

# **A Fresh Appraisal of The Animal-based Subsistence and Domestic Animals in The Ganga Valley**

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## **ABSTRACT**

Due to a number of faunal studies done in last few decades the evidence of animal-based economy in the Ganga Valley is growing. The faunal evidence begins with the Mesolithic phase and is available up to the Early Historic period through the Neolithic-Chalcolithic period. The information about fauna at several sites in the Ganga Valley is now available. These include Mahadaha, Damdama, Sarai Nahra Rai, Senuwar, Malhar, Narhan, Khairadih, Tokwa, Raja Nal-ka-tila, Lahuradewa, Jhusi and Kopia. The archaeo-faunal material of some of these sites is now being examined in relation to taphonomic processes and intra-site patterns of animal usage. Yet one of the key issue of origin of domestic animals in South Asia remains to be resolved due to various methodological constraints such as far less secured chronology and inadequacy of full faunal reports. In addition to this the nature of evidence of animal-based subsistence in the Ganga Valley during the Neolithic-Chalcolithic period and subsequent Early Historic period is not sufficient to trace the history of domestic animals such as the cattle, buffalo, sheep, goat, horse and the ass. This article aims to provide discussion of the limitations of the data, methodological issues involved in faunal analysis and interpretation, and an assessment of the nature of faunal evidence related to the economically important domestic species found in the Ganga Valley.

Keywords : <Domestic Animals> <Indian Archaeozoology>  
<Faunal Studies in the Ganga Valley> < Animal-based Subsistence>  
<Methodological Issues in Faunal Studies>

## **Introduction**

Due to a number of faunal studies done in last few decades the evidence of animal-based economy in the Ganga Valley is growing. The faunal evidence begins with the Mesolithic phase and is available up to the Early Historic period through the Neolithic-Chalcolithic period. The information about fauna at several sites in the Ganga Valley is now available.

These include Mahadaha, Damdama, Sarai Nahra Rai, Senuwar, Malhar, Narhan, Khairadih, Tokwa, Raja Nal-ka-tila, Lahuradewa, Jhusi and Kopia. The archaeo-faunal material of some of these sites is now being examined in relation to taphonomic processes and intra-site patterns of animal usage. Yet one of the key issues, the origin of domestic animals in South Asia remains to be resolved due to various methodological constraints such as far less

secured chronology and inadequacy of full faunal reports. In addition to this the nature of evidence of animal-based subsistence in the Ganga Valley during the Neolithic-Chalcolithic period and subsequent Early Historic period is not sufficient to trace the history of domestic animals such as the cattle, buffalo, sheep, goat, horse and the ass. This article aims to provide discussion of the limitations of the data, methodological issues involved in faunal analysis and interpretation, and an assessment of the nature of faunal evidence related to the economically important domestic species found in the Ganga Valley.

### **The Data and the Methodological Constraints**

Indian archaeozoology has achieved substantially within Indian archaeology in many areas. Archaeozoological methods recognise the importance of the taphonomic processes that affect the formation of the faunal assemblage in archaeological context. The cultural processes (e.g. butchering, burning, marrow extracting), natural factors (e.g. exposure to sunlight, transport by water) as well as non-human scavengers and predators (e.g. hyena, vultures, dogs and rats) leave their distinctive signatures on the animal remains. Careful examination of such signatures is crucial to our understanding of various aspects of human-animal interaction. The importance of site formation processes in interpreting the faunal record has long been known<sup>1</sup> and a step in this direction began at the Deccan College in the late 1980s.<sup>2</sup> Identification of species is a vital and still valid problem faced by all faunal analysts. The Archaeozoology Laboratory at Deccan College is operational for over three decades and has been active in training and support activities. At this laboratory since inception standard archaeozoological methods of identification, age-sex determination, recording bone modifications, pathology, quantification

and reporting are followed. Further since 1991 a computer-based method of recording primary data and its analysis is being used.<sup>3</sup> Although there is a need to have more reference skeletons of fish, reptiles and birds, the collection is adequate for satisfactory identification.<sup>4</sup>

Archaeological explorations and excavations conducted in the Ganga Valley, particularly in Uttar Pradesh and Bihar have revealed presence of human occupation from about sixth millennium B.C.<sup>5</sup> For this article faunal material recovered from various archaeological sites in the Ganga Valley and the adjacent Vindhyan range has been considered. The choice of the material is primarily governed by the availability of usable information. In all faunal material from 13 sites (Neolithic-Chalcolithic onwards) is available for comparison (Table 1), of which the study of Lahuradewa (Sant Kabir Nagar District, U.P.) is preliminary and restricted to only period I. Out of these 13 sites, the author has first hand experience of material from 7 sites. Also the author has worked on faunal material from two important Mesolithic sites of Damdama<sup>6</sup> and Mahadaha.<sup>7</sup> This article summarizes the results of faunal studies conducted at all these sites with an aim to understanding the role of domestic animals in the subsistence economy from the Neolithic-Chalcolithic till the NBP period. Besides the sites included in this study some information about faunal material from a few other sites is available,<sup>8</sup> however, these sites have not been included. These sites are Chirand, Atranjikhhera and Rajghat. The main reason behind inclusion or exclusion of the sites is the nature of 'uneven' information observed in case of the Ganga Valley and Vindhyan sites.

Each year, archaeological explorations and excavations are conducted all over India, so also is in

the Ganga Valley. Some are small-scale excavations whereas a few are large-scale and long-term ones. In the Ganga Valley the main agencies/institutions that are engaged in the archaeological explorations and excavations are the University departments, State departments of archaeology of various constituent States and the Archaeological Survey of India (ASI). However, a few complete reports are published. This is not only true one particular institution or one particular region, but is a widespread phenomenon seen in last couple of years. Chakrabarti<sup>9</sup> even expresses pessimism about the report of three Neolithic sites in Bihar (Chirand, Chechar-Kutubpur and Maner) being published in near future. Obviously this is one of the reasons for 'unevenness' seen in the faunal information base. For example, from Singh

and Singh's recent account of archaeological research in the Middle Ganga Valley, we learn that dozens of sites have been excavated.<sup>10</sup> Of these excavated sites only at handful sites the faunal material has been examined.

Besides regular excavations, debris is cleared at many monuments, forts, temples, *stupas* and buildings of national importance. In urban areas, during building and construction activity in and around towns, cultural material gets accidentally unearthed. Although we are all aware of the importance of the 'salvage archaeology' we hardly give a serious thought to such archaeological material. Most of the times we simply overlook and proceed.<sup>11</sup> Needless to say that such a loss of information about the past also

Table1: The faunal data sources

Site	Location	General Reference	Faunal Material Reference
Senuwar	24° 56' N; 83° 56' E	B.P. Singh (2004) <sup>12</sup>	Sathe and Badam (2004) <sup>13</sup>
Narhan	26° 19' N; 83° 24' E	P. Singh (1994) <sup>14</sup>	Chattopadhyaya (1994) <sup>15</sup>
Varanasi	25° 4' 39" N; 83° 1' 30" E	B.P. Singh (1985) <sup>16</sup>	B.P. Singh (1985) <sup>16</sup>
Khairadih	26° 10' N; 83° 5' 30" E	B.P. Singh (1989) <sup>17</sup>	Thomas and Joglekar (unpublished) <sup>18</sup>
Malhar	24° 59' 16" N; 83° 15' 46" E	Tewari <i>et al.</i> (1999-2000) <sup>19</sup>	Joglekar (2003-2004) <sup>20</sup>
Jhusi	25° 26' 10" N; 81° 54' 30" E	Misra <i>et al.</i> (1999-2000) <sup>21</sup>	Joglekar (unpublished) <sup>22</sup>
Raja Nala-ka-tila	24° 31' 55" N; 83° 19' E	Tewari and Srivastava (1998) <sup>23</sup>	Joglekar (unpublished) <sup>24</sup>
Lahuradewa	26° 46' N; 82° 57' E	Tewari <i>et al.</i> (2002-2003) <sup>25</sup>	Joglekar (unpublished) <sup>26</sup>
Kopia	26° 52' N; 83° 4' 50" E	Kanungo and Shinde (2004-2005) <sup>27</sup>	Joglekar and Tetso (unpublished) <sup>28</sup>
Charda	27° 56' 45" N; 81° 36' 40" E	D.P. Tewari (2002) <sup>29</sup>	Badam (2002) <sup>30</sup>
Tokwa	24° 54' 20" N; 82° 16' 45" E	Misra <i>et al.</i> (2000-2001) <sup>31</sup>	Joglekar (unpublished) <sup>32</sup>
Koldihwa and Mahagara	---	Sharma <i>et al.</i> (1980) <sup>33</sup>	Alur (1980) <sup>34</sup> , Chattopadhyaya (1991, 2002) <sup>35</sup>

affects the data about subsistence and ancient animals. Another important factor responsible for loss of information is selectivity in handling faunal material, especially at multi-culture sites. Usually the amount of faunal material recovered from the Early Historic/ Medieval archaeological deposits is large. In many cases the faunal material from such level is selected (by the excavators themselves) and rest (quite valuable) discarded. It has been found that the faunal material is examined by non-specialists or generalists that could identify animal bones to some extent. These reports contain information such as "the animals identified at this site include the cattle, sheep, goat, pig, dog, deer, antelope, equids, peacock, etc." Such a preliminary guess of what could be expected at that site is fine. But unless the remains are examined by a professional archaeozoologist (at least zoologist or palaeontologist) such information is of hardly any value, because from such data one cannot say whether the pigs were domestic or wild, did the deer include barking deer or mouse deer, or simply the spotted deer were found.

Let us now turn to what is the consequence of such losses. Archaeozoology (zooarchaeology) is not just animal bone identification. It involves interpretative research on the process of domestication, emergence of breeds of animals, disappearance of animal species and changes in the past environment. All these are necessary for writing a comprehensive biohistory (history of animal and plants). One of the major consequences of using 'uneven' faunal information base is that it creates an artificial picture of 'clusters' in a particular region.<sup>36</sup> This is primarily because of no information available for many of the sites in a group of sites.

Neolithic and Chalcolithic cultural phases in the Ganga Valley are crucial to our understanding of the human-

animal interactions and emergence of animal husbandry practices. These interactions are dependent on complex phenomena such as migration of people and their domestic animals, exchange networks involving animals and other goods, and interdependence of hunter-gatherer and settled agropastoral communities. However, incomplete archaeological record prevents us from attempting such fine level interpretations. For example in the Middle Ganga Valley important Chalcolithic sites<sup>37</sup> include Raja Nala-ka-tila, Lahuradewa, Jhusi, Rajghat, Prahladpur, Kamauli, Susipur, Khairadih, Waina, Bhunadih, Sohgaura, Narhan, Dhuriapur, Imlidih Khurd (U.P); and Chirand, Manjhi, Oriup, Champa, Sonpur, Taradih and Senuwar (Bihar). The picture of Ganga Valley excavations in the recent years is not too bad as at many of the sites in U.P. and Bihar, faunal material has been meticulously recovered and handed over to the specialists. Thus some faunal information for many sites is available. These include Khairadih, Narhan and Senuwar, Raja Nala-ka-tila, Lahuradewa and Jhusi. Yet information is not complete in all the cases.

In the Ganga Valley the faunal material from two Mesolithic sites has been studied in detail. The sites are Damdama<sup>38</sup> and Mahdaha.<sup>39</sup> The picture of the animal-based subsistence of the Neolithic-Chalcolithic phases in the Ganga Valley is still unclear. There are two reasons for this. Firstly, the faunal remains from early excavation were not examined in detail (e.g. Chirand and Rajghat). In the recent years too, the faunal material from many sites awaits a detail study, e.g. Manjhi, Taradih, Narhan, Waina and Imlidih Khurd. Secondly, at several multi-cultural sites the evidence of the Neolithic-Chalcolithic phases is emerging due to more and more excavations (e.g. Jhusi, Tokwa and Lahuradewa). The animal-based

subsistence of the Neolithic-Chalcolithic phases in the Ganga Valley would become clear after analysis of the faunal material from important sites is complete. It is necessary to re-examine the material that has been studied earlier such as from Sarai Nahar Rai and Koldhiwa and Mahagara. Also bone measurements from important sites such as Narhan and Senuwar need to be recorded and published.

## The Animal Species

The animal taxa identified at the Ganga Valley and Vindhyan sites comprise 8 domestic mammals, 20 wild mammals (Table 2-3) and several of non-mammals such as birds, reptiles, fish and molluscs. Although, these non-mammals were used as food resources in the past, in the present paper these have not been considered since the main focus is on

Table 2 : Various types of animals identified at the Ganga Valley and the Vindhyan sites

Site	Code	Period/Cultural Context	Domestic Mammals	Wild Mammals	Non-mammals
Mahagara	MGR	Neolithic	3	7	0
Malhar	MLR-I	Pre-NBP (Pre-Iron)	1	2	0
Malhar	MLR-II	Pre-NBP (Early Iron)	5	10	0
Malhar	MLR-III	NBP	4	4	1
Raja Nala-ka-tila	RJN-I	Before 1300 B.C.	4	2	1
Raja Nala-ka-tila	RJN-II	1300 - 700 B.C.	7	15	5
Raja Nala-ka-tila	RJN-III	700- 400 B.C.	6	5	1
Narhan	NHN	2 <sup>nd</sup> Millennium B.C.	3	1	0
Senuwar	SNW-N	Neolithic	6	4	0
Senuwar	SNW-NC	Neolithic-Chalcolithic	5	8	2
Senuwar	SNW-C	Chalcolithic	5	3	0
Charda	CHD	Pre-NBP	4	0	0
Jhusi	JHS-P	Pre-NBP	7	11	12
Jhusi	JHS-N	NBP	4	5	4
Kopia	KOP	NBP	3	1	2
Tokwa	TKW-N	Neolithic	2	7	5
Tokwa	TKW-P	Pre-NBP	5	4	1
Tokwa	TKW-N	NBP	3	10	4
Varanasi	VNS-A	800- 600 B.C.	2	2	0
Varanasi	VNS-B	600- 400 B.C.	6	3	4
Khairadih	KDH-A	Chalcolithic	5	5	1
Khairadih	KDH-B	NBP	3	6	1
Koldihwa	KDW	Neolithic	1	3	0

understanding the role of domestic mammals in the animal-based subsistence. The ubiquity values obtained for the domestic indicate that cattle (*Bos indicus*) have been found at all the sites and in all the cultural periods. The other domestic mammals used as food resource are sheep and goat (0.8696), buffalo (0.6956), and pig (0.5652). Four domestic species (donkey, horse, dog and cat) that are found in less than half cases were not used for food. There are ancient Indian literary records about consumption of the dog and the horse-flesh in exceptional/ritual cases. For example, Rigveda (IV 18.13) mentions about cooking of dog in case of extreme difficulty. However,

in general, the dogs and the domestic equids were not consumed at the Ganga Valley and Vindhyan sites. However, among the five horse bones found at Raja Nala-ka-tila, two (lumber vertebra and cranial fragment) showed charring marks. All the five bones were recovered from. A first phalanx (RJN071) found from Period III (700-400 B.C.) bears a clear chopping mark. There is textual evidence of horse being considered fit for sacrifice (slaughter) from the Early Historic India in *Shatapatha Brahmana* (I. 2.3.6). But, it is not clear whether this has any relation to any ritual or it was an isolated case of horse consumption at Raja Nala-ka-tila.

Table 3: Ubiquity values: Ganga Valley and Vindhyan sites

Wild Mammals	Ubiquity*	Rank (U)	Domestic Mammals	Ubiquity*	Rank(U)
<i>Axis porcinus</i>	0.0435	1	<i>Felis catus</i>	0.0435	1
<i>Canis aureus</i>	0.0435	1	<i>Equus asinus</i>	0.2609	2
<i>Vulpes bengalensis</i>	0.0435	1	<i>Equus caballus</i>	0.3043	3
<i>Acinonyx jubatus</i>	0.0435	1	<i>Canis familiaris</i>	0.3478	4
Large Felidae bone	0.0435	1	<i>Sus domesticus</i>	0.5652	5
Bandicoot rat	0.0435	1	<i>Bubalus bubalis</i>	0.6956	6
<i>Bubalus arnee</i>	0.0870	7	<i>Capra /Ovis</i>	0.8696	7
<i>Hystrix indica</i>	0.1304	8	<i>Bos indicus</i>	1.0000	8
<i>Bos gaurus</i>	0.1739	9.5			
<i>Gazella bennetti</i>	0.1739	9.5			
<i>Canis lupus</i>	0.2174	11			
<i>Muntiacus muntjak</i>	0.3043	12.5			
<i>Lepus nigricollis</i>	0.3043	12.5			
<i>Tetracerus quadricornis</i>	0.3478	14.5			
<i>Rattus rattus</i>	0.3478	14.5			
<i>Sus scrofa</i>	0.4348	16			
<i>Boselaphus tragocamelus</i>	0.4783	17			
<i>Antilope cervicapra</i>	0.6087	18			
<i>Cervus sp.</i>	0.6522	19			
<i>Axis axis</i>	0.6956	20			

\* with respect to 23 archaeological units (site-period)

Although faunal material from several sites has been studied, quantitative information is available only for a few sites. Based on the data available so far it is clear that the domestic animals were valued more than the other resources and these formed a major component (about 90%) of the animal-based subsistence. For instance, at Raja Nala-ka-tila the share of the domestic animals was as large as 91.49% in Period I and II. The contribution of the domestic mammals at Malhar was about 95%. Thus it is clear that as it could be expected for an agro-pastoral economy (based on cattle rearing and agriculture), the role played by wild animals was far less.

The range of wild animals utilised is very diverse. Large as well as small mammals were utilised as food resource. The list includes two commensal species - bandicoot rat and the common house rat. Though from ethnographic work in Ganga Valley we know that rats could also be consumed,<sup>40</sup> these rodents were not valued as food. Two deer species, spotted deer and sambar, have been found with highest ubiquity values. The two antelope species (blackbuck and nilgai) are found at lesser number of sites than these deer.

A classification of the wild mammalian species based on their size (live weight) revealed that during the Neolithic-Chalcolithic periods, species in all size classes from 10-20 kg to 200-500 kg classes were used (Table 4). During these periods, hunting large mammals such as the gaur and wild buffalo that requires community efforts were not used except at Lahuradewa. At Lahuradewa in Period I the gaur was used as food resource as well as a secondary material source. For example, one fragment of *Bos gaurus* found from the lowest level (3.34 m) showed that it was modified as a tool (LRD003). This tool

was perhaps used as a cutting tool. Mostly the animals of medium size were hunted and used in the second millennium BC and the early period settlements. During the pre-NBP phase, the range became wide. Now besides the large mammals, small mammalian species (e.g. hare) were perhaps tapped and used.

Table 4: Ganga Valley: number of species found in various cultural periods

Size Class (in kg)	Neolithic- Chalcolithic	Pre- NBP	NBP
< 5	0	1-2	1
5-10	0	0	1
10-20	1	1	1
20-50	1-3	1-7	1-4
50-100	1	1	1
100-200	1	1	0
200-500	1-2	1-2	1-3
> 500	0	1-2	1

It is interesting to note that at a number of sites several carnivores were identified. It is clear from the marks of charring and cutting that these were consumed. These include three canid species - the wolf (Mahagara, Malhar, Senuwar, Raja Nala-ka-tila and Jhusi), the jackal (Jhusi), and the fox (Malhar). Three felids have been identified - a cheetah at Raja Nala-ka-tila and a large felid at Lahuradewa (IB) and Jhusi (NBP), and a small cat at Raja Nala-ka-tila (Period II). The large felid identification is not certain, though from the size it appears to be either panther (*Panthera pardus*) or tiger (*Panthera tigris*). This fragment of the proximal portion of an ulna (RJN159) was charred and bears cut mark. The small cat found Raja Nala-ka-tila (Period II) could be of *Felis lynx*, *Felis caracal* or some wild cat. It is

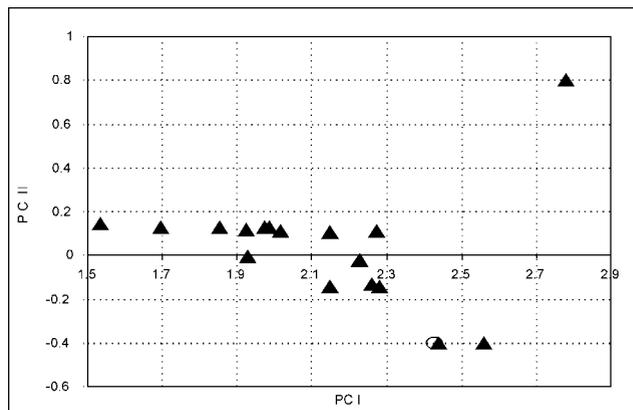
possible that these predators could have come near settlement for poaching on the domestic animals and got killed. Or the inhabitants of Lahuradeva, Jhusi and Raja Nala-ka-tila could have brought these bone pieces as special item while returning from hunting trails.

The presence/absence information about domestic and wild mammals was used to compare the sites for understanding the role of animals in the subsistence economy at a particular site. Multivariate analysis (Principal Component Analysis) of 23 archaeological units (site and cultural periods) was done to reveal similarities among the archaeological units (Table 5, Fig. 1). The PCA (randomised data input, uncentered matrix) revealed that the first two attributes contributed to the 97.41% of the eigenvalues. A scatter plot of first two principal components (PC I and II) revealed that six archaeological units stood apart from the rest. These are Koldhiwa (Neolithic), Senuwar (Neolithic), Varanasi (800-600 and 600-400 BC), Raja Nala-ka-tila (700-400 BC) and Jhusi (NBP). Thus it is clear that the pattern of domestic mammal used is not same all over the Ganga Valley and the Vindhyan sites.

A similar analysis (PCA) performed in case of 20 wild mammalian species occurrence showed that

**Table 5: Ganga Valley Domestic Mammals (23 x 8)  
PCA results**

AXIS	Eigenvalue	% Of Total	Cumulative %
1	153.072	96.44	96.44
2	1.533	0.97	97.41
3	1.318	0.83	98.24
4	0.812	0.51	98.75
5	0.719	0.45	99.20
6	0.598	0.38	99.58
7	0.423	0.27	99.84
8	0.247	0.16	100



**Fig. 1 PCA: Occurrence of domestic mammalian taxa (8) at 23 archaeological units**

the first four attributes contributed to the 97.45% of the eigenvalues. Only two archaeological units-Raja Nala-ka-tila Period I and Jhusi-NBP remained outside of the main cluster of sites (Table 6, Fig. 2).

**Table 6: Ganga Valley Wild Mammals (23 x 20)  
PCA results**

AXIS	Eigenvalue	% of Total	Cumulative %
1	301.117	95.09	95.09
2	2.988	0.94	96.03
3	2.492	0.79	96.82
4	1.998	0.63	97.45
5	1.575	0.50	97.95
6	1.157	0.37	98.31
7	1.147	0.36	98.68
8	1.008	0.32	98.99
9	0.848	0.27	99.26
10	0.546	0.17	99.43
11	0.453	0.14	99.58
12	0.379	0.12	99.70
13	0.228	0.07	99.77
14	0.191	0.06	99.83
15	0.120	0.04	99.87
16	0.113	0.04	99.90
17	0.088	0.03	99.93
18	0.075	0.02	99.95
19	0.073	0.02	99.98
20	0.072	0.02	100

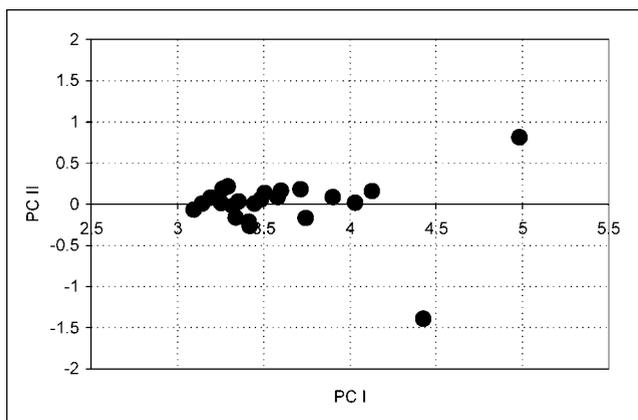


Fig. 2 PCA: Occurrence of wild mammalian taxa (20) at 23 archaeological units

In both the cases (wild and domestic mammals) cluster analysis performed on the standardised Euclidean distance matrix among the archaeological units confirmed the findings of the PCA. Thus, it can be said that at most of the Ganga Valley and the Vindhyan sites the pattern of domestic and wild mammal use is similar with a few exceptions mentioned earlier.

A controlled set of faunal observations could enhance the interpretations related to animal-based component of the past subsistence activities. Faunal study at Raja Nala-ka-tila exemplifies this. Like other sites in the region at Raja Nala-ka-tila the domestic animals were the most valuable resource to the animal-based subsistence throughout the occupational history. The wild mammals and non-mammalian species formed a marginal part of the animals used for food. A thorough quantitative analysis of the faunal assemblage revealed that showed that the distribution of animals used in the three cultural period was not random (Table 7). There existed an interaction between the type of animals used and the three cultural periods ( $\chi^2=27.20$ , significant at  $\alpha = 0.05$ ). A more detailed examination of the interaction revealed that the proportion of wild mammals used

in Period II was more than that expected under the assumption of randomness. Wild mammals in Period III contributed lesser to the animal-based subsistence than other periods.

Table 7: Relative proportion of different animal groups at RJN

Period	I	II	III
Domestic mammals (food)	136	2275	584
Domestic mammals (non-food)	0	28	6
Wild mammals	4	165*	11*
Non-mammals	1	26	3

\* Significant  $\chi^2$  cell value at  $\alpha = 0.05$

### Cattle and their Size

The cattle found at most of the sites were of humped variety as at a number of sites as shown by presence of spina bifida and the shape of the horn-cores. For example one bifid spine of the thoracic vertebra (RJN714) has been found from layer 5 at Raja Nala-ka-tila. Chattopadhyaya<sup>41</sup> has also identified the zebu/Indian humped cattle in the assemblage of second millennium BC at Narhan.

It is possible to comment on the age profiles of cattle in the Ganga Valley based on only two sites - Raja Nala-ka-tila and Malhar, since data on other sites are not available. These two faunal assemblages showed presence of animals of all age categories ranging from less than a year to as old as 8-9 year old animals. The proportion of culling of young and old animals of various ages indicates that cattle were used for a variety of purposes. In some cases, the qualitative markers and the size of the bones were useful to identify sex of the older animals. At least some of these animals above 4 years were

males. These could have been the stud bulls required and castrated bulls doing the heavy-duty works.

The bone measurements are useful for comparing the animal population, especially the domestic ones kept at various archaeological sites within a cultural ambience or between sites of different cultures.<sup>42</sup> The data about bone measurements are incomplete as these are not available at most of the sites in the Ganga Valley. It was possible to estimate the size of the cattle using two bone measurements, i.e. the distal width of the trochlea of the humerus<sup>43</sup> and the medial length of the astragalus.<sup>44</sup> The estimates of the fat-free carcass weight of cattle are too few to be used for statistical tests (Table 8).

Table 8: Fat-free carcass weight (kg) estimated using humerus

Site	RJN	Malhar	Narhan
Mean	160.85	317.52,279.20	164.89,158.71
S.D.	10.50	--	--
n	11	2	2

It was possible to estimate the height of the cattle at the withers at seven sites (Table 9) of which only one estimate available for the site of Narhan is 111.99 cm. The cattle found at other six sites showed considerable variation in terms of the size and forms. Kruskal-Wallis test, a non-parametric test of analysis of variance was conducted using the height of cattle estimated from six sites. The null hypothesis that 'there is no significant difference among the cattle height at five sites' was accepted at 5% error level ( $H= 5.91$ ;  $\chi^2 = 11.07$  for  $df = 5$ ). In all the cases a few very large individuals were found. For example, though average individuals at all the sites were 109-117 cm tall, the distribution of the heights is skewed. At Raja Nala-ka-tila, Tokwa

and Koldihwa a few individuals were as tall as 127 cm tall whereas at other three sites (Jhusi, Malhar and Khairadih) tallest individuals were less than 120 cm. Such a feature has been observed in case of several Chalcolithic sites in the Deccan (Joglekar 1991). Though no statistically significant clusters of the average cattle heights were found among the sites, thus it can be suggested that two size-wise types of cattle could have been present.

Table 9: Cattle height at the withers (cm) estimated using astragalus

Site	n	Max	Min	Mean	S.D.	CV%
Jhusi	7	118.69	099.13	113.01	6.98	6.18
Malhar	5	117.18	106.14	111.50	4.96	4.49
Raja Nala Ka Tila	16	126.27	103.39	113.01	7.23	6.40
Tokwa	10	126.18	106.90	114.90	6.45	5.61
Koldihwa	8	127.73	108.88	117.87	6.23	5.28
Khairadih	6	115.29	104.31	109.08	4.10	3.65

Height of the Kankrej male: 126.27 cm  
 Height of the Kankrej BVC male: 115.84 cm  
 Height of the Desi (nondescript) BVC female: 105.52 cm

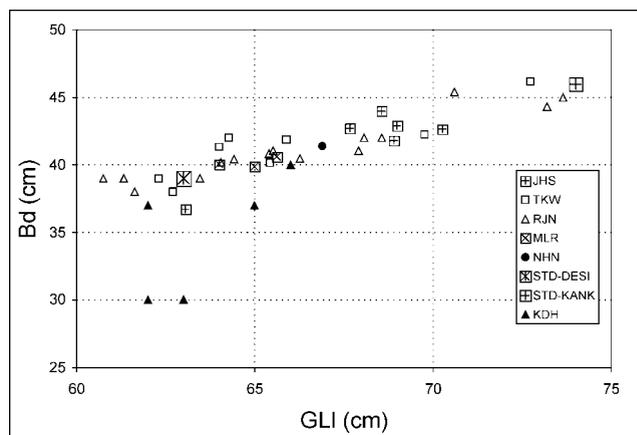


Fig. 3 Bivariate scatter plot of cattle astragalus

On qualitative basis it was observed that the cattle found at Malhar, Raja Nala Ka Tila and Lahuradewa had at least two forms: large-heavy and slender-light. Earlier Alur<sup>45</sup> has recorded such qualitative observations that to Chattopadhyaya<sup>46</sup> it is a result of sexual dimorphism. In order to understand the size variation and effects of age-sex profile, bivariate analysis of astragalus measurements was done (Fig. 3). This scatter plot and low values of the coefficient of variation reveal that the observed variation in the size can not be simply due to difference between the sexes. The possibility of two or three types of cattle (breed-like) present in the Ganga Valley and in the Vindhyan region still needs to be kept open for further studies.

### **Concluding Remarks**

Though some constraints do exist, the archaeo-faunal record of the Ganga Valley and the Vindhyan sites from the Mesolithic period onwards is steadily increasing allowing one to visualise subsistence related activities in the past. The faunal use (domestic and wild mammals) pattern from the Neolithic to the NBP period more or less same with some variability. It is clear that no domestic animals were present at Mesolithic Mahadaha and Damdama. The domestic fauna appears at Lahuradewa IB, Koldihwa, Mahagara in the Neolithic context. However, no site so far is available with us to demonstrate within-site domestication process. It is established that the

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domestic cattle were of the humped variety. The cattle from the Neolithic to the NBP phase in the Ganga Valley and the adjacent Vindhyan region were of diverse type. Both on qualitative and metrical grounds the possibility of 2 or 3 breed-like types exists.

The archaeo-faunal studies have reached a point where one could ask many questions: When and where the domestic animals first appear in record? When animal husbandry began in the Ganga Valley? How was the economy of the Mesolithic and Neolithic periods? How did humans and animals interact over time? What was the role of domestic animals in the subsistence? What were the roles of hunting-fishing-food gathering? What was the technology of bone tool manufacture and use? What was the environment and human adaptation strategy? The number of sites known so far in the Ganga Valley and adjacent Vindhyan region is impressive. Alone in the Upper Ganga Plain there are 150 sites dated to 2000-1000 B.C. The number of settlements in the Mid-Ganga Plain and adjoining Vindhyan region are 80 and 25, respectively.<sup>47</sup> A complex network involving connections at various community levels could have existed resulting in human-assisted movements of domestic animals in the past. With more and more rigorousness in data collection, quantification analysis, and data publication new hypotheses related to the human-animal interaction and its relevance to understanding human past in the Ganga Valley could be formulated and tested.

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