindrical shape. There are also a few cores which have yielded both flake and blade, and are put into the flake/blade category having 283 nos (13.18%) in the assemblage. Very less number of core artefacts is noticed to have produced blade. Observation on the scar pattern on the core surface reveals that prehistoric communities of these river valleys removed more flake blanks from a core than the blades. Therefore blade core (0.17%) is very meagre in the lithic composition which is only 37 in number and sometimes it is completely neglected even in some sites. Certainly some artefacts are there which have removed both blade and bladelet from the same surface which are considered as the blade/bladelet core (0.45%) (Fig-2). In comparison to the blade core the number of this variety is satisfactory in the composition. Another core type which is not common in all sites but present in the material composition, is core rest. It is defined as core rest because a number of flake or blade or bladelet have been taken away from it frequently from various direction of the core, making its size quite small so that no further flaking can be made on it. This kind of core type is only 130 in number which is 0.60% of the total core artefacts. Such kind of core is very significant in technological view point as it was frequently modified and blanks were removed by the stone tool manufacturer.

Blank forms of Core component

To have better understanding over blank forms of core artefact it is essential to study the flake scars found on surface of core. Scholars like Dibble (1987, 1995, 1997) opines that having determining the original shape of flakes which are removed from a core, one can infer about patterns of blank shape selection for the production of specific tool types. Study of the collected lithic assemblages of Bargarh upland reveals that core artefacts are made of three types of blank forms such as river cobble and pebble, hill slope nodules and thick flakes. Usually cobbles are rounded in shape and found in the river bed varying its diameter from 60 mm to 250 mm. The sites close to the river bank have larger percentage of cobble utilization than the nodules. Similarly, use of pebble as core is very common in microlithic sites of Bargarh upland. Pebble is a small rounded or oval shaped rock having its size 10 mm to 60 mm. These are basically larger than granules and smaller than cobbles. Because of the flow of water in the river they are carried away from upper course to the lower course of the river and sporadically found in the river bed. There are also some hill slope nodules that are used as the core in the composition and flakes have been removed from them. These nodules are small, irregularly rounded with knobby surface and very common in the sites of this upland which are located along the foothills and rocky knob areas. Maximum of number of chert nodules seems to have been utilised as core in almost all the prehistoric settlements of the study area. The statistical analysis of core components demonstrates that 63.46 % assemblages are made of river cobble and pebbles. As they are having finer texture, with small to medium size, these were most preferable raw material for tool production. Varied coloured of chert have been noticed in the core components which were basically the hill slope nodules obtained from the nearby hillocks. Although it is dominating all the sites yet it has occupied a considerable position in the assemblage with 20.13% of the total core blanks. In addition to this, there are some artefacts in the core assemblages which are thick flakes made of quartzite. These flakes have also been utilised as core and subsequently the flakings have been made there to obtain few blade and bladelets. Such kind of blank form is rarely noticed in all sites. Despite this, 14.81% of the total core artefacts belong to this category.

Core Morphology

As discussed earlier, lithic core is a distinctive artefact which is obtained from the practice of lithic reduction. The morphology of core always influences the shape of flakes that are detached from it. Hence the morphological study of core components is very essential to know about the dimensional flake attributes including their length and thickness. In core reduction process, the striking platform also plays a crucial role in determining the shape and size of flakes (Pelcin, 1997; Torrence, 1989). The surface area of core which received the blows necessary for detaching the flakes is known as the striking platform. The gradual reduction of cores will result in more flake scars and less cortex, that continued use of platform will result in a decrease platform size. When more mass is struck from a core, the size of the core and resulting flakes might also decrease.

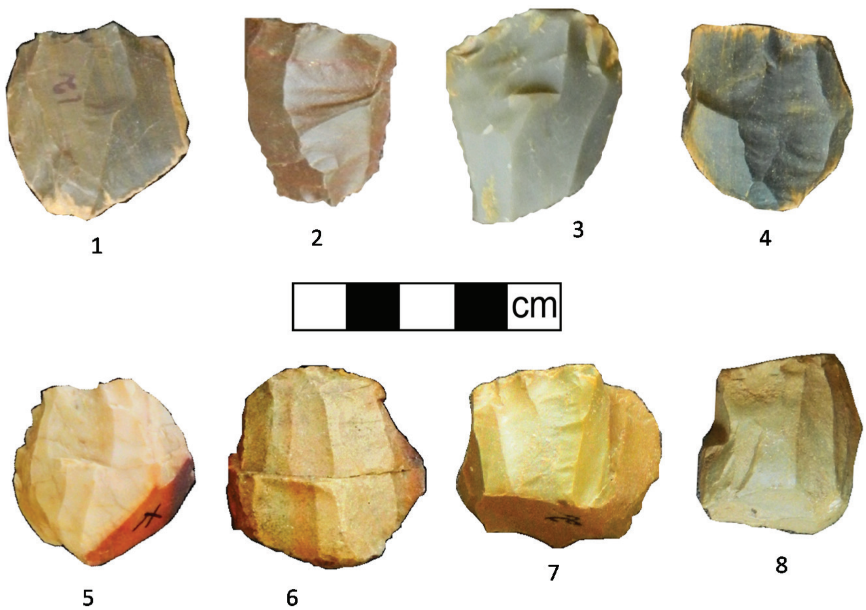

Fig.3 Unidirectional flake core (1-4) bidirectional bladelet core (5-8)

On the basis of the platform preparation it may be cortical, prepared or faceted. Cortical platform cores are those whose area of cortex is used as platform during initial reduction. In the studied assemblages core with cortical platform occupies a dominant position with 49.95% (1072 nos) of total core components. There are some cores in the assemblages, which are noticed to have prepared platform (Fig-3). In this case nodules or cobbles were chosen by the tool makers and prepared a suitable platform on the surface of the core before removal of flakes or blades. As many as 739 specimens are present in the studied lithic assemblages which is 34.43% of the total composition. In addition to this, cores with faceted platform such as single faceted, double faceted and multifaceted are also present in all microlithic sites of Bargarh upland. In comparison to cores with cortical and prepared platform type, this kind of core is very less in number and comprises only 15.61% (335 nos) of total core artifacts. It has been observed that the cores having single faceted platform have removed blade and bladelets. This kind of cores has a flat platform and flaking has been made at the right angle. While analyzing the core artefacts, the physical condition of these components were also studied and classified them into complete, broken, fresh, rolled and partially rolled category. Majority of the artefacts comes under the complete core category whose number is 1006 (46.87%). There are some broken cores (28.09%) present in the assemblages. As the microlith bearing sites are found in different contexts, the physical condition of artefacts also varies accordingly. It has been observed that large number of fresh cores (22.27%) artefacts is reported from the sites which are located along the foothills or rocky knobs. They are all found almost in mint fresh condition. But the sites located either along the river bank or close to the river yielded some rolled or partially rolled artefacts (3.40%). While analyzing the lithic assemblages, physical conditions of each core artefacts were understood on the basis of various parameters. Firstly, the artefacts were classified into complete and broken category. In case it is found broken, then further analysis was made whether it is distal end of the artefact or the proximal part. And accordingly they were placed. Secondly, cortex of the recovered artefacts was minutely observed to record whether it is rolled, semi-rolled or in fresh condition. Those specimens were considered rolled or semi-rolled, in which cortical surface and blank removal concavity is eroded or partially eroded. Thirdly, observation of partination as well as the encrustation on artefacts was also taken as a part of determining the physical condition. Patination of varying degree such as deep, moderate and low was noticed as well as stain of encrustation is recorded too.

Platform types

The fundamental variability in core morphology is determined by platform position. Identifying platform position is very crucial to comprehend how the flake blanks were detached. On the basis of the detachment of flakes as well as the platforms noticed on the surface of the cores, the author classified platform types into six categories such as single platform, opposed platform on same surface, opposed platform on opposite side, multi-platform, Levallo is and Discoidal core. It has been observed from core artefacts that the prehistoric man selected a series of striking platforms to best fit reduction of a specific piece of raw material to produce desired flake products.

Figure-4: Multi-platform core (1-4) and Single platform core (5-8)

The Study of core artefact reveals that single platform core (Fig-4, 5-8) dominated the lithic composition. It has occupied 49.39% of the total core assemblages. The single platform core is followed by multi-platform core (Fig-4, 1-4) having 502 specimens (23.38%). A good number of opposed platform cores has been noticed during the analysis. Some cores have opposed platform on the same surface where as some are found in the opposite site. Core of opposed platform on the same surface is 231 in number (10.76%). As many 313 specimens (15.75%) of cores have been noticed to have opposed platform on the opposite site. The presence of Levallo is core is rarely present in all the sites but some specimens (31 nos) are found within the assemblage. Only a few specimens (9 nos) of discoidal cores have been observed in some sites of Jira valley. Their number is very low as compared to other type of cores.

The above discussion on core technology is clearly stating the relationship between the tool manufacturing processes with human subsistence behavior. Use of the landscape, selection of raw materials and adoption of technique for tool making are certainly the key features of prehistoric time. In the life style of prehistoric hunter-gatherer technology plays a very crucial role as it is central to the adaptation and survival of humans being. But the early hominids groups used this technology in a very limited way and changes in the technology too took place very slowly depending upon the local raw material and ecological requirements (Foley, 1987). Further, technology is also key to the resource extraction as well as judicious use of extracted materials. The lithic artefacts which are often recovered from various prehistoric sites not only give us a picture of human settlement in a particular region but also gives clues to their subsistence strategy and cognitive behaviour. For last few decades our knowledge of the relationship between stone tools and the human brain has been widened to a greater extent. Davidson and McGrew (2005) have suggested that the permanence of stone tools and the products of knapping on the landscape made a distinctive difference to the pattern of cognitive evolution. Since the Pleistocene period to early Holocene period, use of lithic tool was an important behavioural adaptation of our hominid ancestors. With the gradual increase of cranial capacity of early man, the technology used for making stone tools too improved (Whitten *et. al,* 1999). Some scholars attempted to show that the intentional tool manufacturing process of early man can only be noticed through the identification of standardized tools (Nowell, 2000).There is no denying of this fact that stone tools were important in the everyday activities of prehistoric people and we cannot say how they learned to make it. It is only through the study of lithic artefacts and their technological parameter we can infer about the production of standardized tools and technology involved it. Therefore the cognitive behaviour of early man is reflected through the production of lithic tools.

Raw materials of Core

Prehistoric mobile communities moved across the landscape for their subsistence. Their mobility is very significant for obtaining and accessing raw materials. In case of lack of qualitative raw material in a particular area, mobile population must have used the local raw material to fulfill their demands. If raw material is abundantly available locally close to their settlements, they must have used them to make tool of their desired shape with adequate sharpness and durability (Gramly, 1980; Bamforth, 1986, Goodyear, 1989). Therefore, it cannot be denied that the mobility pattern of prehistoric people had a direct impact on the size of shape of tool because the scarcity and adequate availability qualitative raw material adjacent to their settlements determined it. As Gould (1980:125) observed that the prehistoric people may adopt various reduction techniques at different locations keeping the availability of raw material in view. If the raw material is abundant and close to their settlement, the prehistoric man may casually strike of flakes without attempting to control core shape. Sometimes they may also detach as many flakes as they desire and chose the finest one for tool purpose. Hence raw material plays a key role in determining the tool shapes and size. In our study region, the microlithic using people used the local raw material for tool manufacturing. In the studied assemblages, the author has noticed as many as 5 major categories of raw materials such as chert, quartzite, quartz, chalcedony and agate. Among all the raw materials, chert is predominant in each prehistoric sites of this upland. Varied coloured of cherts have been observed in the composition. On the basis of Munshell soil colour chart, raw materials were classified. As per this colour system, lithic artefacts were analysed keeping the colour density in view. A comparison was made between the colour of lithic artefacts with the colour of Munshell chart to infer its category. Besides, some artefacts were noticed to have been complex or multicoloured specimen. Their composition as well as the dominance of colour/colours covering the lithic surface only determines its colour category. They were put into complex category such as blackish grey chert, brownish greenish chert, blueish greyish chert, pinkish greyish chert, banded red chert and off-white chert etc. Chert comprises 42.12% of the total core assemblages. As many as seven types of chert have been found in which green chert (11.55%) and black chert (11.04%) are in majority. After chert another raw material that is very common to all microlithic settlements of Bargarh upland is quartz which forms 41.09% of the total core. Three variety of quartz such as milky, fine and oxidised are noticed within the core components. However, milky (30.16%) and fine varieties (10.48%) of quartz were abundantly used as core for manufacturing of tools. Agate as a raw material is rarely used by prehistoric communities of this region and not common in all sites. Only 4.79% of the total core components are made of agate. Simultaneously, use of chalcedony is also found in very few sites. Except some sites of Danta and Ranj valley, it has not been used as a raw material for microlith production and has occupied 8.94% of total core. Apart from these raw materials, fine grained quartzite has also been used in some site as raw material of core components. But the use of this material was very meagre. Only 52 specimens are found during analysis which is 2.43% of studied assemblages.

Core Shape and Size

The core component reported from various sites of Bargarh upland are basically made of river cobble/pebbles and hill slope nodule although their shapes and size varies from site to site. Majority of core artefacts are either oval or rounded in shape. The metric analysis of core clearly demonstrate that a good number of cores (698 nos) fall in the length range of 10-20 mm. However, a maximum number of studied artifacts *i.e* 1057 specimens fall in the length range of 21-30 mm. Only 312 core specimens are found in between 31-40mm and 60 specimens are available in 41-50 length range. The use of large core were probably neglected or very less for microlithic tool manufacturing as it is revealed from the range table (Fig-5). Only 14 specimens of core are found in the length range of 51-60 mm and 5 artefacts are seen in the range of 61-70 mm. A core specimen having maximum length (69 mm) is obtained from site Apamara and specimen of minimum length is found from site Purapali. Simultaneously breadth measurement of core reveals that maximum breadth is 68 mm and minimum is 8 mm which are found from Patkulunda and Bandhpali site respectively. So far the thickness of core is concerned, maximum thickness is 45 mm recorded from many sites of the study area and minimum if 5 mm recorded from Bandhapali.

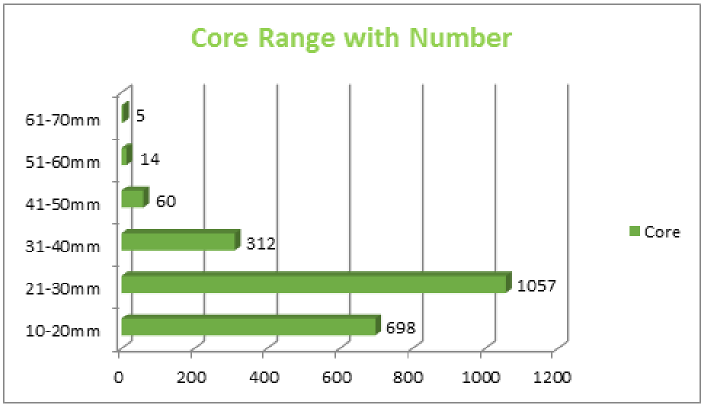

Figure-5: Length range (in mm) of Core components

It is very important to note that the maximum length and width of the flake scar on a core specimen shows the size of the microblades produced from it. But in the studied assemblage, we have not been able to measure to length and width of flake scar. The length, breadth and thickness of core artefacts in the discussed assemblages clearly demonstrate that sizeable and handy pebbles and nodules were brought to the site by prehistoric man for producing microlithic tools. Generally the large variety of cores was not chosen for removal of flakes, blades or bladelet. Even very small river pebbles were also not used as core by the prehistoric communities of Bargarh upland.

TABLE-1: A SITE WISE LENGTH METRICS OF ARTEFACTS

Sl No.	Site Name	No. of Core Specimens observed	Length (in mm)		Average	St. Dev.	Coeff. of Variation
			Max.	Min.			
1	Kumrapali	72	48	12	26.31	7.50	28.53
2	Purapali	49	40	10	24.32	7.01	28.84
3	Lohakhandi	59	56	13	26.45	9.61	36.33
4	Papanga	84	62	14	27.71	9.95	35.92
5	Kutapali	61	61	12	25.13	9.64	38.35
6	Ichhapadar	113	45	15	25.18	6.32	25.12
7	Gurupali	65	45	15	25.39	6.78	26.70
8	Jandol	34	40	15	24.95	7.25	24.25
9	Bhubanpali	92	41	11	24.18	6.59	27.26

10	Govindpur	61	45	12	25.86	7.48	28.94
11	Rugripali	60	50	12	25.88	7.50	28.99
12	Pottalgaon	89	40	11	22.17	5.91	26.96
13	Apamara	49	69	14	22.89	10.00	43.67
14	Barikel	96	68	14	25.71	7.91	30.79
15	Patkulunda	103	59	13	25.26	7.54	29.85
16	Bhatigaon	42	35	10	21.34	5.63	26.39
17	Dalaipali	64	45	10	23.46	7.48	28.94
18	Tenetelpali	83	46	13	24.71	6.73	27.26
19	Rabanguda	63	54	13	24.22	8.25	34.06
20	Raksa	47	60	15	25.82	8.21	31.82
21	Bandhpali	105	55	10	23.71	7.55	31.87
22	Lebri	123	52	12	24.57	7.48	3.44
23	Bandala	77	58	11	22.30	7.59	34.06
24	Hirapali	108	52	11	26.51	7.42	28.01
25	Chichinda	143	49	12	26.37	6.56	24.96
26	Talmenda	65	45	14	22.88	5.86	25.61
27	Remenda	63	48	12	21.06	6.91	32.81
28	Kendumunda	61	64	14	24.94	8.96	35.93

TABLE-2: SITE WISE BREADTH METRICS OF ARTEFACTS

Sl No.	**Site Name**	**No. of Core Specimens observed**	**Breadth (in mm)**		Average	St. Dev.	Coeff. of Variation
			Max.	**Min.**			
1	Kumrapali	72	39	10	21.39	6.70	31.34
2	Purapali	49	37	11	19.86	6.21	31.30
3	Lohakhandi	59	49	10	21.77	7.62	35.04
4	Papanga	84	49	12	22.83	7.75	33.98
5	Kutapali	61	35	10	19.91	5.78	29.06
6	Ichhapadar	113	48	12	21.60	6.10	28.24

7	Gurupali	65	48	12	25.56	5.40	25.07
8	Jandol	34	39	11	20.00	6.29	31.48
9	Bhubanpali	92	52	10	20.66	6.18	29.91
10	Govindpur	61	42	10	22.67	7.20	31.77
11	Rugripali	60	38	09	21.62	6.54	30.26
12	Pottalgaon	89	56	09	19.80	7.37	37.23
13	Apamara	49	50	09	18.13	9.26	51.08
14	Barikel	96	46	11	22.31	6.79	30.45
15	Patkulunda	103	68	12	22.71	8.17	35.99
16	Bhatigaon	42	32	10	19.84	5.91	29.81
17	Dalaipali	64	48	09	22.67	7.20	31.77
18	Tenetelpali	83	40	09	20.74	5.71	27.56
19	Rabanguda	63	48	08	22.60	8.16	36.14
20	Raksa	47	38	11	21.57	5.90	27.36
21	Bandhpali	105	37	08	19.32	5.90	30.52
22	Lebri	123	49	09	20.57	6.64	32.28
23	Bandala	77	40	10	19.42	6.80	35.04
24	Hirapali	108	41	10	23.50	6.28	26.73
25	Chichinda	143	42	11	21.65	5.18	23.95
26	Talmenda	65	37	09	19.70	5.16	26.20
27	Remenda	63	45	09	19.48	6.82	35.01
28	Kendumunda	61	42	12	20.98	5.71	27.24

TABLE-3: SITE WISE THICKNESS METRICS OF ARTIFACTS

Sl No.	Site Name	No. of Core Specimens observed	Thickness (in mm)		Average	St. Dev.	Coeff. of Variation
			Max.	Min.			
1	Kumrapali	72	39	08	16.05	6.73	41.95
2	Purapali	49	27	08	13.64	4.52	33.13
3	Lohakhandi	59	39	07	19.93	5.82	39.35

4	Papanga	84	45	06	17.70	7.89	33.98
5	Kutapali	61	38	07	12.56	5.50	43.76
6	Ichhapadar	113	30	08	14.12	4.87	35.54
7	Gurupali	65	30	08	14.29	4.03	28.20
8	Jandol	34	28	07	14.20	5.52	38.88
9	Bhubanpali	92	42	07	13.42	5.44	40.55
10	Govindpur	61	36	07	16.19	6.99	43.20
11	Rugripali	60	25	09	15.84	4.31	27.24
12	Pottalgaon	89	36	06	14.38	5.16	35.88
13	Apamara	49	25	08	9.84	4.81	48.91
14	Barikel	96	42	06	18.85	6.66	42.03
15	Patkulunda	103	42	07	15.01	5.90	39.35
16	Bhatigaon	42	31	07	13.80	5.44	39.45
17	Dalaipali	64	32	06	16.19	6.99	43.20
18	Tenetelpali	83	45	06	14.44	6.33	43.89
19	Rabanguda	63	43	07	14.26	7.39	51.84
20	Raksa	47	45	08	14.94	6.94	46.47
21	Bandhpali	105	27	05	12.59	4.18	33.19
22	Lebri	123	29	06	13.10	4.42	33.78
23	Bandala	77	27	06	13.25	4.54	34.30
24	Hirapali	108	44	07	15.33	6.17	40.23
25	Chichinda	143	30	08	14.25	3.81	26.77
26	Talmenda	65	26	08	15.01	4.53	30.20
27	Remenda	63	27	06	12.40	5.54	36.65
28	Kendumunda	61	37	08	15.18	5.90	38.93

Conclusion

The lithic assemblage study of microlithic settlements of Bargarh upland clearly reveals that prehistoric people of this region used to produce microlithic tools by removing flakes and blades from sizeable cores. There is a variation in core components in the microlithic sites across Bargarh upland. Morphologically cores were diverse in nature in terms of size, quality, and shape. Such variation is found because of the influence of regional geology, context of a site, availability of raw materials, and distance from raw material source etc. These factors certainly affected how the cores were prepared by microlithic people. In the study area usually pebble/ nodules were used as core, available close to the small stream, river bed, hill slopes, rocky outcrops etc. They are oval, elliptical, oblong, angular and elongated in their shape. Majority specimens are fresh and found complete although in some sites broken cores have also been noticed. Their size falls in between maximum 69mm to minimum 10mm in length and 68mm to 8mm in breadth where as thickness is recorded maximum 45mm to minimum 5mm. It has been observed from the studied lithic assemblages that some core artifacts have a water rolled cortex. They were probably belonged to spit pebbles obtained from river bed. Sometimes flakes were also removed from such splitting small river pebbles. So far the striking platform of core artefacts are concerned, they often exhibit some degree of preparation. Flakes are removed from different direction from more than one platform. However, single platform core dominated the lithic composition where as Levallois and discoidal cores minimally produced by microlith using communities of Bargarh upland. Besides, a good number of cores belong to multi-platform category and they are noticed to have yielded more than three flakes and bladelets from different directions. Within the assemblage most of cores have been utilised for removal of flake tools as it is clearly noticed from the negative scar. In some sites it has been noticed that blade and bladelets have been removed from the core of cylindrical shape. To produce these bladelets, different reduction strategies might have been followed by prehistoric people. They might have started with removal of flakes and later on when the core was found to be small; they might have changed into bladelet production. Finally the core came into category of core rest when it was almost completely exhausted. By such behaviour man shows that they were using the raw material judiciously with utmost economic manner. In spite of the availability of raw materials close to their settlement, they were quite economic while manufacturing tools because they preferred to reduce their labour force for accumulating raw materials. The above discussion in relation to core artefacts is based on the typological and technological analysis of core components of explored sites of Bargarh upland. For last few decades prehistoric research in this part of Odisha has increased substantially. As allmost all assemblages mentioned above have been brought from surface only through exploration, at present situation, we have some limitation that the research lacks providing any information with relation to environmental condition prevailing in the region during the late Pleistocene to early Holocene phase. Besides, the Bargarh upland has been a cradle for prehistoric people since the Lower palaeolithic time to the early historic time with its adequate evidence from various sites discovered so far, but the chronological succession to understand the cultural sequence in this region is yet to be ascertained until a systematic horizontal excavation is carried out. Within the acute limitation of research, an attempt has been made to locate the settlement site and try to understand the prehistoric subsistence strategy, raw material exploitation of early man and their mobility across the landscape of Bargarh upland. It is also recommended that there are several such prehistoric sites which are well preserved and found in a very stratified contexts which can be taken into consideration for carrying out small scale excavation or trial trenching in future to understand the artefact horizon. Besides, lithic artefacts and their associated sediments can also be sampled for absolute dating. Large-scale excavations may also be taken at key sites to obtain better stratigraphic and chronological sequence of this region at least to place these industries within the broader context of terminal Pleistocene lithic industries of South Asia. In addition to this, the techno-typological aspects of lithic artefacts of Bargarh upland has enormous scope for having systematic and scientific analysis of the use wear and treceology on the stone tools to understand the functional use of the particular types of tools. Even proper experimental archaeology is essential for inferring the reduction sequences and process of stone tool manufacture. Simultaneously, provenance studies can also be undertaken in this region to trace the raw material availability zone and their movement across the landscape. Above all, a scientific study with multidisciplinary approach would enhance our knowledge with regard to lithic tool production, raw material economy, landscape use and their mobility pattern as well as human activity in this region.

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