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Archaeological Investigations in Middle reaches of Chautang River to study the impact of climate on Agriculture during the Harappan period

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Abstract - Climate change itself is a complicated subject of investigation, which is thought to be the result of global regional and local geological changes that influence atmospheric and hydrologic circulation patterns. In order to understand the climatic conditions of the Harappan period in the middle Chautang River basin based on past published records and botanical evidence retrieved during excavations taken into consideration. Based on this, a comparative study of sites is carried out and an effort has been made to study the paleo-environment and its effect on the agricultural pattern.
Keywords : Climate, Paleo-Environment, Harappan Period, Agriculture

Introduction- The Harappan civilization has occupied a vast geographical territory from the arid Makran coast to the fertile alluvium plain of Saraswati from west to east and from the fertile piedmont of Shivalik to Kutch and further on to Lothal. In this territory, it has several ecological niches.

Rising from the rural, followed by the proto-urban stage, the Harappan culture transformed into the exceptional advanced urban civilization that flourished between 2600BCE to 1900BCE.

The geography of the Harappan settlement is closely related to the alignment of the Indus and Saraswati valley trunk and tributary drainages in the semi-arid region of Pakistan, although more remote manifestation that extended into the piedmont zone of the Kachi plain and ever crossed the Hindukush to have its settlement in north. It has been estimated that Harappan territory encompasses (Fig. no.1) nearly 700,000 square kilometres (Danino, 2010).

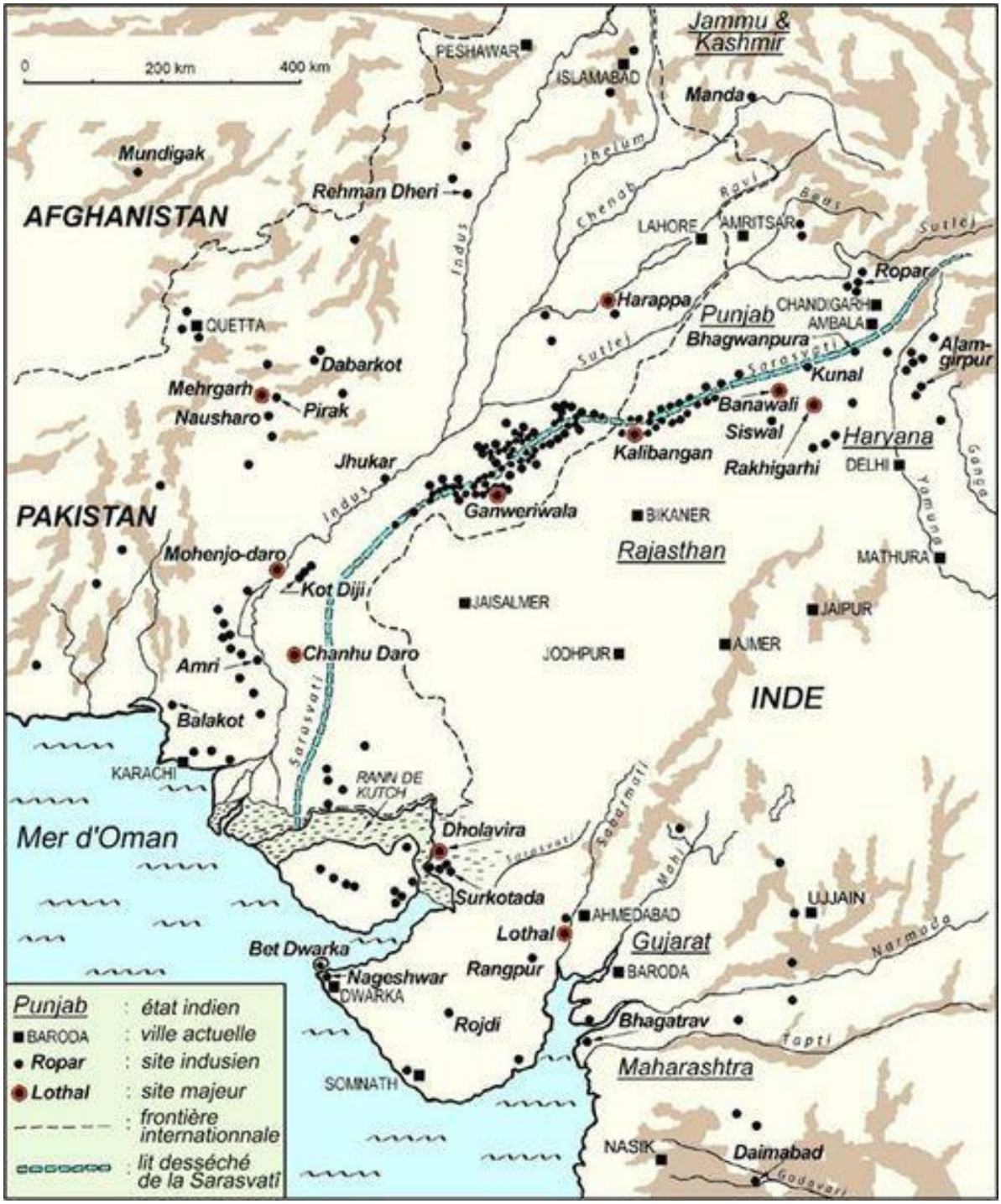

Fig. No.1 Location Map of the Harappan settlements (After Michel Danino, 2010).

Aims and Objectives

Present work focuses on studying the archaeology of the middle Chautang river basin during Harappan times by analysing the present climate, geomorphology, flora, fauna, reconstructed past environment and its effect on agriculture.

Methodology

The methodological part of this study was divided into two parts

On-Site - Archaeological sites and the region was thoroughly surveyed to understand the geomorphological features, landscape and present environmental conditions.

Off-Site - Previously published literature on past environment and botanical evidence related to study area has been referred to get better insight into the region's palaeoenvironmental conditions.

Chautang River Basin and its Environmental Settings:

Chautang (Fig. No. 2) originating from the Shivalik region used to flow through Jind, Hansi, Hissar and then after confluence Ghaggar at Hanumangarh and Cholistan desert, Pakistan used to flow southwardly, independent of the Indus river system. Either due to the uplift of Siwaliks in relation to the Himalayas, the feeding glacier got cut off, similarly, due to increasing aridity in Rajasthan or adjoining areas, the moving sands choked the Sarasvati and Chautang rivers of Haryana. The relict beds are now, more or less low plains. At present only Ghaggar is a seasonal flowing river in north Haryana.

Fig. No. 2 Location of Chautang river basin (After V. Shinde, 2011).

The physical environment features like topography, landforms, water resources, atmosphere, vegetation, fauna, minerals are various dynamics interacting with human communities reciprocally. The environment has been a dominant factor in shaping the human way of life. On a geological time scale, the Harappan settlements in the Haryana plains are part of the early Holocene. So, the understanding present environment of this region becomes the prime factor of the current investigation.

Geology and Geomorphology

The geological formation of the state of Haryana can be divided into the Aravalli system, Siwalik system and Alluvial plains. Aravalli hills are the oldest formations present to the south and west of the Chautang basin in present Bhiwani, Mahendragarh and Gurgoan districts. They are composed of quartzite, quartzitic sandstone, mica schist and crystalline limestone. The Siwalik system is located to the northeast of the Chautang basin composed of sedimentary rocks. The Chautang plain is formed by the deposition of alluvial sediments between Siwaliks and Aravallis as part of a great Indo-Gangetic plain. They contain sand, silt and occasional gravel beds. The exact depth of the alluvium is not known, but from many geophysical and borehole data, it varies from 100 m to more than 400 m cross-sections.

Soil- The soil of this region is alluvium and is spread over a vast region of Haryana. They are the most potential soils of the state with good fertility and water holding capacity. These soils respond very well to the application of fertilizers and irrigation. Wheat, paddy, sugarcane are major crops.

Climate and Rainfall- The climate of the region is the semi-arid type with a prolonged hot period from March to October and fairly cool winters. However, extreme temperature fluctuations may occur within a very short time interval. Further, the year may be divided into 4 seasons. The cold season from November to March is followed by the summer that lets up to the end of June. The period from July to about the mid of September is southwest monsoon season. The later half of September and October constitutes the post-monsoon transitional period; rainfall in the middle Chautang basin is between 500-750 mm. In general, its dryness and extremes of temperature and scanty rainfall characterize the climate of the study area.

Flora

- Rohera, Khhairai, Reru, Kikar, Imly, Babul, Peepal, Shisham, Neem, Kikar, Jall, and Beriare some other trees found in this area.
- Common shrubs are Bans, Vanvar, Babhul, Mallah, Arir, Phoa, Khipand, Ak.
- Some medicinal herbs like Bansa, Kharuti, Bbhakhra and Dhattura are also found.

Fauna

- Monkey and common langur represent the primate group

- The carnivorous found here are: the jungle cat, the small Indian civet, the common mongoose, jackal and the Indian fox
- The five stripped palm squirrel or gilehary, sahi or the Indian porcupine, the Indian Gerbille the common house mouse and rat, are the common rodents found
- Chinkara or ravine deer is also seen, but its number is decreasing. Blackbuck and the blue-bull or Nilgai are also found

Reconstruction of the Past Environmental Changes in Chautang river basin:

The Harappan civilization was spread over the vast plain between the piedmont regions of Afghanistan and the Siwalik hills in India. It was essentially riverine, spread along the Indus and dried-up banks of Ghaggar river systems. Though this area generally falls under the semi-arid alluvium plain category, it comprises several physiographic complexes, local variations, macro and micro environments with several geographical pockets. As seen above, these geographical features have remained base for the division of the entire Harappan Civilization into seven domains (Possehl 1997: 438). The Chautang basin is a part of the eastern domain that did not remain isolated from geo-cultural changes that took place over the last several thousand years. Therefore it is essential to review environmental changes that were taking place over the entire Harappan sphere of influence and how they are reflected in the Chautang basin. The Chautang, at present a dry river; its old channel is filled with silt and sediments; covered by aeolian sand at some places.

There are different views of the scholars regarding the climate in which the Harappan civilization evolved and flourished. There are many views of scholars such as it is evolved in the wetter phase while others hold that it was an arid phase. This is discussed in detail below:

The present discussion would be referring to the two papers published by V.N. Misra, incorporating archaeological data with geological changes of the region under discussion (Misra 1984; 1994). The one published in 1984 examines the archaeological evidence related to the theory of 'wet climate' proposed by Gurudip Singh (Singh 1971; Singh. et. al. 1974). His theory was based on palynological evidence from lakes in Rajasthan and Misra points out that archaeological sites representing early farming communities (Neolithic-Chalcolithic age) are conspicuously absent in this area. In contrast, the dry bed of Ghaggar is marked densely with sites of Pre-Harappan, Harappan and PGW settlements. Thus, Misra asserts based on archaeological evidence that increased rainfall between 8000 B.C.E. and 2000 B.C.E. did not lead to the emergence of agriculture in western Rajasthan and north Gujarat. He also takes a brief review of the Harappan agriculture economy and points out, "…the same crops can be and are grown without artificial irrigation in areas where annual monsoon floods provide adequate moisture and fresh fertile silt to the land. Since there is no evidence of artificial irrigation during Harappan times it follows that these crops were grown with the aid of moisture and silt provided by river floods" (Misra 1984:474). He also adds that the availability of water from Himalayan rivers remains a crucial factor in the wheat-growing areas, against the rainfall pattern. To sum up, he supports the shift of Sutlej and Yamuna to north and east respectively, leading to the drying of Ghaggar or the Rigvedic Saraswati and the decline of the Harappan civilization.

In 2003, M.Staubwasser and three other colleagues analysed the planktonic oxygen isotope ratio of the Indus delta. Their finding revealed climatic changes during the last 6000 years, 'with the most prominent change recorded at 4.2 ka B.P', that is 2200 B.C.E, along with the reduction in Indus river discharge. They observed the 4.2 ka event is coherent with the termination of urban Harappan civilization in the Indus valley. Thus, the drought may have initiated south-eastward habitat tracking within the Harappan cultural domain.

Climate and environment are two different aspects, even if it is accepted that Harappan climate was moving towards aridity it does not mean that the ecosystem was degraded as it is today.

Taking into consideration the above view, it can be said that the Harappans started with a wetter climate and gradually move towards aridity and from 2200 B.C.E onwards. Until around 2000-1900 B.C.E there prevailed drought conditions which eventually coincide with the final disintegration of the urban civilization.

Climate and its effect on agriculture:- The richness of the region's agricultural resources undoubtedly made it an important breadbasket for the Harappans, who extensively occupied it in the coming centuries. As a result, over half of all known Harappan settlements were located in the Ghaggar-Hakra region In the Present study area a large number of settlements were recorded and the dense population is settled here and food is one of the major factors is required for the survival of the people. This area comes under Indo Gangetic plain and one the most fertile region, the evidence retrieved from various excavations we can believe that the agriculture is a very significant factor for survival apart from trade, as we can see now also 70% of the population of this region depends on the agriculture.

As we discussed earlier the climatic condition during the Harappan civilization and is one of the major factors which affect agriculture and their strategies for future cultivation are dependent on the climate. As climate changes, their strategies changes food changes, cropping pattern changes and food habit effects.

As there are so many sites reported in the region but only a few are excavated out of that and out of that also very little data published. Only a few of them get references about botanical data, which is essential for the study of agriculture practices and the environment. On the basis of limited published data, authors are studying the impact of the past climatic condition on agriculture. In the present research the data of two sites in the study area of which the botanical data is published the study is carried out on that basis. The detail and discussion are as follows

Balu(29 °40' 13.8" N; 76° 23' 13.6" E):
Suraj Bhan and Jim G. Shaffer (1978) explored Haryana and discovered Balu, situated about 17 kilometres west of the present District Kaithal. It is located 4 kilometres north of the village Balu. It is presumed that the daily life of the people depended on the river Apaga, a tributary of the river Saraswati, both referred to in the Rigveda. Presently, the Narwana branch of the main Bhakhra canal flows through the north of the mound. The site can be reached by bus from Delhi to Kaithal and from Kaithal to village Deban. Deban is situated on Kaithal to Jind road and from here the site, located at a distance of 4 kilometres, can be approached through a Kachcha road running along the canal. The Department of Ancient Indian History, Culture and Archaeology,

Kurukshetra University, Kurukshetra excavated the site from 1978-79 to 1989-90, 1992-93 to 1994-95 and 1996-97, first under the direction of U.V. Singh and Suraj Bhan and later under the direction of S.P. Shukla (Kesarwani, 2001:140-52).

The site measures 250 metres east-west and 200 metres north-south. The total cultural deposit of the mound is 4.50 meters. A three-fold cultural sequence marked based on pottery tradition, termed as A (Pre-Harappan), B (Mature Harappan) and C (Late Harappan) was brought to light.

Period A (Pre-/Early Harappan):

Botanical Remains - Rice (Oryza sativa), hulled barley (Hordeumvulgare), dwarf wheat (Triticum-sphaeoro-coccum), bread wheat (Triticumaestium), green gram/ munga (Vighnaradiata), horse gram/ kulthi (Dolichosbioflorous), Common vetch (Vicia sativa), musk-melon/ karbuja (Cucumismelo), watermelon/ tarbuja (Citralluslanatus), wild jujube/jharberi (Ziziphusnumularia) and Harra (Terminaliachebula). Harra is important tanning material and laxative tonic. Pre- Harappans at Balu were agriculturists and cultivated almost everything that we grow today.

Period B (Mature Harappan): Botanical Remains - During this period Harappans continued to grow rice, hulled barley, dwarf and bread wheat, horse and green gram. The new evidence includes barley (Hordeum vulgarevar), Lentil (Lens Culinaris), Egyptian clover/ barseem (Trifooliumalexandrinum), field pea (Piscumarvense), chick-pea/ gram (Ciceraretinum), grass pea/ khesari (Lathyrussativus) and til (Sesamumindicum). Moreover the remains of date (phoenix sp.), grapes (Vitis vinifera), kundroo (Cocciniacordifolia) and garlic have also been found.

Farmana: Farmana archaeological site located in Meham block of Rohtak district, Haryana spread over 18.5 hectares (Shinde. et. al.,2011). It is located near the village of Farmana Khas, about 15 kilometres from the Rohtak-Hissar highway and 60 kilometres from Delhi, and based on evidence from the Early Harappan to Mature Harappan period. It is significant particularly for its burial site, with 70 burials, of the Mature Harappan period (2500–2000 B.C.E).

At Farmana, wheat, barley, millets, gram, garlic whose seeds were found, use of horse gram, eggplant, mango, ginger, turmeric, sedge has been confirmed (Shinde. et al., 2011).

The presence of cooked ginger & turmeric starch grains inside ceramic pots & teeth of skeletons in burial sites (Shinde, et. al., 2011) makes Farmana the first civilization to use spices for cooking. Archaeobotanical evidence retrieved during excavation is mentioned below

Cereal retrieved during excavations, such as wheat (during summer), pearl millet (used along with wheat in the winter), occasionally rice and legumes (Vigna species and Bengal Gram). Vegetables are also consumed depending on what is available in the market and what is being grown in the vegetable backyard garden. Weeds such as 'Bathua' (Chenopodium album) are also used widely for cooking. The most common wood types were shisam (Dalbergia sissoo), 'kikar' (Acacia karoo) and kair (Acacia chundra). Archaeobotanical evidence retrieved during excavation is mention below

Cereals :

Hordeum Vulgare (hulled barley)
Hordeum sp. (barley)
Triticum aestivem (bread wheat)
Tritucum sphearococcum (dwarf wheat)
Panicum sumatrense
Panicum sp.
Brachium rumosa
Setaria sp.
Sorghum sp.
Triticum sp. (wheat)

The diet at Farmana appears to have included a variety of crops likely grown locally. Like most Harappan sites, the focus was on cereals and pulses. What is clear is that a combination of indigenous millets and Southwest Asian cereals led to a secure multi-cropping strategy that was in place from the beginning of the occupation of Farmana. This strategy incorporated both summer and winter crops. Rice does not appear to be part of that strategy. With the addition of starch analysis, we have an even clearer picture of cropping and diet as several species were identified that were not present in the seed record (Shinde. et. al., 2011). Millets, barley and gram were crops that were being consumed at Farmana as they were found in human dental calculus. Ginger, turmeric, mango, eggplant and possibly sorghum were all identified in the starch record but not found in the seed record (Shinde. et. al., 2011).

Eggplant and mango were more often found on long narrow stone blades. Some blades were covered with just eggplant starches and nothing else. Wheat and barley decline in use by nearly 60 per cent while millet use remains constant. The net result is an increasing emphasis on summer crops.

Balu was successfully sampled and archaeobotanical remains were recovered (Saraswat and Pokharia 2002). While the data from these sites are not quantifiable, they do contain many of the same crops. The biggest difference appears to be a greater dependence on wheat, barley and rice than what we found for Farmana.

Conclusion: Climate and environmental settings both are important factors that can affect civilization and it is clearly visible in agriculture practices. As we can see in Balu where we get the cultivation of Rice, wheat and barley as the major crop from the Early Harappan period and it continued in the mature period, so we do not have any major changes in both periods. It may be the effect of the environmental setting in which, the site is located. As we know that cultivation of rice required an ample amount of water for cultivation so it could not be solely dependent on the monsoon, there must be an alternate arrangement for irrigation and is also located nearby the Apang river. So this factor works as an advantage point for the people. In Balu, it was the environmental setting that plays an important factor in terms of agriculture.

At the same time, we cannot take out the effect of climate on people as we discussed earlier the same, how the cultivation pattern of site Farmana shifted from winter cropping to summer, as it indicates the effect of climate change and less rainfall in the winter. Climate and environmental settings both are important factors, while looking into the development and growth of civilization.

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