

A Study of Environmental Archaeology of The Site Jagannathpur in Galudih Area in Purbi Singbhum District of Jharkhand

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Abstract : *Environment is one of the important aspects of study of man both in past and present. Environment plays an important role in biological as well as cultural evolution of man. Natural and cultural elements are very much interrelated to each other and used to study different aspects of man. Since 19th century interrelationship of natural and cultural elements of past human societies are focussed by the Archaeologists. Present paper is an attempt to study different aspects of past environment in which prehistoric people lived for a long period of time. The focus of the study is on the prehistoric site Jagannathpur in Purbi Singbhum district of Jharkhand. The site was discovered by A. K. Ghosh of the Department of Anthropology, University of Calcutta. An attempt is made to reconstruct the environmental background in which prehistoric people of the area lived and adapted themselves.*

Keywords: environment, archaeology, stratigraphy, geomorphology, soil, sediments, culture

Introduction : Environmental archaeology is a sub-field of archaeology which deals with the past human interaction with its surrounding natural world including plants, animals and ancient landscape. Study of paleoenvironment

began in the early 19th century. Earlier disciplines like paleogeography, palaeobotany, paleoclimatology studied past environment. Environmental archaeology became a part of the discipline archaeology in the early part of 20th century.

Functional-Processual approach in environmental began to be used in archaeology during 1830s. This was at the time that Steenstrup was discovering Danish bog sites and tried to relate it with forest types (Trigger, 2006). In the beginning of 1848, Worsaae, Steenstrup and Forchhammer pioneered in the study of archaeological findings collected from kitchen middens in Denmark. They studied the materials and related the cultural element with contemporary paleoenvironment and ecology. Soon methods like varve analysis and palynology were discovered. These aided the study of ancient deposits. Paleoenvironment was reconstructed with the help of geological formation and associated flora fauna. Multidisciplinary approach of geography, ethnology and botany promoted the holistic study of culture. This led to the functional-processual view in studying culture against environmental settings. This was a major development in the study of human behaviour and its change (Trigger 2006). In the early part of twentieth century environment study began in archaeology (Trigger 2006). By the middle of twentieth century prehistoric economy was seriously studied (Adams 1988; O' Connor and Evans 2005). Proper use of the term 'Environmental Archaeology' began around late 20th Century by a number of scholars like Shackley (1981), Boyd (1990), Cameron (1993), Reitz (2008) and Campbell (2011). Environmental Archaeology was defined in various ways, such as, an interaction between human and environment (Shackley 1981; Boyd 1990) and as an application of archaeological and environmental theories and methodologies (Cameron 1993). While others dealt with the diverse scope of studying environmental archaeology. These were study of relationship between human and their surrounding physical, chemical and biological environment; human nutrition and health, varied system human behaviour and method of procuring resources (Reitz et.al. 2008).

Environmental archaeology is the study of the past human economy and environment in the background of ecological, cultural economic and climate change. A number of earth sciences and natural sciences help to understand the past environmental background in which prehistoric people survived.

Environmental archaeology also deals with various aspects like environment at the time of occupation and changes with due course of time, the ways human procured and prepared food, the process in which people interacted with the environment, places of habitation in seasonal camps or for long period of time (Campbell 2011).

After the first discovery of palaeolith from India by R. B. Foote in 1863, Indian prehistory was reborn when the Yale Cambridge Expedition under the leadership of De Terra made an extensive survey on geological, climatic, botanical and palaeontological evidences in Kashmir Valley, Potwar plateau in Punjab, Narbada valley in Hoshangabad and Kortalar valley near Madras (Sankalia 1962). Subsequently a number of archaeological studies were carried out in different parts of the Indian subcontinent. In order to study the cultural chronology, most of the surveys incorporated geological context and paleo-climatic background of the prehistoric and protohistoric cultures in different parts of India. However limited efforts have been made on environmental archaeology. Three sub-fields are important in the study of environmental archaeology i.e. zooarchaeology, archaeobotany and geoarchaeology. Present paper mainly deals with the geoarchaeological study of the site to reconstruct past man and environment relationship at the locality.

Eastern India has a very rich prehistoric cultural heritage. The Chotanagpur plateau is an old land mass and rich in resources which attracted the prehistoric people to live for a long period of time. The environmental background was one of the prime factors for continuous human habitation in the region. Present focus is on the prehistoric site Jagannathpur in Galudih area in Purbi Singhbhum district of Jharkhand. As an environmental archaeological approach, the study incorporated different geological, geographical as well as anthropological and archaeological methods to understand the past environmental background in which prehistoric people adapted them. The study may yield different aspects of past environment and prehistoric culture of the area studied in specific and the Singhbhum region in general.

Objective : Main objective of the study is to reconstruct the palaeoenvironment of the studied area, so as to understand distribution pattern of industrial assemblages and the development of cultures of prehistoric men of the area, on the basis of stratigraphy, geomorphology and geography.

Literature Review : Palaeoenvironmental studies are carried out worldwide since post World War II in connection with geographical and geomorphological researches. Notable among them are Woldstedts (1954-58), Charlesworth (1957) and Flint (1957). Their focus was mainly on stratigraphic and climatic interpretations. Later on Zeuner (1958), Laming (1952), Brothwell and Higgs (1963) and Butzer (1966) laid attention on prehistoric culture by examining man and environment relationships. Recently Orchard and Marie (2001) conducted environmental archaeological works at Gwaii Hanas in Queen Charlotte Islands of British Columbia, and in Aleutian Islands of southwest Alaska. They have used recent methods for collecting data on environment from archaeological sites.

Research on environmental archaeology was carried out since 1970s. Some of the remarkable works are done by Rajaguru and Guzder (1973); Farswan (2002); Sarma and Joglekar (2006-2007); Naik and Deotare (2008-2009) and other scholars.

Present study has its focus on Galudih area in Purbi Singhbhum district of Jharkhand state. Prehistoric research in Singhbhum region was initiated by Captain Beeching who discovered the first Neolithic implement in Singhbhum in 1868. V. Ball visited Beeching's site and collected stone tool. Later on Anderson (1917) made an extensive study of prehistoric culture of East Singhbhum. P. Mitra in 1924 discovered an *in situ* hand-axe in old alluvial deposits on a tributary of the Subarnarekha near Ghatsila. In 1941 Murray discovered Paleolithic artifacts from Eastern Singhbhum. S. C. Sinha in 1951 discovered some Palaeolithic implements from Northern Singhbhum. D. Sen and A. K. Ghosh worked in the area since 1959. Later R. Ray (Ray et al, 1993) also conducted a number of prehistoric field surveys in the area with emphasis on Mesolithic, Neolithic and Chalcolithic cultures.

Ghosh (1970) divided the Palaeolithic cultural zone of Singhbhum district into five groups, namely, Chandil, Chaibasa, Sini, Ghatshila and Jamda (Gua). He included Jagannathpur in the Ghatshila Group. His emphasis was on prehistoric culture. He found various types of *insitu* tools and artefacts lying in different geological strata. Such findings threw light on the palaeoenvironment of contemporary prehistoric cultural milieu. Ghosh (1970) found 31 tools from the deposit of detrital laterite at the site Jagannathpur. Crude choppers came

from lower part of the deposit. Handaxes, scrapers and well-made choppers were found from upper part of detrital laterite while the artifacts of the Flake Industry were recovered from the upper part of Upper Gravel. Ray (1978), a geologist had studied the basal formation of the deposits at the site. He observed a succession of wavy topography of sandstone and shale, followed by a rough irregular topography of hard shales which formed table like platform made of alternative shale and limestone deposit. The rocks belong to the Kolhan series and are roughly dated about 1500MY.

Methodology : Both primary and secondary data were used in the present study. Primary data was collected from the field and secondary data was collected from the existing documents and maps.

For collection of primary data archaeological field work methods and techniques were used. Surface survey was carried out by foot with the help of compass, GPS (Global Positioning System) and topographical maps. Such survey helped to understand the geographical landscape, geomorphological features of the area as well as the geological depositions in the form of stratigraphic sequences. A grid was laid down measuring 30 ft X 30 ft, divided into 25 squares, each measuring 6 ft X 6ft. This was done for understanding the pattern of cultural assemblage at the site.

Stratums in stratigraphic sections were identified by colour, composition and texture following Karl W. Butzer (1966) and Ghosh (1970). Analysis of sediments were done with a focus on stratification, sorting, orientation and degree of consolidation. Analysis of different types of geomorphological features was done according to Goudie (2004) and Huggett (2007). Morphometry of the sediments were done after Cailleux (1956) and Luttig (1956).

Area under study (Figure 1) : The present study was conducted at Jagannathpur in Galudih area of Ghatshila block in Purbi Singbhum District of Jharkhand. The site is under the jurisdiction of Galudih police station and Mahulia (Galudih) post office. Nearby village is Kalimati at the north and Jagannathpur village at the south of the site.

Jharkhand is situated on the Chotanagpur plateau region. The older formations are of Archaean rocks belonging to Pre-Cambrian period and Gondwana rocks belonging to Palaeozoic period. The common minerals and ores found in the area are coal, bauxite, limestone, graphite, mica, uranium, iron and copper (National Atlas Plates, Survey of India Maps 1991).

Climate of the area is tropical with humid to semi humid condition. Average rainfall is 1000-1500 mm. The vegetation is tropical deciduous type rich in Sal (*Shorea robusta*). The vegetation includes acacia, date, tamarind, mango and some bushes and shrubs. Common fauna are monkey, jackal, fox, hyena, buffalo and cow. Common animals in jungles are black bear, sloth bear, elephant, Indian wild boar, tiger, leopard and deer.

The soil type is mostly lateritic in nature while alluvial soil is found mainly in agricultural lands. Grass lands are found in flat and open areas. The area is predominately inhabited by tribal communities like Santal, Munda and Ho.

Site Jagannathpur (Figure 2) : The site Jagannathpur (22°37'N and 86°25'E) lies at an altitude of approximately 300ft. from MSL by the side of the river Kundra, locally known as *Kondor Nalha*. Kundra is a tributary of river Subarnarekha. It originates at Paharpur and flows over a long distance of about 6 miles from the north-east and within 3 km. from the site, it merges into River Subarnarekha. stream is full during rainy season. The stream is narrow near Jagannathpur because of a meander.. The villagers made dams at certain intervals to reserve the water for daily use and also for the irrigation purpose.

On the right bank is a huge deposit of silt over the bedrock. On the left bank a gravel bed is exposed. Palaeolithic cultural remains like hand axe, chopper, cleaver, side scraper, end scraper, notch scraper, blade, point etc. are found from the gravel bed. Soil type is sandy in nature and yellowish in colour. The vegetation found in the area indicates dry climate and river becomes dry during the summer season. Perhaps proximity to source of water, availability of tool making raw materials, games in the jungle attracted pre-historic people to live in the area for a long time. The site is encircled by the stream, which gave protection to the people.

Stratigraphic sequence : Environmental factors are responsible for the formation of deposits. Stratigraphic analysis is useful in archaeology because three principles of geology i.e., law of superimposition, law of uniformitarianism and sequence. The stratigraphy is used in prehistory to date artefacts found from the strata with reference to other layers and the related consecutive palaeoenvironment of the area (Butzer 1966).

The section at Kondor Nalha, Jagannathpur shows the presence of an undulated deposit of loose gravel lying on bedrock, which was formed during an intense wet pluvial phase, when water in stream was more in volume and velocity. Some gravels are dislocated and fell on the stream bed due to erosion. Bedrock is 5¹ in height. The colour of the bed rock became black due to water logging in rainy season. Bed rock is overlain by a bed of gravel, 2.5¹ in thickness. The gravel bed yielded Palaeolithic tools like hand axe, chopper, cleaver, side scraper, end scraper, notch scraper, blade, point etc. Cultural remains of Flake industry have also been found from this layer. Gravel bed is topped by a silty clay layer of 2.5¹ thickness.. The section shows alternating gravel and silt beds in sequential order, indicating alternating phases of wet (gravel) and dry (silt) periods (Figure 3).

Besides the stratigraphic section studied at Jagannathpur, different sections were also observed in and around Galudih area, on the left bank of Subarnarekha River near the Bridge Colony site, at the foothills of Lakridungri hillock and on the right bank of Garra nalla.

One of the sections observed at the left bank of the river Subarnarekha comprises of three strata, namely bedrock (formed during Pre-Cambrian Period) overlain by gravel bed formed during wet phase. This gravel bed is topped by a silt deposit representing dry phase. Gravel lens is found in the upper silt bed, which indicated by short wet phases at the end of Pleistocene (Figure 4). Alternating gravel and silt beds were deposited during the Pleistocene climatic fluctuations (Ghosh 1970). Another section was observed on the left bank of the river Subarnarekha, which comprised of silt deposit mixed with with ghutting. Ghutting indicated end of Pleistocene epoch and beginning of Holocene period. Above the silt layer a thin deposition of alluvium was also seen in some areas which was probably formed during the Post-Pleistocene period (Ghosh, 1970). (Figure 5).

Two sections were studied at the foothills of Lakridungri hillock. First section comprises of alternating gravel and silt deposition indicating wet and dry phases. Gravels are unsorted. Pebbles and gravels of different sizes are found lying in the sandy matrix mixed with kankar. The silt is yellowish in colour (Figure 6). The second section was also observed at the foothills of Lakridungri, which comprised of lateritic gravels mixed with the laterite (Section 7). According to Ghosh (1970) this is the most ancient Pleistocene sedimentary unit of the area. Its formation started from late Tertiary (Pliocene) period and continues up to Lower Pleistocene period. It consists of pebble-size fragments of lateritic gravels; sometimes hard conglomerate was also formed. The pebbles were derived from primary laterite which was formed during the late Tertiary and early Pleistocene period. Huge deposition of mottled clay has also been noticed in the area of Lakridungri hillock. This mottled clay was formed during Lower Pleistocene period (Ghosh 1970).

The right bank of the Garra River shows deposition of gravel bed, silt bed and clay bed deposited in sequential order on the bed rock (Figure 8). Gravels are loose found in sandy matrix mixed with kankar. The gravel bed is topped by a silt bed which is reddish in colour. On the top of the silt a clay deposition was noticed which was formed during the dry phase of Upper Pleistocene period (Ghosh 1970).

An attempt has been made to correlate the prehistoric cultures found from the area in respect to stratigraphy, modified after Ghosh (1970). Lateritic gravels and mottled clay are found in upland areas near the hillocks. These were formed during Wet (lateritic gravel) and dry (mottled clay) climatic condition during Pliocene up to Lower Pleistocene and Lower Pleistocene period respectively. Lower gravel conglomerate (Wet phase) and Lower silty clay (dry phase) were formed during Middle Pleistocene period. The development of Acheulian technology from Acheulian I to Acheulian II are found in this phase. Upper loose gravel (wet phase) and upper clay (dry phase) were formed during Upper Pleistocene period. Here we can find the development of flake and flake blade technology from the final Acheulian or Acheulian III. Flake tool tradition was found from the junction of Upper loose gravel and upper silty clay which later on developed in to flake blade culture. At the site Jagannathpur, artefacts were found from the upper loose gravels and tool typology shows a decline

of Acheulian technology and development of flake technology and introduction of few blades. Recent alluvium belongs to the Holocene deposition and it yielded microliths (Table 1).

Geomorphology : “Geomorphology is the study of different landforms and the processes that create them” (Huggett 2007). The present area studied belongs to the humid subtropical region and mostly shows fluvial landscapes. The area is undulating in nature and situated on the plateau area an arm of Dalma range extends from North-East to South-West direction. A schematic drawing of the cross section of the area is drawn to understand the geography and geomorphology of the site Jagannathpur (Figure 9).

The area is mostly formed due to erosional and depositional activities of the stream flowing through the area in the past as well as present. The site is undulated, sloping towards the river. Maximum height is found at the top of the silt layer. This silt layer gives indications of presence of comparatively dry phase which was thought to be deposited probably during the Upper Pleistocene Period (Ghosh 1970). A single loose gravel layer was found lying on bedrock. At present the surface is dissected. The Quaternary formation was laid over Precambrian formation and bed rock.

Soil types : Types of soil are good indicators of the environmental condition that once prevailing in the area. The soil type found in the area is primarily lateritic soil. Lateritic soil is formed in humid tropical and sub tropical areas. The colour varies from reddish to yellow because of high iron oxide content. Exposed surface becomes blackish-brown. Prolonged process of tropical weathering (laterization) of parent rocks produced thick deposition of laterite soil during continuous wet climatic condition. The lateritic soil is formed during heavy rainfall with alternative wet (pluvial) and dry (interpluvial) periods. Lateritic soil lacks fertility. However, agriculture would be possible by good manure and irrigation.

Alluvial soil is also found in the form of silty clay deposits in some area. Alluvial sediments (alluvium) is formed from the weathering of pre-existing sediments and carried by flowing water as suspended particles and ultimately

deposited when volume and velocity of the flow of water decreases. Alluvium is deposited ever since the stream existed in the area. Gravels were formed during a wet phase when there more water in the stream and velocity of water was strong. Deposition took place when dry period prevailed and volume and velocity of water is less. The sedimentary characteristics of modern alluvium are used to interpret the origin of ancient alluvium. At present alluvial silt deposited along the floodplains are much fertile for the agriculture (Goudie 2004).

Study of sediments : Study of sediments is very crucial for understanding of environment which are also important in understanding of macro setting of the sites and stratified culture. Palaeontological evidences also contribute to the reconstruction of past climate. Detail description of the area included soil zones and morphology of the land. Sediments are analysed on the basis of stratification, sorting, orientation and degree of consolidation (Butzer 1966).

Stratification

There are different types of stratification like cross bedding, undulated bedding, inclined bedding and horizontal bedding. In the present study undulating bedding, horizontal bedding and inclined bedding are noticed. Undulating beds are found in stream deposits and indicate swift and irregular flow of water. Pebbles and gravels are also laid down horizontally by laminar flow of water. Up to 2.5 cm. thick beds are formed during moderate flow and thick beds exceeding 5 to 10 cm. indicate violent torrential flow (Butzer 1966). In the present studied sections gravel beds are thick and indicate strong flow during the pluvial environmental condition.

Sorting

Sorting of various sized components of clay, silt, sand and gravel in the beds depend on the flow of the stream. The coarser materials are deposited first and finer materials are swept further downstream. Coarser stones are water borne and smoothened into pebbles. These are deposited when water in stream is reduced. Pebbles indicated pluvial climate. During period of gentle flow

(inter pluvial dry climatic condition) fine silt is laid down. Graded bedding is marked by progressive decrease in particle size formed during the flood level erosion and subsequent deposition due to gradually declining velocity of water. This type of flood condition was also found in the area under study.

Orientation

Orientation of the beds or gravels also provide information. During transportation pebbles become rolled and their major axis is oriented perpendicular to the direction of movement. Orientation of the gravels shows the dominance of sliding motion.

Degree of consolidation

Degree of consolidation also gives the information about the past climate. Cemented gravels were noticed at some places indicating wet climatic condition and continuous water logging (pluvial climate). Sediments found in the area are consolidated and semi-consolidated indicating the wet climatic condition (pluvial phase).

Morphometric Analysis of Different Sediments (Table 2) : Different types of gravels found from the site were analysed. Length (L) of the gravel varies from 6.5 cm to 25 cm. Width (l) varies from 4 cm. to 15 cm. and Height (E) varies from 0.5 cm. to 5 cm. (Table 2). Two types of indices are calculated following Cailleux (1956), i.e. Index of rounding $(2r.1000)/L$ and Index of flattening $(l+L)/2E$ four types of gravels are found, such as, rounded and square; spherical and almost flat; subangular and flattened; and subangular and square in nature. Transport of motion also has been calculated following Luttig (1956). The value of E/L or E/l indicates (also can be shown in %) the range of transport motion. In case of E/L below 50% indicates dominance of sliding motion, 50% to 60% indicates both sliding and rolling motion, and above 60 % indicates dominance of rolling motion. In case of E/l less than 65 % indicates dominance of sliding motion, 65% to 75% indicates both sliding and rolling motion and above 75 % indicates dominance of rolling motion. In the present study both the values of the sample gravels indicated the dominance of sliding motion while transportation dominated over rolling motion.

Artifacts Found at the Site : A grid (30 ft. X 30 ft) was laid dividing into 25 squares each measuring 6ft. X 6 ft. to understand the distribution pattern of the assemblage found from the site. The assemblage is comprised of different types of Palaeolithic tools, cores, flakes and a huge quantity of debitage. Out of 1813 artefacts found from the site debitage showed the highest frequency (77.11%) followed by cores (11.14%), raw materials without work (8.05%) and finished tools (3.70%). The frequency of debitage, core, raw materials and tools indicated presence of factory site in the area. Prehistoric men once stayed at the site and collected river pebbles for making of stone tools (Table 3).

The finished tool types comprise of chopper, handaxe, different types of scrapers (side, end, side-cum-end and notch), blade, point, pick, knife, anvil, hammerstone and a few unfinished tools. Side scrapers are in maximum frequency (49.25%). End scrapers, side-cum end scrapers and notches are 1.49%, 5.97% and 2.98% respectively; while point comprises of 8.5% of total tool frequency. Heavy duty tools are hand axes (5.97%) and chopper (2.9 %). Blade and knife show the minimum frequency 1.49%. Two pick like implement and two hammer stones and an anvil are also found from grid at the the site (Table 4).

Overall assemblage indicates the flake tool tradition of Upper Pleistocene period. Frequency of flake tools shows an increase with the subsequent decrease of heavy-duty tools. They used both free flaking and controlled flaking techniques for removal of flakes. Both Clactonian and Levalloisian technology were used for making flake tools. Quartz was predominant raw materials though quartzite was also used to make tools.

Tool typology and functions of the tools provide evidences about cultural practices and behaviours of prehistoric men. These suggest how early men adapted themselves to the changing environment. The distribution of tools, cores, debitage and raw materials on the sites revealed facts about past human behaviours, which they made and used to cope with the contemporary environmental conditions. Presence of anvil and hammer stone on the site shows how prehistoric men used different techniques for shaping the desired tools of their need. Each tool type has specific functions. Hand axes are heavy duty tools that might have been used for digging up roots, stabbing or piercing and scraping or skinning of game fulfilling a multipurpose use. The choppers were probably used for chopping or butchering the bones of either hunted or

scavenged animals. Different types of scrapers made on flakes were probably used for cutting and skinning of the games and making into small pieces to carry it easily back to the camp (Oakley 1952). Knife and blade were probably used for efficient cutting and skinning of animals while points were probably used as an arrow to kill fast moving animals while hunting by probably hafting it with a stick (Braidwood 1957). In addition to hunting preparation of plants as food, and for making shelters out of wood and branches were the works of the tools. Probable functions of the tools indicate that the people who lived in prehistoric period in the area were in hunting gathering stage. They maintained their livelihood by utilizing natural resources from the surrounding. Game animals are very common in surrounding jungle areas even now. Big game hunting as well as small game hunting was in practice. The site is also favourable for hunting when the animals used to come for water. Gathering of edible roots and fruits from the jungle also supplemented prehistoric diet. Plant and animal resources which make the prehistoric diet also depended on environment. On the other hand, plant and animal resources are also useful to know the past environment. The environment is reconstructed and it was seen that humid and dry and primarily deciduous types of vegetation were common in the area. Local plants also give some clues about the past environment. Presence of date plum and thorny trees like jujuba indicate dry climatic condition. Grass land also has been noticed in the area. This also indicates the past dry climatic condition. Small games like deer, hyna, jackal, wild cat were available in this grass land. Big games like elephant, wild bear inhabited the dense jungle areas of Dalma range. These animals are also found at present. So, the tool types, its functions provided information man and environment relationship of the prehistoric times.

Discussions and Concluding Remarks : Present paper deals with the environmental archaeological study in Galudih area with a focus on the site Jagannathpur in Purbi Singhbhum district of Jharkhand. The site is located on an undulated land by the side of the River Kundra. The aim is to reconstruct the past environment with the help of geoarchaeological methods. The evidences of geomorphology, stratigraphy, sediments and cultural remains are used to

understand the environment during the prehistoric times. The stratigraphy consists of a set of gravel bed and silt beds belonging to Upper Pleistocene Period. Palaeolithic tools were found from the Gravel layer.

The analysis of sediments was made by calculating indices of roundness and flattening suggested presence of alternative wet and dry phases in the area during Upper Pleistocene period. The types of gravels show the dominance of sliding motion during transportation.

Soil type is also a good indicator of the vegetation types of the area. Subsistence pattern of the prehistoric people is also dependent on the vegetation pattern of the area. Soil type, vegetation and subsistence pattern of early man are always interdependent on one another.

The distribution of cultural remains of prehistoric men found from the area was studied by grid method. The site was primarily a factory site. Cultural assemblage shows the presence of heavy-duty tools like hand axe, chopper and light weight flake tools. Flake tools are predominant. An anvil was found. Large quantity of debitage, unfinished tools and hammer stones were found around the anvil. Prehistoric men made stone tools with the pebbles and gravels collected from the river beds.

Both geological and cultural evidences revealed the picture of man and environment relationship in the past and adaptation of man with the prevailing environment.

In future this study could be extended in its scope and be made more effective by increasing the sample size of sediments, physical and chemical analysis, spatial distribution of the site. Zooarchaeological and palaeobotanical study may enlighten more hidden factors of past environment, biome and culture. Ethnoarchaeological study and transdisciplinary approach is recommended for further study. Further investigations in the area may yield valuable information about bio-cultural evolution of human in the background of man and environment relationship in the region rich in prehistoric evidences in Chotanagpur plateau.

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Source of Maps :

National Atlas Plates, Survey of India Maps 1991

Web Source: <http://www.mapsofindia.com> (accessed on 26/04/2020, 13:50);

<http://www.soinakshe.gov.in> (accessed on 26/04/2020, 14:10)

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Figure 1 : Location of the site Jagannathpur in Political map of Jharkhand
[Location of the site is indicated by O]₂

Source : <https://www.mapsofindia.com/maps/jharkhand/jharkhand.htm>

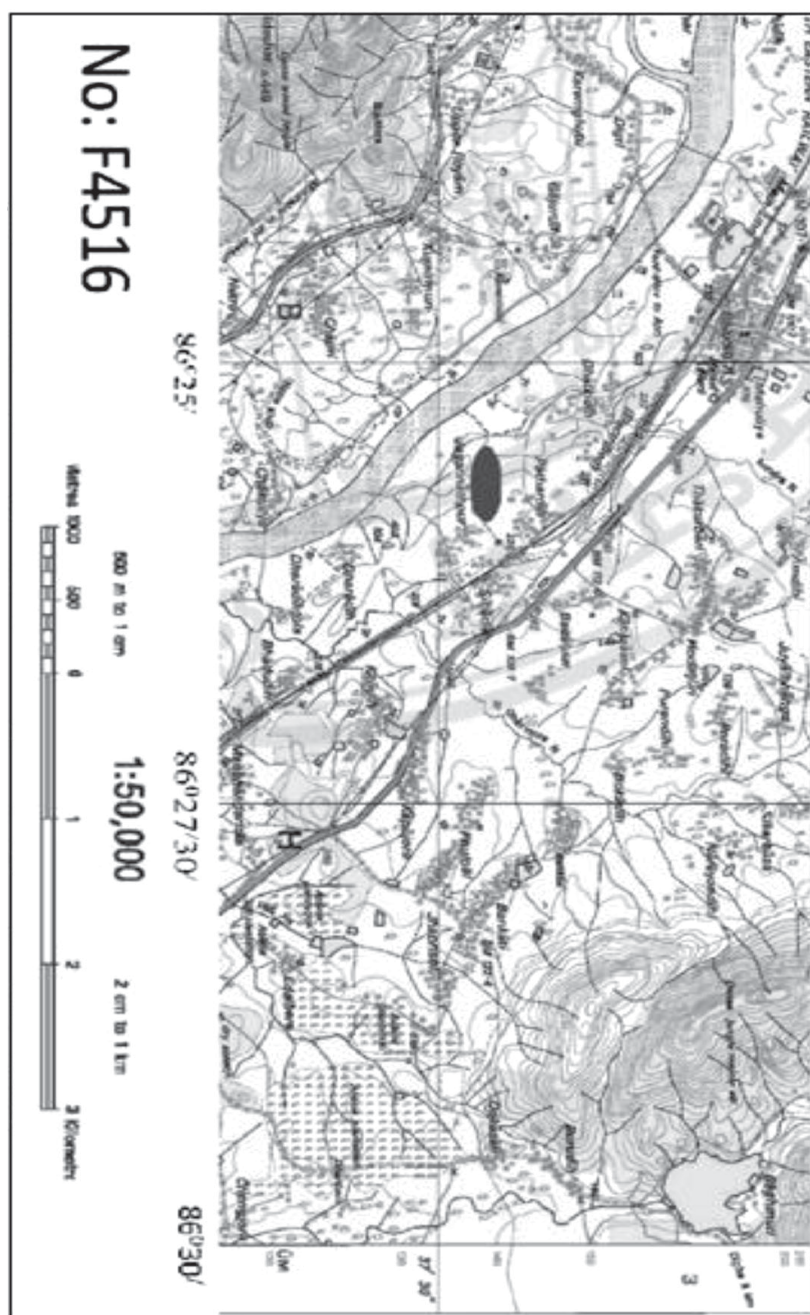


Figure 2 : Location of the site Jagannathpur in Toposheet No.F4516
Source : www.soinakshe.gov.in

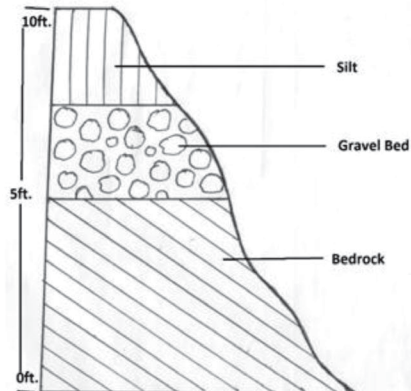


Figure 3: Section I

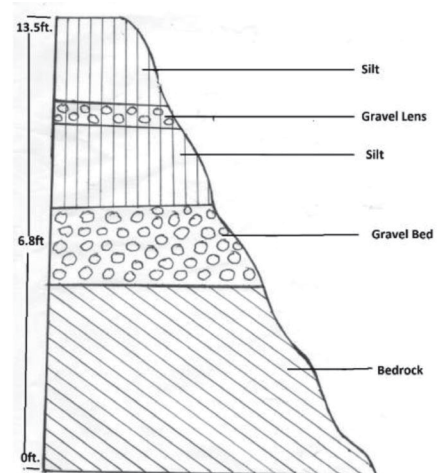


Figure 4: Section II

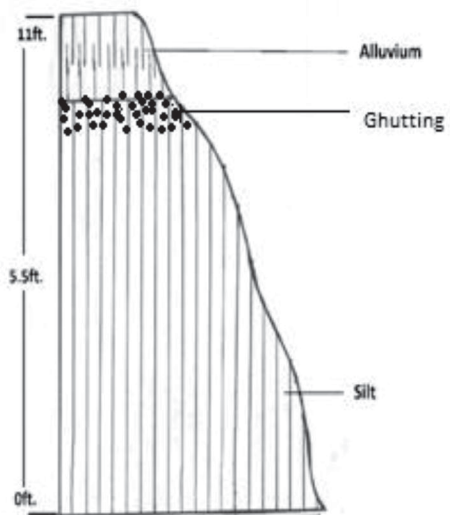


Figure 5: Section III

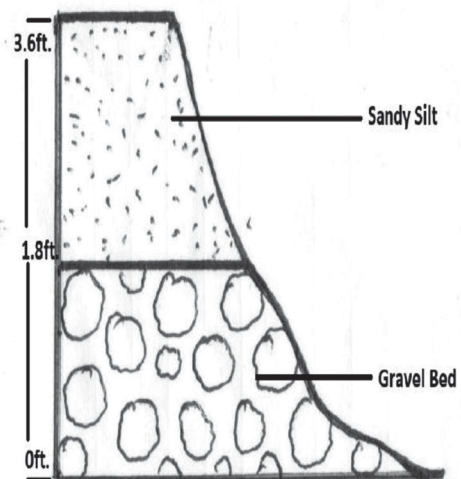


Figure 6: Section IV

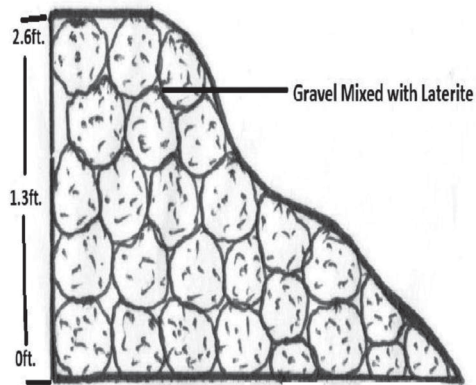


Figure 7: Section V

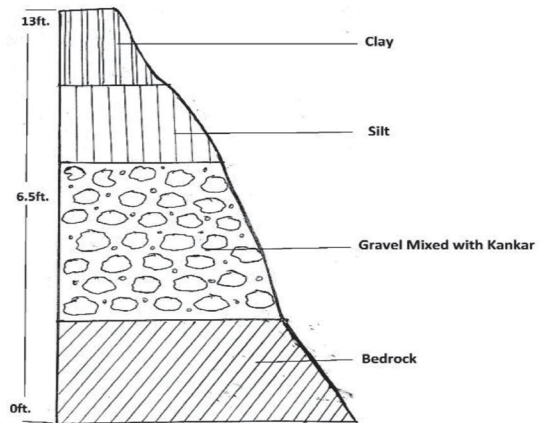


Figure 8: Section VI

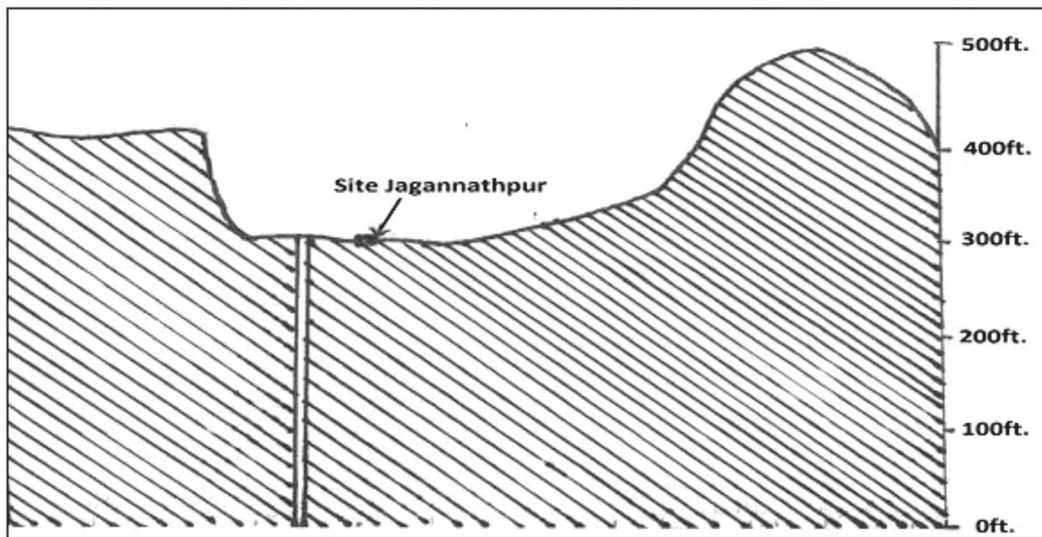


Figure 9: Cross section of the area locating the site Jagannathpur (SW ⇒ NE Direction)

Table 1: Quaternary geological sequence and prehistoric cultural stages of Galudih area, Jharkhand
(Modified after Ghosh 1970)

Quaternary stages	Sediments	Climate	Industries
Holocene	Recent Alluvium	Relatively wet	Microliths
Upper Pleistocene	Upper silty clay	Dry	Flake-blade
	Upper loose gravel	Wet	Flake tradition Acheulian III
Middle Pleistocene	Loose silty clay	Dry	Acheulian II
	Lower gravel conglomerate	Wet	Acheulian I
Lower Pleistocene Pliocene	Mottled clay	Dry	-
	Lateritic Gravel	Wet	-
		-	-

Table 2: Morphometric analysis of gravels

Sample No.	Length (L)	Width (l)	Height (E)	Smallest radius of curvature (r)	Index of rounding $(2r.1000)/L$	Index of flattening $(l+l)/2E$	Indices of transport motion	
							E/L (%) *	E/l (%) *
1	25	15	5	6.5	520	4	0.2 (20%)	0.3 (30%)
2	6.5	4	1	2	615.4	5.3	0.2 (20%)	0.3(30%)
3	7	7	1	3.5	1000	7	0.1 (10%)	0.1(10%)
4	7.5	4	0.5	1.5	400	11.5	0.1 (10%)	0.1(10%)
5	17	14	4.5	2.5	294.1	3.4	0.3(30%)	0.3(30%)

Index E/L and E/l also may be expressed in percentage to know the transport motion (Lutting,1956)

Table 3: Distribution of artifacts found from the site Jagannathpur

Artifact	Number	%
Core	202	11.14
Debitage	1398	77.11
Tools	67	3.70
Raw materials	146	8.05
Total	1813	100.00

Table 4: Distribution of tool types found from the site Jagannathpur

Tool types	Chopper	Hand Axe	Side Scraper	End Scraper	Side-cum-End Scraper	Notch Scraper	Blade	Point	Pick	Knife	Anvil	Hammer stone	Unfinished tools	Total
No	2	4	33	1	4	2	1	6	2	1	2	1	8	67
%	2.99	5.97	49.25	1.49	5.97	2.99	1.49	8.96	2.99	1.49	2.99	1.49	11.94	100.00



Plate I : Panoramic view of the site Jagannathpur



Plate II : Tool Bearing depositio



Plate III : Laying of Grid

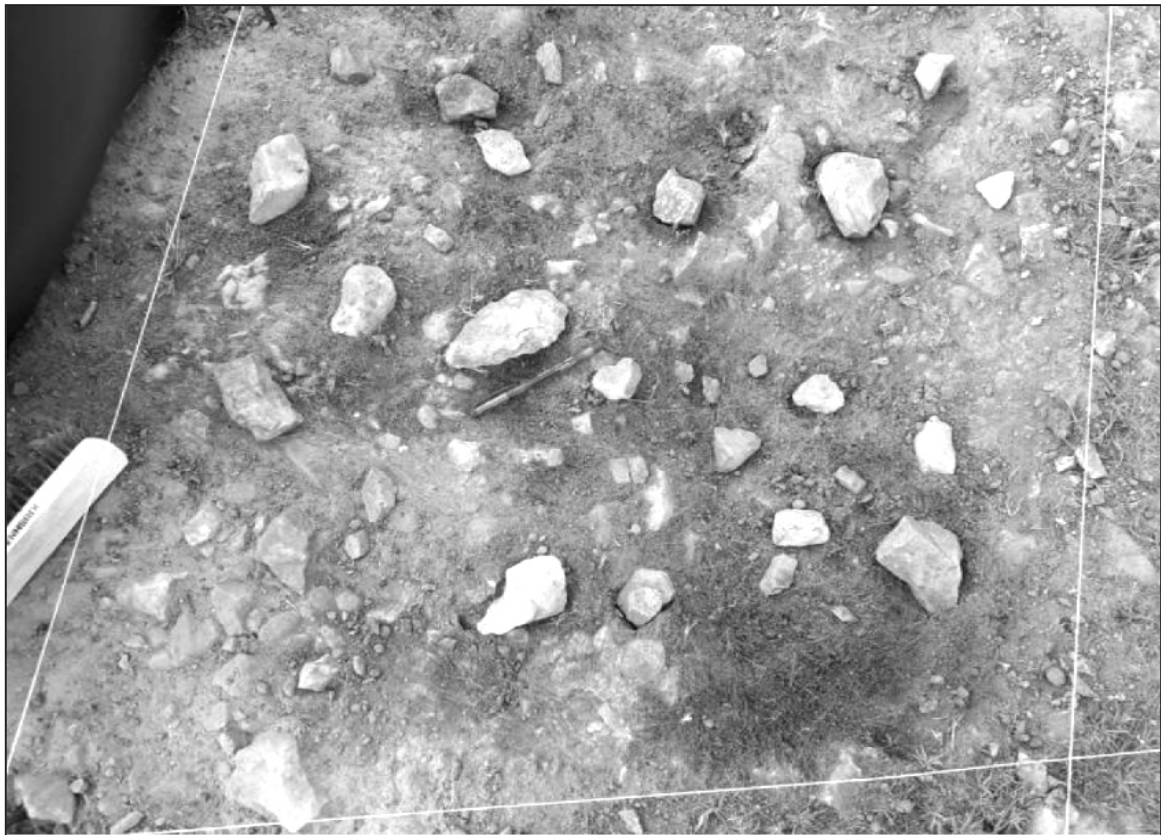


Plate IV : Distribution of artifacts in grid