Introduction

The Quaternary period is often known as “The Age of Humans”. This period had witnessed the beginning of human culture and its progress through ages. Understanding the interrelationship between the culture, environment and landscape is the major concern in Palaeolithic archaeology. For such type of studies earth sciences have played a crucial role. To explain human-land relationships during the Palaeolithic, it is necessary to understand the physical and biological environments of that period. Thus, palaeo-environmental studies form the basis of prehistoric archaeology. Such studies involve applications of various methods and techniques of earth sciences. A new discipline known as ‘geoarchaeology’ has developed in recent decades which is primarily concerned with the investigations of landscape contexts where archaeological remains are found (Renfrew 1976). According to Gladfelter (1977, 1981), geomorphology with its roots in geology and geography offers a broad basis for uniting the earth sciences and archaeology. The main contribution which geomorphology can make to archaeology relates to the recognition of terrain types on which the prehistoric communities operated. The term geoarchaeology was first coined by Butzer (1972, 1982). He described it as an approach that collects and interprets data from diverse fields and emphasizes human-land interrelationships for understanding behavioural patterns of prehistoric communities. Geoarchaeology deals with stratigraphical and environmental aspects of archaeological sites preserved in various geomorphological settings such as river valleys, lake shore, pediments with regolith, hill slope colluvium, cones, fans, dunes, sheet sands and ancient soils, etc. Apart from traditional techniques of geology and geomorphology, modern scientific techniques of geophysics, geochemistry, mineral magnetics and stable isotopes are used for interpretation. These studies are being supported by absolute dating methods e.g. Carbon-14, Accelerator Mass Spectrometry (AMS), Luminescence including OSL, Uranium series, Fission Track and K-Ar or Ar$^{40}$-Ar$^{39}$ and Palaeomagnetism.
In India many of the earlier scholars (Foote, 1866, Cammide and Burkitt 1930, Krishnaswamy 1938, de Terra and Paterson 1939, Zeuner 1950, Sankalia 1950, Rajaguru 1970) realized the crucial need to investigate palaeoenvironments and to establish the stratigraphic context of prehistoric artifacts. Subsequently, many scholars applied the techniques of geomorphology for understanding the prehistoric past. In this context, investigations carried out by Rajaguru (1968, 1969, 1970, 1973) in Maharashtra, Pappu (1974, 1981, 1984, 1990), Korisettar (1979) and Deo (1991), Pappu and Deo (1994) in Karnataka; Guzder (1980) in Konkan, Rajendran (1979) in Kerala, Marathe (1981) in Saurashtra and Kale (1983) in Goa, are of relevance in which the geomorphological investigations have been used to interpret the Palaeolithic landscapes. These studies have provided a wealth of information on site contexts, stratigraphic sequences and palaeoenvironmental inferences. The contributions of earth sciences to understand Paleolithic sites in India have been summarized by many scholars (Rajaguru et al. 1992; Korisettar and Rajaguru 1998; Pappu 1995, Deo et al. 2007).

These studies reveal that there are some major regions in India where details of Quaternary formations are known and these are- Siwaliks-Himalayan foot hills, Karewa Lake in Kashmir, Thar Desert, Deccan Upland region, and Central Narmada. From these regions fluvial and lacustral deposits of Early to Late Pleistocene age are well documented. Recently, Deo and Rajaguru (2014) adopted a landscape approach to critically examine the geomorphic and sedimentary contexts of palaeolithic particularly of the Acheulian sites. Using this landscape-related data together with available absolute dates, they further infer that wet climate prevailed in the Indian subcontinent in Early Pleistocene; it became semi-arid during Middle Pleistocene and, finally, distinctly arid in Late Pleistocene.

Of these, the Central Narmada valley (Fig 1.1) is the main area where numbers of Paleolithic sites were reported in stratigraphic context. This area also has a rich mammalian fossil record. The stratigraphic sequence with Paleolithic industry in Narmada valley was first classified by De Terra and Paterson (1939). The stratigraphic sequence observed and classified by them is: Newer Alluvium (cotton soil group), Upper Group and Lower Group. The pre-Soan type and rolled handaxes of the Abbevillian and Acheulian characters in association with the fossils of Middle Pleistocene period (Upper and Lower Group) and flake
assemblage without handaxes (Proto-Neolithic Microlithic Industry) were recovered from the Newer Alluvium.
Table 1.1: Stratigraphic Sequence of Narmada Basin (After de Terra and Paterson 1939)

<table>
<thead>
<tr>
<th>Stratigraphy</th>
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</thead>
<tbody>
<tr>
<td>Black Soil</td>
<td></td>
</tr>
<tr>
<td>Sandy Gravel</td>
<td>Newer Alluvium</td>
</tr>
<tr>
<td></td>
<td>(Cotton Soil</td>
</tr>
<tr>
<td></td>
<td>Group)</td>
</tr>
<tr>
<td>Pink Silt</td>
<td>Upper Group</td>
</tr>
<tr>
<td>Gravel</td>
<td></td>
</tr>
<tr>
<td>Red concretionary silt</td>
<td></td>
</tr>
<tr>
<td>Basal Conglomerate</td>
<td></td>
</tr>
<tr>
<td>Laterite</td>
<td>Lower Group</td>
</tr>
</tbody>
</table>


Khatri (1961, 1962 and 1966) re-examined the stratigraphy provided by de Terra and Paterson and proposed a slight modification in the sequence. According to him, the red clay horizon is the lower most stratum on the Narmada and not overlying the basal conglomerate. However, Sen and Ghosh (1963) refuted Khatri’s claims and agreed with de Terra and Paterson. They also suggested that the Lower Narmada group belongs to the Middle Pliocene and Upper Narmada group belongs to the Late Upper Pleistocene. Badam (1979, 1982) discussed the problems of stratigraphy, chronology and difficulty in correlating the sections. He further suggested that most of the exposed Narmada alluvium belongs to Upper Pleistocene and the Middle Pliocene alluvium (rich in fossil records) is present at few localities such as Hathnora, Barman Ghat and Devekachar.
Misra (IAR, 1983-84 and Misra et al 1990 a), conducted, explorations in central Narmada valley and its tributaries and conducted two small scale excavations at Gauri ghat and Middle Paleolithic site at Samnapur. Misra et al (1990 a and 1990 b) based on their geoarchaeological finding claimed that Narmada river acquired its present integrated course some time during the early late Pleistocene and the lithological units of middle and upper Pleistocene age are product of colluvio-alluvium process controlled by the structural configuration of the Vindhya mountain ranges. Mishra (1985-86, 1986-87) reported number of Paleolithic sites in the context of alluvium in East Nimar District, Madhya Pradesh. Salahuddin (1987) has worked on the Quaternary ecology of Narmada valley in relation to fauna and human cultures. Mishra and Rajaguru (1993) and Rajaguru et. al (1994) studied Quaternary deposits of central Narmada. These studies were attempted to revise the earlier concepts of litho and bio-stratigraphy of the Quaternary deposits.

Tiwari and Bhai (1997) completely revised the Quaternary stratigraphy of the Central Narmada basin. They have identified seven geological formations to replace the earlier concepts of ‘Older’ and ‘Younger’ alluvium. According to them following is the stratigraphy:

1. Pillikarar formation: Pillikarar is the earliest unit comprised of evenly bedded, clast-supported gravels (consist of laterite, quartzite, jasperoid, quartzite, banded hematite quartzite, limestone, marble and sandstone fragments) and large-scale cross bedded, very coarse sand and is most probably Pre-Quaternary in age.

2. Dhansi formation: The Dhansi formation comprises red sandy silt, yellowish brown silty sand, medium to coarse grained yellow sand and cross bedded fine to medium grey sand. This formation is dated by paleomagnetic technique (Rao et al 1997) and shows a reserve polarity (0.7 ma) that belongs Matuyama reverse epoch.

4. Baneta formation: The Baneta formation consists of calcareous brown silt and fine sand with lenses of charcoal-bearing red silty sand, calcareous brown silt, grey and dark grey carbonaceous clay, coarse sand, gravel and conglomerate. It shows normal polarity of Brunhes epoch (Rao et al 1997) and its most probable age is Upper Pleistocene.

5. Hirdepur formation: The Hirdepur formation comprises grey homogenous calcareous silt, interlayered sequence of grey calcareous silts and sand, coarse sand, graves and conglomerates. Similar to the Baneta formation it shows normal polarity of Brunhes epoch (Rao et al 1997) and its most probable age is Upper Pleistocene.

6. Bauras formation: The Bauras formation comprises light grey to dark grey interlayered sequence of silt and sand, coarse to medium sand and unconsolidated gravel. It is formed by the erosion of the Hirdepur formation and the probable age is Middle Holocene.

7. Ramnagar formation: The Ramnagar formation comprises pebbly sand, medium to fine sand and silt. The sediments of this formation are the activities of recent floods.

Patnaik and Chauhan (2011) have suggested that there is a need of revision in the chronology of Narmada Quaternary stratigraphy. According to them the Pilikarar formation does not exist stratigraphically below Dhansi formation, where theoretically it should be. It is composed of both primary and secondary laterites which can be of any age ranging from early tertiary to Holocene.

The Central Narmada basin has also proved major concentration of archaeological research where numbers of Paleolithic sites were reported in stratigraphic context. While concentration of the research was focused mainly on Narmada, most of its tributaries have been less studied. The present research is aimed to study a major tributary of the Narmada i.e ‘River Tawa’.
1.1. The Study Area:

River Tawa originates in the hilly regions of Chindwada at an elevation of 822.9 m and after a course of about 32 km enters the Betul District. It flows in a westerly direction for about 35 km and takes a northerly course from Ghodadongri. It finally joins river Narmada, 8 km North of Hoshangabad town. The river basin lies between 21° 22´ and 22° 24´ North latitude and 77° 04´ and 78° 33´ East longitude. The total length of the river is 189.5 km from which 104.3 km falls in the present study area.

The river Tawa flows in a structural plain of the Gondwana rocks surrounded with middle level and low level plateaus of Satpura ranges with a mean elevation of 396.24 m AMSL, between the peaks of Kilendeo and Bhanwargarh. Kilendeo is the highest peak in the East and Bhanwargarh in the West. The general slope of the valley is towards North. It is a well-wooded tract, with sparse population and less cultivated land.

There are six major reserve forests surrounding the grass land basin of Tawa. Panchmarhi and Chaurasi Deo reserve forests are situated in the North; the North Eastern area is covered by Asin Reserve Forest; Ranipur Reserve Forest has covered the South and South East and Banwera and Katwari Reserve Forest in the West. Out of these, Four Reserve Forests are located in the Betul District namely, Asin, ranipur, Banwera and Katwari Reserve Forest.

In the Hoshangabad-Betul District border there is a big Dam on the river “Tawa Dam” which has been selected as the northern extent for the study area. River Tawa is rich in coal mines especially the area near Sarni which is in the lower reaches near the Betul-Chindwada district border. Sarni coal mines are one of the biggest coal mines of Madhya Pradesh, also famous for its thermal power station.

There are also number of Government as well as private wood depots in the area, which has caused the permission problems.

Hence all these areas which have Reserve Forrest, dam, coal mines and wood depots were avoided during the explorations.
1.2. Previous Work:

The geomorphic studies of river Tawa are mostly restricted to the issues related to environmental sciences like ground water level (Ministry of Water Resources 2009), sediment and dissolved load on Tawa reservoir (Choubey 1990), coal mines (Pareek 1989, Coal India 2012), environmental changes (Coal India 2011, 2012), etc. Geoarchaeological research carried out in this basin so far has been confined to its lower reaches in the Hoshangabad District.

There are only 3 major excavated prehistoric sites in the Lower Tawa basin at Hoshangabad District namely Adamgarh, Hirapur Khadan and Panchmari.

Adamgarh a painted rock shelter site was excavated in 1960-61 by R.V Joshi and M.D Khare (Joshi, 1978; Sharma and Misra, 2003). The site (ADG-2) revealed the presence of laterite at the bottom overlain by sandy red clay and angular debris. The latter two deposits yielded Early and Middle Stone Age artifacts respectively. Over these beds rests the dark soil containing microliths, the top layers yielded a few objects of Early Historic period (Joshi 1978).


Panchmarhi, the rock shelter site also known as the Mahadeo hills and Dorothy Deep. It was excavated by G.R Hunter in 1932 and 1934-35. The excavations in 1932 and 1934 has revealed two periods: the earliest one was Mesolithic and the later pottery using-men (the culture was not defined). The excavation in 1935 confirmed the earlier excavation and with addition to that the Lower Plaeolithic, Upper and Middle was also discovered in the stratified layer (Sharma and Misra, 2003).
Table 1.2. Excavated Sites in Tawa Basin

<table>
<thead>
<tr>
<th>Sites</th>
<th>Year of Excavations</th>
<th>Excavator</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adamgarh</td>
<td>1960-61</td>
<td>R.V Joshi</td>
<td>Cave Shelter, Acheulian and Microlithic (Mesolithic and Historic)</td>
</tr>
<tr>
<td>Hirapur Khadan</td>
<td>1974-75</td>
<td>M.D Khare</td>
<td>Acheulean, Middle Stone Age and Microlithic</td>
</tr>
<tr>
<td>Panchmari</td>
<td>1932 and 1934-35</td>
<td>K.D Banerjee</td>
<td>Cave Shelter, Lower, Middle, Upper Plaeolithic and Mesolithic</td>
</tr>
</tbody>
</table>

None of these researches throw much light on the geomorphological history of river Tawa. On this background, the present research on geoarchaeological investigations on river Tawa has been carried out. To study the whole length of river Tawa was beyond the limitation. The lower reaches of the river has already seen some archaeological investigations and hence, the geoarchaeological investigations were carried out in the middle reaches of river Tawa which is in Betul District.

For the fulfillment of this doctoral thesis explorations of five seasons were conducted from 2009 to 2013 in Tawa river Basin at Betul District. During the exploration 14 prehistoric sites were discovered. A detailed discussion of the same is done in the chapter 3.

1.3. AIMS AND OBJECTIVES

The major aim of the present study is to understand the relationship between the man and land during the prehistoric period in the area. Briefly this work consists of following aims:

1. To locate Paleolithic sites in the study area

2. To understand geomorphic contexts of Paleolithic sites

3. To reconstruct Paleolandscape and Quaternary history of the Tawa river basin

4. To understand stratigraphy of Tawa against the background of known Narmada stratigraphy
1.4. METHODOLOGY

To fulfill the above mentioned aims following methodology has been applied:

Field Observation:

Intensive exploration was carried out for the documentation of the site. Exploration was done with the help of, Survey of India maps, Google earth images, District maps and GPS for coordinates and elevation.

1. Site Documentation: The exploration was conducted from the Middle reaches of the river in the border of Hoshangabad and Betul Districts near village Bhawra which was continued towards the upper reaches of Tawa till Sheoni coal mines. The area was surveyed on foot and by hiring a jeep. Toposheets were used for finding the routes, to locate eroded surface in land near the present water source, big and deep sections, small hillocks and hill ranges and rock outcrops and other potential localities.

2. Sampling: Random sampling was preferred because occurrence of the artifacts was very random, restricted to certain exposed areas, like near the recent rain gullies, agricultural fields near the water resources and eroded surfaces. Random sampling is taken to estimate a representative sample of a population. The process of Random sampling is often misunderstood as a bias method and taken without any conscious. There are two kind of random sampling, Simple Random Sampling and Stratified Random Sampling (see; Sinha and Glover, 1984) the former is a kind of orderly selected sample and in later according to the situation area is divided into different strata and independent random samples are taken from each Stratum. During the present research work both the methods were adopted in each site for the collection of the archaeolectical artifacts.

3. Site Observation: Study of river sections rocks and soil were done for understanding geology and geomorphology of the area and their impact on the archaeology of the area.
Mapping:

The positions of the archaeological sites were taken through GPS and are placed in online google earth images. The length of the whole river, its drainage with the sites was traced online on google earth images. All the data further were managed and mapped through Geographical Information System and with the help of Global Mapper digital elevation model, slope map, aspect map and contour maps were created. The traced (from google earth) drainage maps of the area are further used for the linear aspects of the drainage system.

Artefact Analysis:

To understand typology and technology the stone tools collected from different sites various attributes were applied to understand the reduction strategy, tool technology and their functional aspect. The detail discussion regarding methodology of the artifact study has been done in the chapter 4.