



Agriculture and Irrigation Practices in India before Christ

Abhijit Ghosh ¹

Prof. Ashis Sarkar ²

¹Faculty, St. Xavier's College, Siliguri, Darjeeling, West Bengal, India

²Professor, PG Department of Geography, Chandernagore College, West Bengal, India

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Abstract

Agriculture started with domestication of plants and animals in a few pockets of the globe during prehistoric times. Agrarian societies came into existence and flourished in different parts of India since the 13th millennium BC. Indians are believed to irrigate their rice fields during the 6th millennium BC and cotton fields during the 4th millennium BC. It is not easy to draft the story of early agricultural development as there are neither corroborative texts, nor archaeological evidences. However, archaeologists and historians had been trying to reconstruct that history, especially after the discovery of the Indus Valley civilization. The present study attempts to trace the history of development of agriculture and irrigation in India till the commencement of Christian era.

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Introduction

Hunting and gathering was the only mode of economy during the early phase of human history. This type of economy had little yields (Boserup, 1965). Human population experienced a considerable increase during the long Palaeolithic period (Chen, 1997). The drastic postglacial environmental changes (after the Pleistocene) forced some of the large animals to move away from their actual habitats. Some of them faced complete or partial extinction. These developments greatly disturbed the existing food chain and caused food shortages for the hunter-gatherers (Cohen, 1977). They were forced to shift towards agriculture (Boserup, 1965). However, some scholars believe that introduction of agriculture was not a reaction to food shortages from an uncertain wildlife supply. They rather argue that early humans began plant and animal domestication in order to widen food variety even when supply was abundant (Hayden, 2003). Those people settled down near places favourable for farming activities and eventually formed villages. This phenomenon is known as the 'Neolithic Revolution' (as

people were using sophisticated stone tools for farming activities) in human history (Childe, 1942). Thus, the history of agriculture started with domestication of plants and animals at different pockets of the globe before during late Pleistocene (Chen, 1997; Cahil, 2012).

The early farmers eventually became skilled in extraction and utilization of metals like copper and iron. Such developments resulted in technological advancement in agriculture including use of much sophisticated metallic tools and superior water management. Culture and agriculture of the early civilizations of Mesopotamia, Egypt, the Indus Valley and Chinawere largely dependent upon irrigation developments. They are often referred to as "hydraulic civilizations" (Leach, 1959). As water is the font of life, irrigation has been the font of civilization. It underlay the rise of the first sedentary societies organized on a large scale (Norton, 2004). Since the onset of human civilization, irrigation has been enabling mankind to feed an ever-increasing population (Bos et. al., 1994). India is one of those early agrarian societies.

Objectives

The present study attempts to trace the ancient developments in agriculture and irrigation in India before the birth of Christ. Historically, *India* refers to a broader geographical area including the Indian subcontinent and parts of Afghanistan that lie south of the Hindukush and the Himalayas.

Methodology

Reconstruction of the early history of agriculture and irrigation in India is a difficult task due to lack of textual as well as archaeological evidences, especially for pre-Vedic times. However, archaeologists and historians have uncovered at least a part of that history. Those existing literature on this theme and allied issues were surveyed to trace the early developments in Indian agriculture. It includes study of translations of ancient religious texts and literary pieces, ancient travelogues, reports on archaeological excavations, and research papers and books authored by reputed historians and archaeologists.

History of Agriculture and Irrigation Practices in India

There is no other choice to rely on, other than the archaeological evidences to explore the prehistory of Indian agriculture. Such evidences undoubtedly prove that Indians were cultivating their fields of wheat, barley and paddy around seventh millennium BC (Jarrige et al., 1995; Agrawal, 2002). However, a few archaeologists suspect the presence of primitive agricultural practices in the Ganga Plains as early as in 13th century BC (Sharma, et al., 2004).

Indian irrigation, too, has a long history of 7000 years. Studies have confirmed the existence of irrigated rice in Assam (Sharma, 1990; Hazarika, 2006) and irrigated wheat and barley in Baluchistan during the 5th millennium BC (Jarrige, 2000). Glimpses of a flourished water culture may be found in the Girnar reservoirs (Gujrat) built in the 3rd millennium BC, the ancient irrigation canal near the Harappan site of Shortughai (presently in Afghanistan), the dam and canal system in Imangaon (1300 BC) near Pune (Maharashtra), ancient step-wells in Rajasthan and indigenous water harvesting practices throughout the arid provinces (Nair, 2004). The long history of agriculture and irrigation in ancient India may be subdivided into the following four periods —

1. The Neolithic Period

The early agricultural developments were associated with rise of Neolithic cultures in different parts of the globe since the late Pleistocene or the early Holocene. *Neolithic* does not mean a specific historical era. Rather this was a phase in human history when the hunter-gatherers attained the skill of making polished stone tools like slick blades, hoes, axes, and harvesters. They

started clearing forests, cultivating grain-giving grasses and raising animals of their interest. They also acquired skills like wood-working, pottery and weaving. For the first time, they formed permanent settlements. To be precise, this was a cultural revolution that took place in different parts of the world at different times. Advent of the Neolithic period caused qualitative changes in human lifestyle.

Indians were possibly the first to start primitive agriculture during 13,000 BC (Sharma et al., 2004; Cahil, 2012). There is, evidently, no textual evidence to substantiate that prehistory of agriculture. The Neolithic cultures emerged in different parts of the country at different times. Archaeological evidences help us to identify five regional units of early (Neolithic) agricultural societies in Prehistoric India.

(A) The Western Neolithics

Excavations in a site near Mehrgarh (near the Bolan Pass, eastern Baluchistan) revealed remnants of one of the oldest 'civilizations' of India. This site, known as Mehrgarh-I, shows presence of granaries and seeds of cereals that date back to the seventh millennium BC. Those wheat and barley growers of Mehrgarh were usually referred to as "the first farmers of India" (Jarrige et al., 1995). Those people also domesticated cattle and sheep (Meadow, 1981). Further excavations near Mehrgarh revealed remnants of another civilization of the fifth millennium BC, known as Mehrgarh-II. Larger granaries found here indicate accelerated agricultural developments. Seeds of the same cereals found here were 'irrigated' varieties. These people are believed to water their crops during fifth century BC (Jarrige, 2000). Mehrgarh (II) farmers used to construct small dams across the streams to divert water for irrigating their wheat and barley fields (Habib, 2001). Control over water resources enabled them to cultivate cotton plants that are still the earliest known occurrence (4000 BC) of cotton on this planet (Moulherat et al., 2002).

Remnants of agricultural civilizations comparable to Mehrgarh were found in a few sites in Baluchistan, North Western Frontier Province (NWFP) and Sindh of Pakistan (Jarrige, 2008). This region, according to a section of historians, was possibly the first to see the onset of agriculture in India (Habib, 2001). This Neolithic zone was perhaps an extension of a larger contemporary society that dominated the Middle East (including Jordan, Israel, Persia, Anatolia and Iraq).

(B) The Central Neolithics

Historians doubted the presence of agriculture (especially rice) in the Indian mainland before 1500 BC (Habib, 2001). However, the earliest traces of primitive agriculture (slash and burn cultivation) as early as during the thirteenth millennium BC has been found in Sanai Tal (lake) deposits in Rai Bareli, Uttar Pradesh (Sharma et al., 2004; Cahil, 2012).

Lahuradewa lake deposits (Sant Kabir Nagar, Uttar Pradesh) gave evidences of a rice-based agricultural community in the Ganga plains around 6200 BC (Tewari et. al., 2003; Cahil, 2012). Neolithic sites at Koldihwa and Mahagara (in Allahabad, U.P.) showed remnants of domesticated rice that dates back to seventh millennium BC (Agrawal, 2002). Belan Valley, in the northern edge of the Vindhyas (south of Allahabad, U.P.) shows evidences of locally domesticated rice and humped cattle during the sixth millennium BC. Wheat, barley, pea, lentils and pulses like *moong* and *masur* were also cultivated in the middle Ganga Neolithic zone (Singh, 2008). Therefore, it may be concluded that the central parts of India (especially the Ganga plains) experienced the Neolithic agricultural revolution as early as in the sixth millennium BC.

(C) The Eastern and North-eastern Neolithics

A few excavated sites in Daojali Hading in North Kachhar hills and Sarutaru in Kamrup showed presence of irrigated rice culture in Assam during the sixth millennium BC (Sharma, 1967 & 1990; Rao, 1973; Hazarika, 2006). Similar Neolithic traces (belonging to later ages) have been found in Marakdola (Brahmaputra valley, Assam), Parsi Parlo and Daporijo (Arunachal Pradesh), Nongpok Keithelmanbi and Napachik (Manipur), Selbalgiri and Pynthorlangtein (Meghalaya), Chungliymati and Changsang (Nagaland) and a few sites in Darjeeling and Kalimpong (Northern hills of West Bengal), Djangu (Sikkim) and Khowai valley (Tripura) (Dikshit and Hazarika, 2011-12; Pokharia et. al., 2013). These North-eastern Neolithics present perhaps the oldest traces of sophisticated agriculture found in India till date. These first farmers of India (Worman, 1949; Thapar, 1978) are believed to be a part of a large Neolithic culture that included the Hemudu culture of Yangtze Valley, South China and the Hoabinhian culture complex of Vietnam and Thailand (Saha and Howe, 2001; Rispoli, 2007) or extension of much earlier rice cultivating civilizations of Yuchanyan (Hunan Province), Xianrendong and Diaotonghuan in China that date back to eighth millennium BC (Yasuda, 2002). Traces of similar societies have been found in Mayurbhanj and Dhenkanal Districts of Orissa (Mohanty, 1993), Susunia hills and Gandheswari basin of West Bengal (Dutta, 1992) and one site in the Himalayan foothills of eastern Nepal (Bannerjee & Sharma, 1969).

(D) The Northern Neolithics

The Kanispur (Kanishkapur) excavations disclosed the first Neolithic society (fourth millennium BC) in Kashmir (Mani, 2008). The Burzahom excavations near Shrinagar revealed another early Neolithic society (Gordon, 1960). Burzahom people were living in pits and caves dug on a *karewa* (table land composed of lacustrine deposits) around the third millennium BC. Presence of primitive harvesters and a few other

agricultural tools (axes, harpoons etc.) confirm that Burzahom people practised agriculture (Pande, 1971). Archaeological investigation of a *karewa* in Gufkral, Pulwama, (2000 BC) shows remnants of Neolithic folks who domesticated varieties of wheat, barley and lentils along with sheep, goat and cattle (Sharma, 1982-83). Similar traces of Neolithic cultures were found in at least ten archaeological sites (e.g. Begagund, Hariparigom, Panzogom and Olichibag) on the *karewas*, especially in the south-eastern parts of the vale of Kashmir. The valley is believed to house an ancient agrarian society that had extra-Indian affiliations (Ratnagar, 1998).

(E) The Southern Neolithics

There is not a single evidence of agricultural activity in South India till 3000 BC (Fuller et. al., 2007). The earliest occurrence of agriculture, found near Bellary (Karnataka), dates back to the first half of the third millennium BC. However, it was found comparable to the older Neolithic cultures that developed in other parts of the country during much earlier times (Shelach, 2000). This culture-complex, commonly known as the Southern Neolithic, includes agricultural societies found near Kurnool as late as 1900 BC (Boivin et. al., 2008). However, presence of much advanced agriculture and sophisticated irrigation technology with large cascading tanks and water control systems by third century BC has been confirmed in Sri Lanka (Brohier, 1934).

2. The Chalcolithic Period

Around 3000 BCE man learnt the art and science of metallurgy. It enabled him to make use of metals like copper and bronze to begin with. Introduction of metallic tools made agricultural activities much easier. It led to expansion of agriculture in copper-using (commonly known as *Chalcolithic*) societies in different parts of world. As production increased, there was a surplus of food that favoured the practice of exchange of goods. This eventually resulted in development of trade and commerce. Commercial activities laid the foundation of urbanism in a few pockets of the globe. In India, three regional units of Chalcolithic development may be identified.

(A) The North-western Chalcolithics

Remnants of the Helmand civilization (third millennium BC) were found in Helmand valley (south-western Afghanistan), west of the Indus (Cortesi et. al. 2008). This was an agriculture-based urban civilization. Excavations around cities like Shahr-e-Sokhta reveal presence of cultivated wheat, barley and linseed before 2600 BC. Grapes and melons were also grown, and these required cautious cultivation with irrigation facilities (Habib, 2002). Civilizations contemporary to Helmand flourished in Amri, Nal, Mundigak and Seistan (Kennedy, 2000). This region had witnessed the earliest

advent of urbanism in India. The wheat cultivators of Mungdigak had also domesticated sheep, goat, cattle, ass, horse and dog (Tosi et. al., 1999).

The Indus Valley civilization came into existence before 2600 BC. This too was an agriculture-based urban civilization. Indus people had the knowledge of multi-cropping (Wright et. al., 2008). Those technologically innovative farmers cultivated wheat, barley, various legumes (Margaret and Miller, 1991) and possibly grapes, jujube, dates and cotton (Wright et. al., 2008). They had the knowledge of scientific irrigation. A seal from Mohenjo Daro possibly bears an imprint of *Shaduf* and *dhenkli* (lever-lifts based on stone counterweights). A stone-masonry well, built on higher ground at Allahdino, near Karachi, is believed to be an irrigation source for the low-lying fields around it. The Indus civilization invaded into Bactria across the Hindukush Mountains. The *Amu Darya* (River Oxus) plains witnessed a flourished agricultural civilization (commonly known as the Bactria-Margiana Civilization or Oxus Civilization) with sophisticated water management system before the Harappan period. Archaeological excavations traced an irrigation canal that used to divert water from the river Kokcha (a tributary to the Oxus) near Shortughai, a Harappan outpost in the Oxus plains (Singh, 2008). The Kokcha Canal, a water engineering marvel, was designed so wisely that it could irrigate the upper terraces of the Oxus plain (Viollet, 2007). Irrigation canals also played a key role in flourish of agriculture in the Taluqan area, south of Shortughai, during third millennium BC (Viollet, 2007). The mastery of Oxus people in water management might have influenced the Indus people as remnants of similar canal networks have been traced in other Harappan sites. Those canals indicate large scale irrigation development in Indus Valley (Nair, 2004).

(B) The Eastern Chalcolithics

Chalcolithic agricultural communities effectively settled in the *Rarh* Plains of Bengal by the middle of the second millennium BC. Archaeobotanical and archaeozoological remains found in the river basins of Ajoy, Damodar and Kansabati prove the presence of a flourished agricultural community (Datta, 1981; Nag, 1987; Banerjee, 1981). The famous sites like *Pandu Rajar Dhibi*, *Mahisdal* and *Bharatpur* show evidences of rice cultivation and animal (cow, buffalo, pig and goat) domestication (Datta, 2005). There is a remarkable dominance of domesticated cereals (rice) and marine creatures (fish and turtle) within the biological remnants found in these sites (Datta, 1991). *Maachh-bhaat* (rice and fish) was, probably, the staple food of Bengalis since those early days. However, remnants of wild grains and animals (*nilgai*, deer) indicate a simultaneous existence of hunting and gathering activities (Ghosh, 1991). There is no direct evidence of irrigation practice in this area. However, dominance of a

'water-loving' crop like paddy in this subhumid country indicates an obvious presence of effective water management practices.

(C) Deccan Chalcolithics

The Inamgaon excavations near Pune, Maharashtra, show the presence of a flourished Chalcolithic agricultural society around fifteenth century BC (Thomas, 1988). Inamgaon farmers cultivated wheat, *jowar* (a millet), barley, lentils, black grams, horse grams etc. (Panja, 1999). They also domesticated sheep and goats (Dhavalikar and Possehl, 1974). Those people were familiar with practices like crop rotation, double cropping and mixed cropping (Kajale, 1988; Dutta, 2006). For intensive agriculture, they used to divert water from the Ghod River by an earthen dam on a stone foundation and an artificial irrigation canal during thirteenth century BC (Dhavalikar, 1984; Naik and Mishra, 1997).

3. The Early Iron (Vedic) Age

Iron was introduced in the Indian history by the *Aryans* after 2000 BC. Compared to scanty copper deposits, iron deposits were abundant in India, particularly in the central Indian plateaus. Iron, being a much stronger and harder metal than copper (and bronze), was much useful for clearing dense forests of the Gangetic plains. This was much useful, even in other uses, especially, weapon-making. Therefore, the copper-bronze using cultures (like the Harappans) were outperformed by the Aryans. Iron played a crucial role in the extension of agriculture-based Aryan civilization towards east, particularly in the subhumid region of the Gangetic plains (Misra, 2001). Many excavated sites lying south of the Vindhyas revealed the presence of an iron-using non-Aryan culture in south India. Therefore, two distinct regional units of iron-based agricultural development may be identified in India.

(A) The Northern (Vedic) Cultures

In *Mahabharat*, Lord *Krishna* was a cow-boy in his childhood. His brother, *Balaram*, always used to carry a plough with him. In *Shantiparva* of *Mahabharat*, the grand old man *Bhishma* asks king *Yudhishtira* whether his farmers are overburdened of royal taxes and duties. He also teaches *Yudhishtira* that "it is indeed the cultivators who carry the burden of the King on their shoulders and also provide for the sustenance of all others" (Nene, 2012). In *Ramayana* (*Aranyakanda*), *Ram* asks his brother *Bharat*, whether he had ensured special care and attention to people engaged in agriculture and animal husbandry. There are more such examples that prove the importance of agriculture and animal husbandry in *Vedic* India. The *Rigved* classifies lands into different fertility classes like *anurvar* (infertile), *artana* (less fertile), *apnasvati* (fertile) and *urvar* (most fertile). The *Satapatha Brahman* discusses agricultural operations like *karshan* (ploughing), *vapan*

(sowing), *lava* (reaping) and *nispava* (threshing) (Yadav, 2008). The Vedic farmers knew how to improve land fertility by implementing methods like crop rotation and keeping a land parcel fallow after a few agricultural years (ibid.). They used to manure their fields to maintain fertility levels (McDonnell and Kieth, 1912).

Vedic Agriculture was basically rainfed (Srivastava, 2008). However, there are numerous references in the *Rigveda* to irrigation (Habib and Thakur, 2003; Yadav, 2008). It speaks of the *ashma chakra* (stone pulley wheel), and of its use in drawing up of water in *ahava* (strapped wooden pails) out of the *avata* (well) by 1500 BC. Mentions of wells in the Vedic texts confirm groundwater development and utilization during that period. Use of *surmisushira* (broad irrigation canal) and *khanitrama* (small canal) has also been discussed in *The Rigveda* (Srivastava, 2008; Yadav, 2008). Conservation and management of water were given considerable importance. *Mantras* of the *Rigveda* denote that evolution started with the origin of water. *Lord Sri Krishna*, in the *Bhagavad-Gita*, highlights the role of water in the evolution of life (Nair, 2004). Vedic scholars had the basic knowledge of water science. Diversion of river water into a man-made channel has been discussed in the *Atharva Vedas* "Here, ye waters, is your heart, here is your calf, ye righteous ones! Come ye, mighty ones, by this way here, by which I am conducting you here!" (*Atharvaved*, III, 13 as translated by Bloomfield). *Balaram* diverted the course of River Yamuna (Prime, 1994). This might be his attempt to ensure water for agriculture in his locality, *Vraja* (Sanford, 2011). Even the River Ganga, according to Vedic legends, could find its way to the sea after strenuous endeavour by king Bhagirath and his ancestors. Scholars like Sir William Willcocks believe that the channel of Ganga (at least part of it) is an ancient water engineering marvel (Menon, 2009). The *Panchavimsha Brahmana*, XXV, reveals that such interventions resulted in disappearance of rivers like Sarasvati and Drishadvati. This possibly resulted in shortage of irrigation water that pushed the Aryans to shift towards the eastern lands of the Ganga after 1000 BC (Habib and Thakur, 2003).

(B) The Southern Megalithic Cultures

Many excavated sites in Vidarbha (Takalghat, Khapa, Mahurjhari, Naikund etc.), Karnataka (Brahmagiri, Chandravalli, Jadigenhalli etc.), Andhra Pradesh (Nagarjunakonda), Tamil Nadu (Adichanallur, Amirthamangalam, Sanur etc.) and Kerala (Porkalam) have exposed a collection of weapons, tools and domestic objects made of iron (Deo, 1970; Deo, 1973; Deo and Jamkhedkar, 1982; Wheeler, 1948; Seshadri, 1960; Subrahmanyam et al, 1975; Rea, 1902; Banerjee, 1956; Banerjee and Soundara Rajan, 1959; Thapar, 1952; Ghosh, 1989). Economy of these Megalithic societies was based on farming and animal husbandry. Iron was introduced in south India around

the first millennium BC. It speeded up the expansion of agriculture to a great extent, particularly in the riverine plains of Krishna, Kaveri, Ponnaiyar and Vaigai. Presence of iron artefacts like hoes, dagger blades, axes and fishhooks in the excavated sites indicates a flourished agricultural community. Barley, rice and lentils were the major crops (Singh, 2008). Presence of horse-bit (made of iron) suggests that those people had domesticated horse. Agricultural advancement resulted in an increase in population and loss of forest cover. Traditional hunter-gatherers living in the forests were steadily cornered, and finally most of them were forced to get assimilated into the advancing farming societies (Misra, 2001).

4. The Post Vedic Period

Vedic Civilization was primarily rural in nature, though there were cities known as *janapadas*. The agricultural prosperity caused a consistent development in the social, economic, political and technological fields. This multidimensional growth resulted in the rise of *Mahajanapadas* from the early *Janapadas* in the sixth century BC (Tripathi, 2008). This was the earliest phase of urbanism in Indian mainland.

Kautilya's *Arthashastra* contains records of scientific rainfall measurements, rainfall predictions and subsequent agricultural planning in *Mouryan* India (Kautilya, 300 BC, translated by Shamasastry, 1929, p-128). Krishi-Parashara (400 BC) discusses processing and preservation of seeds, land management, manuring and conserving water for drier months (Nene, 2009). Buddhist literatures (500-300 BC) confirm the presence of small irrigation tanks during *Mouryas* (Randhawa, 1980). Megasthenes in 'Indica' (fourth century BC) describes India as a country with "vast plains of great fertility, more or less beautiful, but all alike intersected by a multitude of rivers... The greater part of the soil, more over, is under irrigation, and consequently bears two crops in the course of the year". He mentions a "double rainfall" (summer and winter rains) resulting in abundant production of wheat, rice, millets and fodders in the Indus and upper Ganga plains.

According to Kautilya's *Arthashastra*, *Mouryan* irrigation was dominated by small-scale systems drawing water from *nadis* (rivers, lakes, tanks and wells) (Shamasastry, 1929, p-129). Kautilya talks about tank, *setubandha* (irrigation works), *apare* (sluice gates), *srotoyantpravaratimam* (water lifts) and *udakabhagam* (irrigation duty) etc. (ibid. p-129, 327). He also mentions penalty for unauthorized access or blockage of the sluice-system. According to him, "persons letting out the water of tanks at any other place other than their sluice-gate shall pay a fine of six *panas*; and persons who obstruct the flow of water from the sluice-gate of tanks shall also pay the same fine" (ibid. p-193). He also states that "the water of a lower tank, excavated later on, shall not irrigate the field already

irrigated by a higher tank and the natural flow of water from a higher to a lower tank shall not be stopped, unless the lower tank has ceased to be useful for three consecutive years" (ibid. p- 192). Such a wise management of the natural resources resulted in a great agricultural prosperity that may be attested by Megasthenes's words when he says "famine has never visited India.

Conclusion

The early history of Indian agriculture is still partly in mist. There are numerous factual gaps that do not allow a complete framing of prehistory of Indian agriculture. The North-east shows a rich agriculture-based society during the Neolithic, but its developments during the Chalcolithic are almost unexplored. Nobody knows what happened to the Helmund Civilization after the rise of the Aryans. Some scholars treat the Indus Valley Civilization and the Early Vedic Civilization as a single 'Indus-Sarasvati' Civilization. Moreover, there are contradictions over exact age (of certain periods), historical facts, and their explanations.

However, it is unanimously accepted that India had a rich agricultural heritage since prehistoric times. Indians were always efficient in managing natural resources like land and water. They mastered the art and science of water management under subhumid climatic conditions. Traces of that knowledge of natural resource management are still strewn over rural India. Glimpses of this traditional knowledge may be found in the tank systems in Karnataka plateau, cascading *bunds* of Chhotanagpur, groundwater structures in Rajputana and community canals in Manbhum.

As 'traditional knowledge' is gaining its ground in the present academic arena, these traditional practices become much important. This set of knowledge, if wisely coupled with modern technological advancements, will certainly help in boosting the agricultural economy of India.

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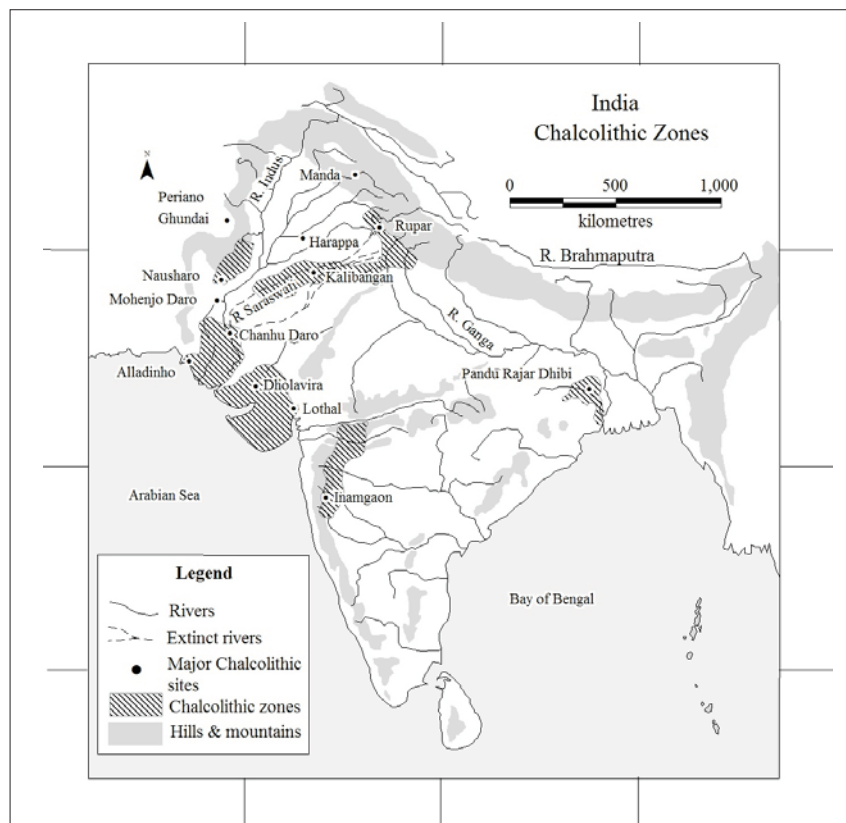


Fig. 1: India - Chalcolithic Zones

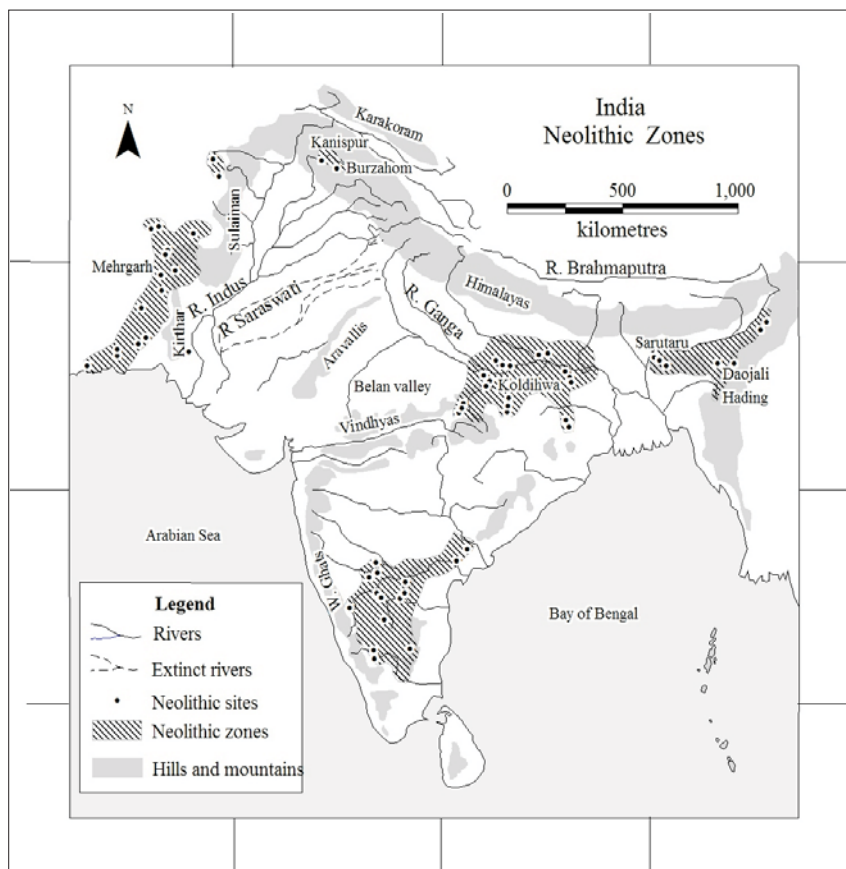


Fig. 2: India - Neolithic Zones

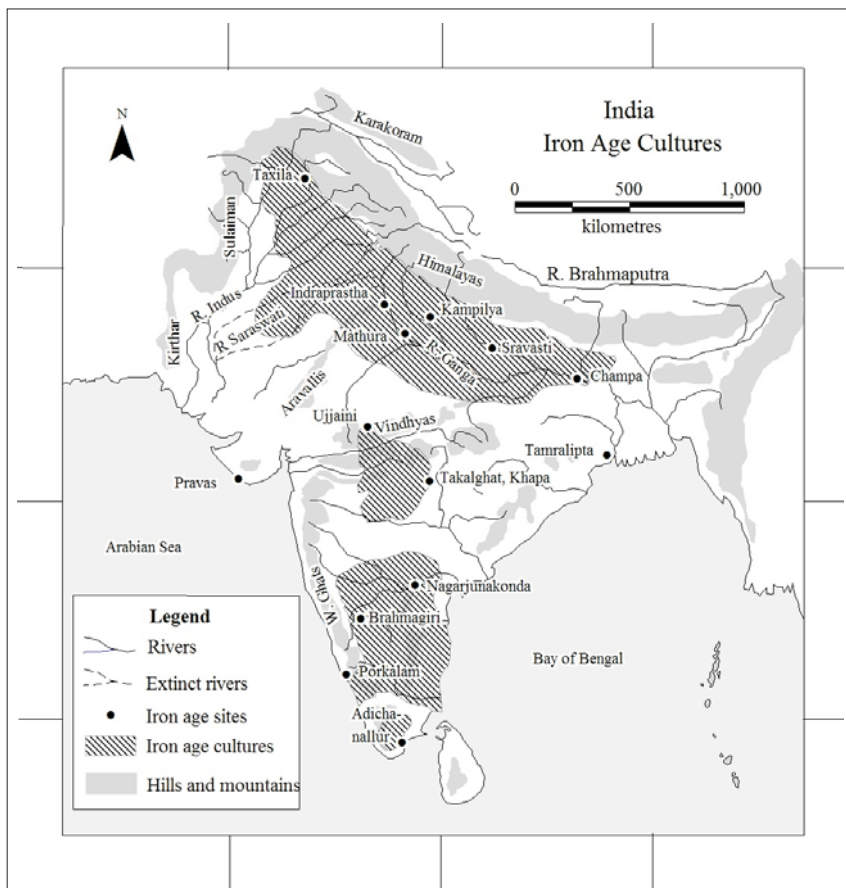


Fig. 3: India - Iron Age Cultures



Abhijit Ghosh
Faculty of Geography,
St. Xavier's College, Rajganj, Jalpaiguri
West Bengal, India 735 134
Email: ovgt.2344@gmail.com



Dr. Ashis Sarkar
Professor, P. G. Department of Geography
Chandernagore College,
Chandernagore, West Bengal, India 712 136
Email: profdrashis@gmail.com