



Palaeoflood signatures and human response: A brief study in Middle Ganga Plain from Neolithic to Gupta period

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Abstract: *Enchanting as they are, instances of great floods have always dominated the literary compositions all around the world. The same compositions also talk about human response to such calamities in form of construction of a boat as per divine guidance. This attests to the fact that the humans never surrendered to the vagaries of flood and devised ways and methods to cope with the devastating power of the river. This is the very theme of present paper which deals with the archaeological records relating to Palaeo floods in Middle Ganga Plain from Neolithic times to Gupta period and tries to synchronize the data available from various site to postulate certain flood types and to study the associated human response in form of either site desertion or continuation of habitation at a site by adapting to certain means of survival such as construction of embankments.*

Keywords: Palaeo floods, Middle Ganga Plain, Archaeological records, Literature, Embankments, Site desertion, Flood categorization, Human response.

Text:

“There can be few stories more familiar to us than that of the Flood.” - Woolley 1953:52.

Floods are a recurrent feature in the course of human history. They have brought end to human settlements and have led to the establishment of new settlements as well. Their story represents a cycle of creation and destruction and thus they are closely linked with the history of human settlements.

Scientific research on Palaeo floods in India is a recent but fast growing development. During the last few decades hydrographers, geographers and geologists have applied their specialized knowledge to the geophysical systems which condition the life of man in the Ganga plain. Palaeo flood records on the Narmada and Tapi have been studied in detail by Kale et al (Kale et al 2003:338). Kale also studied possible flood signatures in Luni river, Thar, Rajasthan (Kale et al, 2000:337). Palaeo flood records of the Pennar river were studied by Thomas et al (Thomas et al 2007:747). Slackwater deposits in the alluvial reach of the Mahi river at Dodka were documented by Alpa Sridhar (Sridhar 2007: 330).

Archaeologically speaking, evidence relating to Palaeo flood can be seen in stratigraphic deposits. Presence of structures like ramparts, also indicate a measure devised to tackle the danger of flood (Roy, 1989:181). Literature too provides references relating to flood. Thus we have a rich repertoire of evidences relating to flood.

Archaeological scenario, however, lacks utilization of such scientific studies. The excavation reports do refer to floods, destruction caused by them and the steps taken to overcome the danger of floods. Some like Lal and Woolley have even correlated archaeological floods with the literary references (Lal 1952-52:19, Woolley 1953: 53). But a wholesome study of palaeo floods on the basis of scientific data across time and space is lacking. Therefore, this task of compiling the palaeo flood evidence from Middle Ganga Plain is undertaken to identify certain peculiarities in the palaeo flood data, which are otherwise missed out and to derive whatever information we can from such records for the reconstruction of past. To begin with, data from various sites in Middle Ganga Plain (see Map 1) is presented below.

I: Factual data

Balirajgarh

Balirajgarh is located 80 km north-east of Darbhanga district of Bihar. The excavations were conducted here by Archaeological Survey of India under the direction of Sri S. Mukherji and Sri Raghbir Singh during 1961-62. The defense wall at Balirajgarh served more as a defense against floods than invaders. It consisted of a mud brick core with brick encasement. Three phases of construction including the repairs were recognized. The earliest phase consisted of a mud brick core with battered brick revetments dating 2nd century BC. In the 2nd phase representing Kusana times, a brick-concrete ramp was built against the inner face. The 3rd phase witnessed further reinforcement of the ramp in the shape of a 3m high platform of earth mixed with potsherds, built against the inner phase of the fortification wall. The reinforcements were necessitated by heavy floods as evidenced by silt deposits. This might have been done to check floods in river Kamala which might have led to gradual decline of this settlement during the Post-Gupta and Pala period (IAR 1962-63: 3-5).

Buxar:

Archaeological site Buxar, locally known as Charittarvan, was excavated by Dept of Archaeology and Museum, Bihar under the direction of Professor .B.P.Sinha and Lala Aditya Narain Sri L.A. Narain during 1962-63. The excavations revealed fourfold cultural sequence. Period I was BRW, Period II NBPW, Period III Kusana and Period IV was Medieval period. At Buxar, sometime after the end of Pd II (dating early centuries of Christian era), there came a heavy flood in the river Ganga, which washed away most of the occupational strata. The thickness of the flood deposit, which probably came in four successive phases, was about 3.20m (IAR 1963-64: 8-9) The impact of inundation was such that the site was soon abandoned leading to complete disappearance of erstwhile flourishing urban centre. The site was reoccupied only in medieval period.

Champa:

Champa is one of the important sites in Bihar which are mentioned in Buddhist and Jain literature as a prominent ancient city. The site is situated about 5 km west of Bhagalpur. Excavations were conducted by the department of Ancient Indian History and Archaeology, University of Patna under the directorship of Prof B.P. Sinha during 1969-70 (IAR 1969-70:2). Three fold cultural sequence was identified at the site- period I was NBPW which was further divided into sub period IA, IB and IC, Period II was Gupta and Period III was Muslim period (IAR 1971-72: 5). However, Sharma believes that periodization of cultural sequence at Champa is not very clear (Sharma, 2010: 70). The excavations revealed existence of a mud rampart divisible into two phases. In the earlier phase, it was made of blackish soil capped by rubble spread and rammed NBPW sherds. Few Copper cast coins were also reported from the capping. In the later phase, an embankment of brick debris and yellow and red soil possibly to prevent scouring by water was built (IAR 1969-70: 2). Use of bricks in the embankment itself attests to the vital need of protecting the settlement from flood.

Kausambi:

Remains of ancient Kausambi are located 52 km south west of Allahabad district on left bank of Yamuna river. The sprawling remains at Kausambi were first recognized by Sir Alexander Cunningham in 1861. However, the site was taken up for excavation by ASI as late as in 1963-37. This was followed by major excavations conducted by Allahabad University from 1949-50 to 1966-67. Excavations brought to light a huge fortification wall with five phases of construction. Period I, *circa* 700 BC; Period II 500 BC; Period III 200 BC; Period IV, 50 BC; and Period V AD 150 (IAR 1957-58:57). It is important to note that that was also a pre defense deposit at Kausambi revealed a sandy deposit which is probably indicative of flood. The defenses were constructed for the first time during the third phase of Period I. In the fourth phase, they consisted of a mud wall with a burnt brick revetment on the exterior, the latter being available to a height of 42 ft. 5 in. At a height of about 6 ft. from the bottom there were a number of holes, perhaps weep holes, situated 6 feet apart from each other. These were probably meant for water exit. The rampart also had at least three clear stages of repairs subsequent to its original construction. That the rampart and the first phase of the superstructure were earlier than the introduction of the North Black Polished Ware was indicated by the absence of that Ware in the corresponding level (IAR 1956-57: 33). The second stage of the rampart, was separated from the first stage by a long gap of time. (IAR 1954-55: 26). Period II marked an appreciable change in the plan of defenses: the defenses being raised, revetted by brick facings along with addition of guard-rooms (IAR 1957-58: 56).

Mahagara:

Mahagara lies in neighborhood of Middle Ganga Plain, about 85 km south east of Allahabad on the right bank of the river Belan. Excavations carried out by Allahabad University at Mahagara revealed that it is a single culture site of Neolithic period. The earliest documented evidence of palaeo flood comes from Neolithic Mahagara where evidence relating to some water activities, probably flood, occurring at least twice has been encountered (Sharma *et al* 1980:141). These are manifested by the presence of alternate bands and rolled kankar nodules with fresh water snails, shells etc. The site is located, though above, but quite close to the flood plain. The selection of site for occupation near the flood plains, even though at the risk of inundation during the times of unusual floods, is significant.

Oriup:

Habitation mound at Oriup is situated 2 km south-west of the famous stupa of Antichak in Bihar. The excavations were carried out by Dept. of Ancient History Culture and Archaeology, Patna University under the supervision of Prof B. P. Sinha and Dr R. C. P. Singh during 1965-66. Excavations brought to light fourfold cultural sequence beginning with microlith bearing deposit (IAR 1966-67:6). Period I was identified as Pre NBPW period and period II as NBPW period. After period II, the site was deserted was re-occupied only during Pala period and habitation at site continued till medieval period. This site along Champa gave evidence of erosion due to the river action since Pre NBPW period which continued till NBPW period as well. NBPW period remains from Trench OPP-2A revealed that the entire area during this period was affected by the river action as evidenced by silt deposits. One of the reasons for the desertion of site after NBPW period may be attributed to the dangers due to flood.

Patiliputra:

Patliputra is located on the bank of the river Ganga in Patna district, Bihar. The excavations were carried out at various localities in different times by different excavators right from Spooner to V. Mishra (IAR 1955-56:22-23). Collectively speaking, five periods of occupation, ranging in point of time from *circa* sixth century BC to the seventeenth century AD, with a gap of nearly one thousand years, between AD 600 and 1600, were found (IAR 1955-56: 22). Location of Patiliputra was very much susceptible to the vagaries of floods. It was surrounded

by four important rivers- Ganga, Gandak, Son and Palaeo flood. Buddha is said to have predicted that the city might perish through fire, flood or mutual dissensions. Ancient Patiliputra seems to have perished at least about 50 years before the visit of Yuan Chwang. The cause of catastrophe was probably a terrific and unprecedented flood in Son in the month of Bhadrapads (September), which has been described in a Jain work called Titlhogali Painniya (Altekar 1959: 12). As per the text, it rained heavily and continuously for 17 days and nights. The Ganges water rose as also that of Son. The later was terrific in its force and engulfed Patiliputra all around. In course of 1912-13 excavations at Kumrahar, about 8 to 10 feet deep silt and a thick layer of ashes were recovered at the site of the 80 pillared hall, which clearly indicated that the destruction of the hall had a lot to do with floods also. Spooner however failed to ascertain the time of its occurrence (ASI AR 1912-13:57). Waddell too suggests that the palace might have been destroyed by floods.

Prahaladpur:

Prahalpur is situated on the right bank of the river Ganga, about 11 km south-east of Danapur in Chandoli, U.P. The excavations at Prahaladpur were conducted by Prof A.K. Narain of Dept of A.I.H.C and Archaeology B.H.U during 1961-62 (IAR 62-63:41). The site has a longitudinal extension, more in alignment along the river than against it is significant. The site, as revealed from excavations, represents one culture occupation of NBPW period ranging from c. 7th cent BC to the beginning of Christian era. This long span is conveniently divided into sub period IA, IB and IC (Narain & Roy, 1968:14).

A nullah, probably an ancient moat, surrounds the mound at Prahaladpur on its southeastern, southern and western sides and finally joins Ganga. The cutting at nala revealed a structure of clay, a type of small clay bund or fortification made just at the right bank of the nala at the point where it looks attacking the habitation, in order to divert its course and also to prevent water scouring inside the habitation. It was built directly above the natural soil with a basal width of 6.70 m and revealed evidence of three structural phases (fig. 1). In the first phase, a brick revetment of seven courses was laid over very sticky clay up to a height of 90 cm. During the second phase of its construction, its height was again raised by 1.23m and it was riveted with 18 single courses of bricks while at either ends it was packed and well rammed with clay and brick bats. In the last phase, its height was further raised by 1.17 m by adding compact clay along with some brick bats. Its total height was 3.30m with a steeper slope towards the outer course of the nullah (Ibid: 11). However, the date of its construction is not very clear. Nevertheless, it does records multiple attempts of raising the height of embankment during the whole period of occupation against the threat of flood.

Rajghat:

Immensely significant archaeological site Rajghat is situated in the north eastern outskirts of Varanasi. The site was excavated by Department of A.I.H.C. and Archaeology, B.H.U. under the directorship of Prof. A.K. Narain and T.N. Roy (IAR 1957-58:50-51). It is enclosed on the north and north-east by the river Barna, on the west and northwest by a steep depression said to be an old bed of the Barna and on the south-east by the Ganga. Six cultural periods were identified here. Period I 800-200 BC; Period II 200 BC to Christian era; Period II Christian era to end of third century AD; Period IV c.AD 300-700; Period V AD700-1200 and Period VI was Medieval period. Period I was again subdivided into Period IA, IB and IC ranging from 800-600; 600-400 and 400-200 BC respectively.

In the early part of period IB, we find smooth laying of wooden planks up to a length of 34m along the bank of Ganga forming some kind of a platform. As a result of periodic rise in the level of Ganga during floods, this wooden platform fell into disuse and floods became a source of constant danger to the city. It was at this structural phase that a massive clay embankment was built as a measure against floods (Narain and Roy, 1976:22). Built directly over the natural soil and available to a height of about 10 meters, the rampart had a pronounced slope towards the river. Location of this bund corresponds with the inner bend of Ganga which is the point where the

habitation was most vulnerable to the vagaries of the river. Furthermore, a series of successive gravel-sandy deposits alternating with silt just over the outer embankment also show that the bund on the northern side was breached several times by heavy floods which also affected some portions of the habitation where they left vestiges in form of silt, sand, kankar and river shells (fig.2) (IAR 1960-61: 36).

Ramnagar: period and embankment

Ramnagar lies on a cliff on the left bank of the river Ganga in Varanasi (Jayaswal & Kumar, 2006: 85). The excavations were carried out here at Oriyaghat locality by Prof Vidula Jayaswal from Dept of A.I.H.C and Archaeology, B.H.U. during 2004-05 and 2006-07 (fig.3). The ancient settlement here appears to be confined to the bank and does not extend beyond half a kilometer from the river side. During archaeological investigations conducted at Oriyaghat, Ramnagar, it could be ascertained that this region was under occupation between Maha-Janapad and Late Kusana periods (Jayaswal, 2013: 82). Here, palaeo floods were recorded in trench C3 form of a 0.78 m thick platform made of rammed brick bats, potsherds and kankar. This was probably constructed during late NBPW period. It served as protective device from the rising water in river Ganga (ibid: 83).

In trench D3, the palaeo flood was evidenced by a gray colored fine grained micaceous sand unit embedded with anthropogenic layers containing pottery. In trenches B'2-C'2 and C'3, sand was concentrated in patches and also distributed with silt and mud forming laterally continuous bands. In all the three trenches, sand unit resting over artificial pavement was recovered. It was made up of compacted calcretes mixed with silty mud and was covered by a similar layer bearing signatures of human activity. As evidenced by the compact anthropogenic hard layer at the base with many backing pits intruding through the layers up to more than 1 m and filled with broken pottery, it is believed that a catastrophic flood might have inundated the adjacent cliff surfaces where human activity was in progress (Shukla 2006: 149-50). The thick platform/embankment appears to be constructed as protective device to the frequent rising water levels of the river. On archaeological grounds, palaeo flood at Ramnagar may be dated to around 3rd-4th century BC.

Sravasti:

Sravasti is situated on the banks of Rapti river in Bahraich district of Uttar Pradesh, about 160 km from Lucknow. Archaeologically, site is known as twin mounds of Sahet-Mahet. Sir Alexander Cunningham identified the site as Sravasti in 1861 and excavated the remains at Sahet. After independence site was again excavated during 1957-58 by K.K. Sinha of A.I.H.C. & Archaeology department, Banaras Hindu University (IAR 1958-59: 47-50). The excavations revealed a threefold cultural sequence- Period I dating from mid 6th century BC to 300 BC, period II dating from c.275 BC to 50 BC and period III dating 4th-5th century AD (Sinha, 1967:12, 14)

Period II at Sravasti was marked by the coming up of a mud rampart which, with a circuit of 3 miles was laid roughly in the form of a crescent with the northern side overlooking the river Rapti (IAR 1958-59: 47-50). Thus the township was extensively fortified with mud ramparts which were topped by fortification walls of burnt bricks, constructed at regular intervals. But this feature was provided sometimes after the building of the original rampart (Sinha, 1967: 10). This mud rampart had three structural sub periods which demonstrates regular efforts for its maintenance which was important for the safety of the city (fig. 4). Though the excavators attribute the fortification to have been constructed as a measure against the threat of Indo Greek invasion, it appears that the earlier beginning of the fortification in form of brick less mud rampart had something to do with flood. The site was deserted after Sunga period only to be re-occupied later.

Tilmapur, Ashapur and Kotwa:

All these three sites represent different locales of habitation in modern Varanasi. Prof. Vidula Jayaswal discovered these sites in course of search for art workshop sites in Varanasi region (personal communication). They

are mainly associated with remains from Kusana period. Soil samples obtained from the alluvial horizon lying below and in the vicinity of the Kusana period archaeological deposits at Tilmapur, Asapur and Kotwa, favors the deposition of silt. For inundation water only gradually floods the territories at different levels filling up the depressions and depositing layers of silt which after floods dries up and in time shows deposition of salts making soil alkaline. The action of water is further indicated by the color of these soils which exhibit light to dark yellowish brown color (Rana 1998: 249-50).

II: Observations and Interpretations

Above survey of palaeo floods in Middle Ganga Plain has brought to light three different impact type of flood events which can be divided into following categories:

Catastrophic floods: These types of floods have the highest impact on the human settlements. The effect of these floods is so much that settlement is deserted by the human population. Such devastating floods were recorded at Oriup, Sravasti, Buxar and Patiliputra. At these sites, the next evidence for human occupation appears as late as medieval period. At Prahaladpur which is a single culture site, it appears that threat owing to flood restricted the continuity of habitation in next period. This itself is indicative of the disastrous effect of flood on human settlement.

Floods as a regular recurrent feature: river banks have always been a centre of attraction for human settlements (Thakur, 1981:300). But the river banks have their own benefits and risks. Recurring floods is one such risk to which the river bank settlements are exposed to. At times the human settlement is made on the high cliff to avoid the dangers of flood. Embankments and ramparts are also made use of to tackle the problem of floods. But they do not make settlement flood proof for always. We have many examples when embankments were breached or were repaired/ reinforced as at Balirajgarh, Champa and Rajghat. But probably the risks of flood were not as high as the importance of location was. Moreover, the flood in the river was restricted to a certain time period and was not a year round phenomenon. In such a situation, it was better to take measures to safeguard settlement than to leave it. Thus, the investments in the maintenance of embankments were worth it. Settlements were only deserted when an extremely large flood came. Otherwise the settlements kept going on and on.

Beneficial floods: Floods are not only symbol of destruction but they do have their own benefits. They bring with them fertile soil which is so very good for agriculture. With its annual inundation, the value of flood plain in context of early agriculture is obvious. Flood plains provided fields with excellent soil that could be exploited for cultivation of rice without any man made irrigation device and manuring. From Ramnagar, during Post NBPW period, evidence of antlers with use marks in form of pointed sharp tips which probably resulted from tilling operation was recovered. It is important to note here that these antlers could only have been used for tilling carried out in soft flood silt. Flood silt could also be used in pottery making owing to its plastic properties. But there is one other lesser known benefit of floods for settlements. rivers were often used for transporting commodities. But those sites which were not on the river banks such as Tilmapur, Ashapur and Kotwa had to face the problem of transportation more so because these were craft specialized sites. At Tilmapur, Ashapur and Kotwa, on account of archaeological discoveries and general morphology of the explored area, it was possible to suggest the existence of an ancient rivulet (Jayaswal, 1998:116). Besides being fed by the rain water, this rivulet might have been receiving major bulk from the flood backwater of the river Ganga during the months of July to September, a very common scenario in this region today. Then transportation of large stone blocks through this channel may, thus, be pre assumed to be done during rainy season. That is to say that inhabitant artisans and sculpturists waited for the annual flooding of Ganga so that they could transport both raw material (Chunar Sandstone) and finished products to these sites which were not directly connected to Ganga. Thus flooding of Ganga was very important event which was required to sustain the specialized economy of Tilmapur, Ashapur and Kotwa.

It was observed that palaeo flood record in Middle Ganga Plain is mainly based on two types of data- flood deposit in form of silt and presence of embankment. However, there is ambiguity in both these types of data. First and foremost, the time frame of NBPW period is different at different sites. Generally, this period was taken to indicate timeframe ranging from 800BC to 200 BC. There are sites like Buxar and Oriup which refer to this period simply as NBPW period and offer no distinct time boundary. At some sites, this long span is conveniently divided into sub periods as at Champa, Rajghat, Prahaladpur. There are also sites where two/three distinct periods were classified within the general time frame of NBPW period. For example at Kausambi, period I, II and III are classified as 700 BC, 500 BC and 200BC. In light of these observations, it becomes rather difficult to pinpoint the first construction of embankment at sites which refer to chronology as NBPW period.

In archaeological literature, many terms are found referring to such arrangements as defense walls, bunds, ramparts and fortification wall. However, it is very important to understand that all of these connotations are not synonyms and that they are meant to have a different function. Defense wall is a general term indicating a construction for defense. But it does not make clear if it offers defense from foreign enemy or flood. Embankment/rampart/bund is taken to indicate a construction to prevent flood water from entering the settlement. Initially, they were made of mud bricks but later burnt bricks were also used. Such constructions are generally made along the river side where the greatest threat of flood lies. Due to the same risk, they often bear evidence of breaching and alternate deposits of sand and clay alongside their wall such as at Rajghat. In special cases as at Kausambi, they are provided with weep holes to facilitate water exit. On the other hand, fortification wall is an elaborate formation purely for defensive purpose against enemy. They cover a settlement from all the exposed sides and not just one side along the river. That is why they generally have provisions for bastions and guard rooms which are not needed for protection against flood. Therefore, one must use such terms with utmost care keeping in mind the respective function associated with each.

Human response to flood:

It is observed that human response was different at different sites across time. Initially people chose to settle on higher grounds, safe from dangers of flood and the river cutting. It was only when man devised measures to tackle the flood impact that he settled near the river banks. This intentional avoidance is very clearly visible in paucity of sites along the major rivers during Neolithic Chalcolithic period and their sudden upsurge during/before historic period when the settlements were often made on the river banks even at the risk of floods. The best example comes from Patiliputra which was surrounded by four mighty rivers-Ganga, Son, Gandak and Punpun and was still a flourishing settlement. It appears that with the passage of time, the fear of flood was often conquered by the economic value that the river provided. This choice of settling near the river bank had also a lot to do with the coming of tradition of construction of embankments. But one must keep in mind that though the building of embankment may have facilitated the safety of human settlement from flood, nevertheless it could not offer a complete guarantee against flood (table 1). On one hand we have sites which did not have any embankment and were deserted owing to flood threat such as Buxar and Oriup while on the other there are also sites which successfully made embankments but still perished and were reoccupied later such as Balirajgarh, Champa, Prahaladpur and Sravasti. None the less we also have sites with embankments which survived such as Rajghat, Ramnagar, Patiliputra and Kausambi. Then there are sites where embankments are not made by choice since the annual flooding of the river helped in transportation such as Ashapur, Tilmapur and Kotwa. Thus this brief survey of palaeo floods in Middle Ganga Plain has brought to light the fact that floods were not always a negative factor for a settlement. Humans adapted to the vagaries of flood by careful site selection and construction of embankments which helped them to avail greater benefits of settling alongside the river.

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