Late first millennium BC to second millennium AD agriculture in Nagaland: a reconstruction based on archaeobotanical evidence and radiocarbon dates

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We present here the results of a study of plant macroremains in the archaeological lexicon from six sites in Nagaland, NE India dated between late first millennium BC to second millennium AD as obtained by radiocarbon dating of wood charcoal. The excavations at these sites were conducted between 2008 and 2010 jointly by the Department of Art and Culture, Government of Nagaland and the Anthropological Society of Nagaland. Analysis of 46 samples indicates that the likely staple foodgrains were *Oryza* sp. (cf. *officinalis, rufipogon, sativa*), *Setaria* sp. and *Echinochloa* sp. However, at some sites there is evidence of indigenous *Paspalum scrobiculatum, Vigna* sp. (cf. *radiata,* cf. *aconitifolia*) and *Macrotyloma uniflorum* in addition to rice–millet cultivation/collection. Crops of the Near East (*Triticum aestivum, Hordeum vulgare, Lathyrus sativus*) and *Vigna unguiculata* of African origin have also been recorded. In addition, there is evidence for cotton (*Gossypium* sp.) as well as economically important fruits/seeds of *Ziziphus* sp., *Emblica officinalis, Coix* sp., *Bombax* sp. and *Zanthoxyllum* sp.

Keywords: Agriculture, archaeobotany, millets, radiocarbon dating, rice.

NORTH EAST (NE) India, comprising the states of Assam, Arunachal Pradesh, Meghalaya, Tripura, Mizoram, Manipur and Nagaland, commonly known as the 'seven sisters', is a lesser known area for archaeological research. While there are small-scale excavations carried out in a few Neolithic sites such as Deojali-Hading, North Cachar Hills, Assam[1–3] (T. C. Sharma, unpublished); Marakdola and Sarutaru, Assam[4–6]; Parsi Parlo, Arunachal Pradesh[7,8]; and Napachik and Nongpok, Manipur[9,10] (O. K. Singh, unpublished), no direct evidence for domestication of animals and plants has so far been obtained from this region. The prehistory of agriculture in this region is therefore obscure till date. According to Fuller[11], limited excavations, absence of study of floatation samples, faunal reports and radiocarbon-dated sequences have been limitations to understand the early agricultural societies in this part of the Indian subcontinent. Realizing the potentiality of the area, an intensified archaeological research programme in NE India was considered important in the resolutions made during the Indo-Pacific Prehistoric Congress in 1978 at Pune, India for gaining knowledge on early plant domestication in this area. However, no adequate efforts have been made till date to identify the plants domesticated and cultivated first in this region[12]. Thus, the present study based on cultural deposits together with associated radiocarbon dates provides the first direct archaeobotanical evidence from Nagaland which may open up new perspectives and scope for future archaeological research programmes. The other aspect which has remained unstudied in detail is the prehistoric chronology of cultural sequences of NE India. Sharma (unpublished) proposed a relative cultural sequence for NE India beginning with the Early Holocene Hoabinhian succeeded by the Early Neolithic, and the Late Neolithic phases. In recent times, several Stone Age sites have been reported in the valleys of Hoara and Khowai rivers near Agartala, Tripura[13]. Ramesh[14] (Geological Survey of India) discovered at least half a dozen rich Stone Age sites and some stratified pottery sites in the Sadar and Khowai sub-division of West Tripura district. As reports suggest, these are believed to be primary camping sites on the elevated grounds (tillas) on the river banks. The most remarkable feature of the Stone Age is the utilization of silicified fossil wood for manufacturing tools as exemplified by the Anyathian culture of Myanmar. Based on geomorphological, geological and typo-technological grounds, as well as radiocarbon dates of the stone implement-bearing deposits, the Stone Age assemblage of West Tripura can be tentatively classified as Neolithic assemblage dominated by polished axes and pre-Neolithic assemblage in which the implements are not polished[14]. Recent archaeological studies in Manipur

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are also supported by chronometric dates from two Neolithic sites: (i) Napachik which consists of fully ground celts, cord-marked pottery and tripod wares which yielded thermoluminescence (TL) date of 1450 BC and (ii) Nongpok Keithelmanbi found with corded ware and paddle impressed ware dated at 4460 ± 120 BP (ref. 15).

Archaeological, geomorphic and geological setting

Nagaland (lat. 25°6′–27°6′N; long. 93°21′–95°15′E) is a small state in the NE corner of India. Far from being a potential region for archaeological research, owing to its proximity to Myanmar, it also serves as a physical and cultural bridge between mainland India and Southeast Asia. In spite of the rich collections of Neolithic tools, our understanding of the early farming cultures of the region is still patchy. The present study is an outcome of a programme jointly carried out by the Department of Art and Culture, Government of Nagaland and the Anthropological Society of Nagaland between 2008 and 2010. The archaeological and archaeobotanical datasets from a few early Naga ancestral sites in the districts of Kiphire, Phek and Tuensang (Figures 1 and 2) presented in this study deal with the archaeological context of the cultural materials and their chronological position (Table 1).

Physiographically, Nagaland comprises a narrow strip of hills of Arkan Yoma mountain range extending northeast and southeast and facing the Assam Plains to its north and northwest. The area is composed of geological formations of Cretaceous–Tertiary age[16]. The rock sequence is of geosynclinal facies, represented by the Disang Group (Early–Middle Eocene), the Barail Group (Late Eocene–Oligocene), the Surma–Tipam Groups (Miocene), the Namsang beds (Miocene–Pliocene) and the Dihing Group (Pliocene–Pleistocene). The Disang Group is characterized by a monotonous sequence of dark grey splintery shales intercalated with thin sandstone bands and is highly prone to erosion. The Barail Group consists of well-bedded sandstones with shale intercalations, whereas the Surma Group is essentially an alternation of shales and sandstones with rare thin conglomerates beds. The Tipam Group is characterized by ferruginous sandstones. The mottled clays, sandstones, conglomerates, grits and coal pebbles and some lenticular lignite seams constitute the Namsang beds. The Dihing Group is represented by pebble beds, thin clays and sands. Whereas the Older alluvium comprising clay, coarse sand, gravel and boulder deposits covers the areas along the northwestern flank of Naga-Patkai ranges and parts of Manipur, the Newer and low-level alluvium, comprising clay, sand and silt covers vast areas bordering the Naga Hills[16].

Nagaland witnesses heavy rainfall. At the sites under study, the average annual rainfall varies from 860 to 1634 mm (ref. 17). The temperature varies from –3°C in winter to about 40°C in summer. Relative humidity ranges from about 45% to 90% during different seasons[16]. The variations in altitude, climate and soil have given rise to forests of different types, ranging from tropical evergreen to temperate evergreen and conifers. About 20% of the total land area of the state is covered with the tropical evergreen and subtropical forests. The economy of Nagaland is dependent on agriculture with both slash-and-burn and terrace farming as the main methods of cultivation.

Archaeological observations of Naga ancestral sites

New Phor (Figure 3 *a*)

Plain potteries and potteries bearing vertical paddle impressions, criss-cross patterns, incised geometric patterns, incised vertical lines, perforated, vertical cord impressions and punctuated potteries were retrieved from this site. No stone celts were found. Perforated slates used for house roofs, fragments of sharpening stones, and a quern of phyllite with circular depression on both surfaces were also reported. Potsherds were mainly of coarse, reddish brown and brown variety with the thicker sherds devoid of designs. The thinner sherds possess criss-cross pattern probably executed by overlapping patterns while padding. A grey variety of sherd with different tempering material was also found. The bottom cultural layers were composed of a dark ashy layer associated with large quantities of charcoal. Coarse reddish-brown and grey potteries form the bulk of the assemblage from the lower layers. A significant find is a Hoabinhian-like, disc-shaped cobble tool. It is flaked on one surface while the other surface is smooth. Its dorsal surface is pitted on the edges and at the centre.

Chungliyimti (Figure 3 *b*)

The site lies about 4.5 km from New Chare, a small town located in the northernmost corner of Tuensang District in the northwest. It is in the lower drainage area of the river Dikhu and is marked with high hills and rugged terrain. There are rich oral accounts narrating the historical events of this ancient site. Of the seven localities marked, four were excavated. One of the most significant findings is the excavation of several residential areas concentrated around localities 1–3 where a few ancient megalithic structures are standing. In all, seven residential areas were excavated and their plans reconstructed. The excavations revealed 25 large pits from locality 3 (Longtrok area), and one each from localities 2 and 6. These pits had been dug in the soft sandstone/shale bedrock. The pits in most cases were found in association with houses, either on the

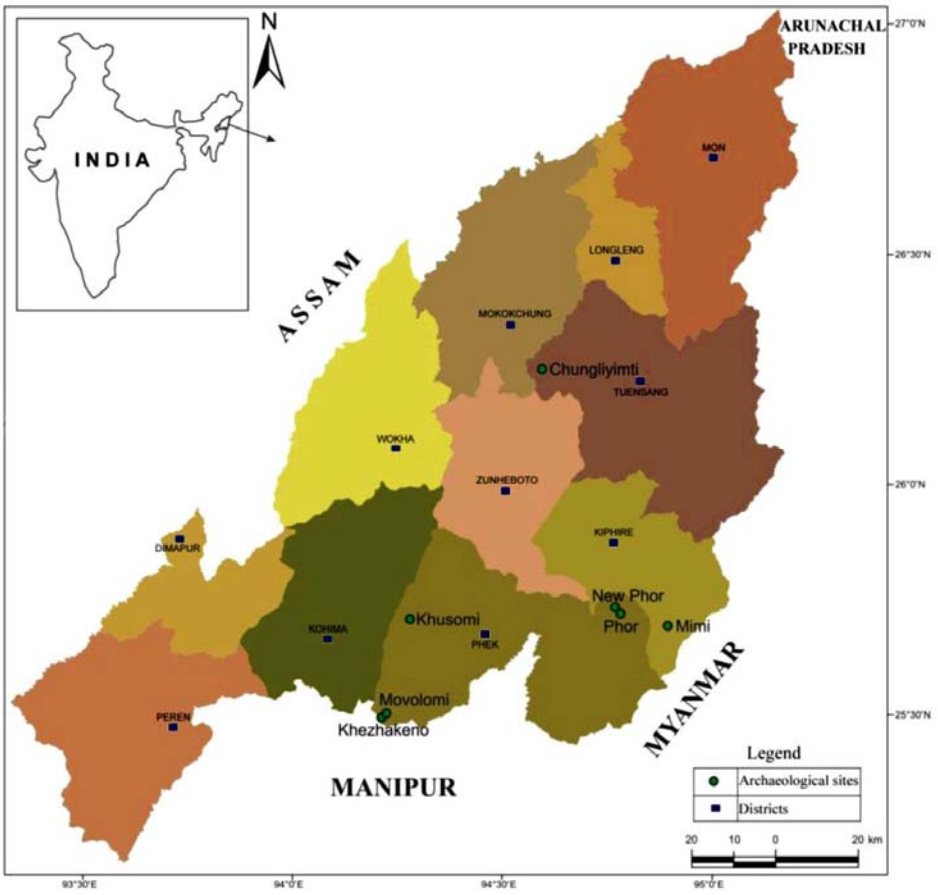

Figure 1. Map of Nagaland showing archaeological sites discussed in the text.

Figure 2. General view of the archaeological sites. (***a***) Khusomi and (***b***) Movolomi.

frontal porch or inside. The exact function of these pits is unknown, but local sources suggest that they were used for brewing purposes. Both finished and unfinished stone and iron tools were recovered from the excavations. Other artefacts include terracotta objects like smoking pipes and pottery lids, stone bowls, stone pestles, hammer stones, sharpening stones, spindle whorls, saddle querns and beads. Except for a few edge ground celts made from spilite, an igneous rock found in the Naga Ophiolite Belt, most stone artefacts are made from local materials like sandstone, phyllite and black chert nodules. The dominant ceramic types from this site consist of a dark brown and yellowish-brown sandy ware. Grey and coarse ware also occurs in considerable quantities. Cord and carved paddle impression, appliqué, incisions and punctuations are the most common design elements. Pottery is mostly

Table 1. Archaeological sites excavated and sampled for archaeobotanical investigations from Nagaland

Site (code)	Location	Geographical coordinates	Period	Site type	Botanical remains
New Phor (NPHR)	District Phek	Long. 25°43′40″N–Lat. 94°46′45″E	Late first millennium BC–early first millennium AD	Ancestral site, near present-day village	Grains/seeds
Chungliyimti (CTI)	District Tuensang	Long. 26°15′5″N; Lat. 94°37′E	First–second millennium AD	Ancestral site, high on hill	Grains/seeds/fruits
Khusomi (KSI)	District Phek	Long. 25°43′7″N; Lat. 94°17′9″E	Second millennium AD	Ancestral site, near present-day village	Grains/seeds/fruits
Khezhakeno (KNA)	District Phek	Long. 25°30′47″N; Lat. 94°12′50″E	Second millennium AD	Ancestral site, near present-day village	Grains/seeds
Movolomi (MLI)	District Phek	Long. 25°30′47″N; Lat. 94°12′50″E	Second millennium AD	Ancestral site, hilltop	Seeds
Phor (PHR)	District Phek	Long. 25°43′40″N; Lat. 94°46′45″E	Second millennium AD	Ancestral site, near present-day village	Grains/seeds/fruits
Ranyak Khen (RYK)	District Kiphire	Long. 25°42′58″N; Lat. 94°54′13″E	Fifth millennium BC	Cave site, 80 m above perennial river, hunter-gatherer	None

handmade, but a few stray finds of wheel-made pottery using kaolin and black slipped clay ware are also found. A few extraneous materials collected both from the surface and excavations, such as the buff-coloured wheel made of pottery kaolin better known as 'Ambari ware' from the early historic site of Ambari, Assam; beads made from glass, tile, jade, agate, amethyst, carnelian, celts made from spilite and iron implements seem to indicate an inter-regional exchange network.

Khusomi (Figures 2 *a* and 3 *c*)

Important legends of migration and narratives of the Angamis and Chakhesangs are narrated at Khusomi (A. Aier, unpublished). Excavation was undertaken in order to bring out the site chronology and relate the cultural material with other sites in the region. All landscape features of historical importance and megaliths were marked to understand their location with reference to the settlement area. Trenching was mostly confined to the lower sections of the village. Altogether five trenches were excavated – four within the lower settlement and one trench in the upper section of the village. Both finished and unfinished stone axes, blades, huge collection of crude cord markings on potteries, particularly on coarse ware and a few traces of iron were reported from the excavations.

Khezhakeno (Figures 3 *d* and *e*)

This is another important settlement from which references to group migrations and dispersals are traced. Oral traditions suggest that the village was once densely populated as a consequence of which people were compelled to migrate and establish six settlements – Movolomi, Cholumi, Latsalomi, Tepfulomi, Pfulomi and Chichülomi[18]. What remains of the sites today are few megalithic monuments. Most portion of the site is disturbed due to the present habitation. A survey was made to sample areas which would yield adequate information within limited time. Three trenches were excavated in the lower section of the village. Four human burials were exposed and documented. Other cultural materials include iron spearheads and points, terracotta smoking pipes, and plain and cord impressed potteries.

Movolomi (Figures 2 *b* and 3 *f*)

For a comparative study on the cultural materials and depositional sequence with Khezhakeno, Movolomi was chosen for test excavation. The site is situated in the lower part of the hill near Etholo River and close to Khezhakeno. A 4 m × 3 m NE–SW trench was excavated just above a terrace paddy field. Sections exposed on the terrace walls revealed potsherds and thick habitation deposit. Few numbers of menhirs and sitting platforms were reported from the site. The northwest and northeast corner of the site has steep ridges that offer strong defence to the settlement. Few burnt stones, charcoal and cord mark potteries were retrieved from the excavation.

Phor (Figure 3 *g*)

Legend relates that the people of Phor sprang out from a large underground hole at a place called Zheüpfükwi (located above the present-day Wuzu village) and that the population gradually grew in great numbers. Three

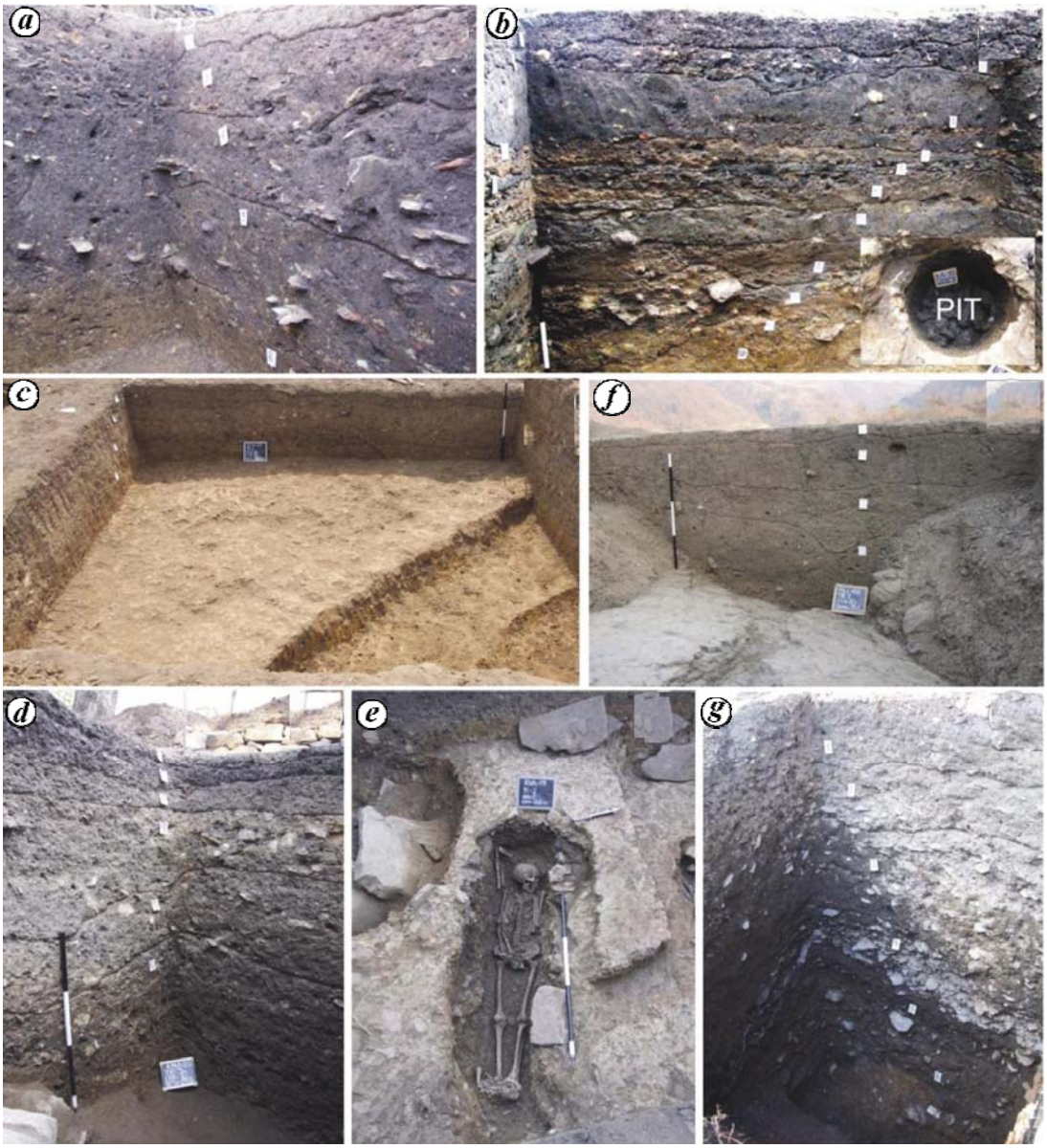

Figure 3. Excavated trenches showing layers of cultural deposits, pit and human skeleton at archaeological sites. ***a***, New Phor (NPHR); ***b***, Chungliyimti (CTI); ***c***, Khusomi (KSI); ***d***, ***e***, Khezhakeno (KNA); ***f***, Movolomi (MLI) and ***g***, Phor (PHR).

locations were identified for excavation. Two trenches were excavated within the residential sites of the village chiefs. They had been identified by the locals as ancient garbage disposal areas. Six standing stones stood close to the excavation area. Preliminary observation of the charred animal bones from the excavation showed at least seven different species of animals (pig, cattle, deer, fish, tortoise, monkeys and big cats) with cut marks on some. Potsherds, brass ornamental object (?), well-finished bone points, terracotta smoking pipes, sharpening stones, perforated slate fragments (used as roof tiles), iron implements and charcoal were among the major finds. Traces of charred paddy and millets were also reported (layer-4). In terms of texture, colour and design, the ceramics from Phor were found to be similar to those from New Phor. Few of the sherds bore cord impression. Ceramic types are mostly weak red, dark brown and reddish-brown in colour. Incisions on both body and neck of the vessel, oblique lines on rim, appliqués on neck and body were some of the designs observed.

Ranyak Khen

In addition to Naga ancestral sites, a few prehistoric cave sites were also explored. Considering previous archaeological research undertaken by Singh and Sharma[10] in Songbu (Chandel district) and Khangkhui caves (Ukhrul

district) in the Ophiolite belt, the Kiphire district of Nagaland around Mimi area close to the Myanmar border was explored. This preliminary exploration was undertaken primarily to study the local prehistoric hunter–gatherer communities and identify evidence of early domestication, if any, in the region. Of the seven caves explored, cave-2 locally called Ranyak khen (RYK) was excavated. Situated at about 780 m amsl and located at 25°42′59″N–94°54′13″E, the cave lies 80 m above a small perennial river. The mouth of the cave facing west is 8.2–9.0 m high and 7.0 m wide, and is well lit. A trench measuring 2 m × 6 m in E–W direction was excavated at the cave entrance. Evidence revealed traces of human habitation that used edge grinding tools and bone tools. Human burial of an adolescent male was also found along with a quadrangular axe made of limestone. Faunal remains are exclusively wild species such as deer, monkeys and bats. Wet-sieving of soil sediments from the layers did not yield any botanical evidence.

Archaeobotanical studies

Materials and methods

Forty-six soil samples from distinct strata or layers were collected at different depths in the cultural deposits/pits/hearths/grave pit/pot from New Phor, Chungliyimti, Khusomi, Khezakenoma, Movolomi, Phor and Ranyak Khen (cave). Each sample was poured into a wash-tub filled with water and agitated, so that carbonized light botanical material buoyed on to the surface. The floating matter which consisted the botanical remains was collected on 25 mesh sieve (approximately 700 μm) and then sun-dried. The botanical remains were studied at the Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow. The carbonized remains were complete as well as in distorted condition. Grains/seeds/fruits were examined and sorted into categories of distinctive morphological types under stereo-binocular microscope. These were cleaned in acid-alcohol (glacialacetic acid 10% + ethyl alcohol 50% in equal volume) and photographed under digital Leica MZ-16 microscope. The identification of charred remains is based on the morphological details preserved in grains, seeds and fruits. Changes in shape, size and proportion caused by heat were taken into account, in order to visualize the original appearance of the deformed and mutilated carbonized grains and seeds. Majority of the plant remains recovered from these are a mixture of carbonized grains, seeds and fruits of cultivated and wild plants along with a bulk of wood charcoal pieces. The botanical remains are listed in Table 2.

Results

The identified plant remains include *Oryza* sp. (cf. *officinalis*, *rufipogon*, *sativa*), *Triticum* cf. *aestivum*, *Vigna* sp. (cf. *aconitifolia*, *radiata*, *unguiculata*), *Lathyrus* sp., *Macrotyloma uniflorum*, *Paspalum* sp., *Setaria* sp., *Echinochloa* sp., *Gossypium* sp., *Ziziphus* sp., *Coix* sp., *Bombax* sp., *Emblica* cf. *officinalis*, *Zanthoxyllum* sp. and *Solanum* sp. (Figure 4). In addition to these remains, some samples included seeds which could not be identified due to lack of modern counterparts from this region. The most widespread finds were those of *Oryza* sp. and millets, but there are also finds of other cereal crops, pulses, fibre crop, fruits and few wild taxa. The co-occurrence of millets (*Setaria* sp., *Paspalum* sp. and *Echinochloa* sp.) with wild and cultivated rice suggests that these millet-grasses were also gathered/cultivated for consumption. The main food crop taxa are discussed below with their identification criteria.

Oryza sp. (rice, Figure 4 *a*, *b*, *d* and *e*)

O. sativa ranks as one of the world's most important food plant and is cultivated in all warm regions for the grains (rice), which constitute the staple food of millions. The wild progenitors of Asian cultivated rices *O. rufipogon*, *O. officinalis* and *O. nivara* are most widely distributed in northern and eastern India[19,20]. The general shape of grains of both wild and cultivated rice is oblong, longer than broad. Moreover, the differentiation between *Oryza* sp. only on the basis of charred caryopsis without husk is difficult to untangle[21] (G. B. Thompson, unpublished). Both wild and cultivated rice cohabit in the extensive marshy areas in the region. The wild varieties of rice are also occasionally harvested with cultivated crops. The elliptic grains somewhat broad, short and flattened (Figure 4 *a*) have been attributed to *O. officinalis* Wall.; the terete grains relatively much longer than broad compare with that of *O. rufipogon* Griffith (Figure 4 *b*) and the elongate to narrowly oblong, flattened and conspicuously ribbed grains (Figure 4 *d*) compare with those of cultivated form of rice (*O. sativa* L.). The husk attached with the cultivated form shows almost cubicular granules and at places their alignment in horizontal wavy rows (Figure 4 *e*).

Triticum cf. *aestivum* L. (wheat, Figure 4 *h*)

Grain measuring 3.07 mm × 1.58 mm (L × B) is somewhat elongated, narrower towards both the ends and slightly broader in the middle. Dorsal side is somewhat rounded and exhibits hump-like raised area. The grain closely resembles to bread-wheat (*T. aestivum* L.).

Paspalum sp. (kodon-millet, Figure 4 *f*)

Broadly elliptic grain enclosed in glume, showing the upper lemma finely striate, measures about 1.78 mm × 1.25 mm (L × B). Caryopsis with striations and larger

Table 2. List of samples with archaeological provenience, context, botanical remains and mode of preservation

Site with code	Archaeological provenience	Context type	Botanical remains	Mode of preservation
New Phor (NPHR)	Trench-1 Layer: 6 Depth: 162–173 cm	Deposit	*Oryza* sp. (cf. *sativa*), *Setaria* sp.	Charring
	Trench-1 Layer: 4 Depth: 88–131 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Setaria* sp., *Echinochloa* sp., legume cotyledons	Charring
	Trench-1 Layer: 3 Depth: 22–88 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Oryza sativa*, *Setaria* sp.	Charring
Chungliyimti (CTI)	Trench-2/L3, Qdt. (S) Layer: 9 Depth: 242–244 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Setaria* sp.	Charring
	Trench-2 Layer: 9 Depth: 236–240 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Oryza* sp. (cf. *rufipogon*), *O. sativa*, *Paspalum* sp., *Setaria* sp.	Charring
	Trench-2 Layer: 9 Depth: 236 cm	Deposit	*Oryza sativa*, *Triticum aestivum*, *Hordeum vulgare* (got devoured during handling), *Macrotyloma uniflorum*	Charring
	Trench-2/L3, Qdt. (S) Layer: 9 Depth: 236 cm	Deposit	*Oryza* sp. (cf. *officinalis*), legume type	Charring
	Trench-2/L3, Qdt. (N) Layer: 9 Depth: 203 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Setaria* sp.	Charring
	Trench-2/L3 Layer: 9 Depth: 187 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Oryza* sp. (cf. *rufipogon*)	Charring
	Trench-2/L3, Qdt. (S) Layer: 8 Depth: 162 cm	Deposit	*Oryza* sp., legume type	Charring
	Trench-2/L3, Qdt. (N) Layer: 8 Depth: 150 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *O. sativa*, *Setaria* sp.	Charring
	Trench-2 Layer: 8 Depth: 142 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *O. sativa*, *Echinochloa* sp.	Charring
	Trench-2/L3, Qdt. (N) Layer: 7 Depth: 147 cm	Deposit	*Oryza* sp. (cf. officinalis), *O. sativa*	Charring
	Trench-2/L3, Qdt. (S) Layer: 7 Depth: 135 cm	Deposit	*Oryza* sp (cf. *officinalis*)., *Setaria* sp.	Charring
	Trench-2/L3, Qdt. (N) Layer: 6 Depth: 109 cm	Deposit	*Oryza* cf. *officinalis*, *O. sativa*, *Setaria* sp., *Coix* sp., *M. uniflorum*	Charring
	Trench-6 Layer: 4A Depth: 85 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Oryza* sp. (cf. *rufipogon*)	Charring
	Trench-17 Layer: 2 Depth: 100 cm	Deposit	*Oryza* sp. (cf. *officinalis*)	Charring

(*Contd*)

Table 2. (*Contd*)

Site with code	Archaeological provenience	Context type	Botanical remains	Mode of preservation
	Trench-17/L3 Layer: 2 Depth: 68 cm	Deposit	*Oryza* sp. (cf. *officinalis*), legume type	Charring
	Trench-16/L3 Depth: 830 cm	Pit no. 22	*Oryza* sp. (cf. *officinalis*), *Ziziphus* sp.	Charring
	Trench-15 Depth: 117 cm	Pit no. 21	*Oryza* sp. (cf. *officinalis*), *O. sativa*, *Vigna* sp., *Gossypium* sp., *Echinochloa* sp., *Setaria* sp., *Zanthoxyllum* sp., *Solanum* sp.	Charring
	Trench-15 Depth: 50–89 cm	Pit no. 19	*Oryza* sp (cf. *officinalis*), *Oryza* sp. (cf. *rufipogon*), *O. sativa*, *Lathyrus sativus*, *Coix* sp., *Embica officinalis*	Charring
	Trench-15/L3, Qdt. (S) Depth: 54 cm	Pit no. 13	*Oryza* sp. (cf. *officinalis*), *O. sativa*	Charring/ mineralization
	Trench-9/L3 Depth: 35 cm	Pit no. 6	*Oryza* sp. (cf. *officinalis*)	Charring
	Trench-11A Depth: 45 cm	Pit no. 4	*Oryza* sp. (cf. *officinalis*), *Zanthoxyllum* sp.	Charring/ mineralization
	Trench-11, Qdt. 1 Depth: 82 cm	Pit no. 3	*Oryza* sp. (cf. *officinalis*), *O. sativa*, *Echinochloa* sp.	Charring
	Trench-9/L3 Depth: 39 cm	Pit no. 1	*O. sativa*, *Gossypium* sp., *Emblica officinalis*	Charring
	Trench-9 Depth: 39 cm	Circular pit	*Oryza* sp. (cf. *officinalis*), *Vigna unguiculata*, *Gossypium* sp.	Charring
	Trench-11/L3, Qdt.11 Depth: 56 cm	Hearth	None	
	Trench-9 Depth: 33 cm	Drainage	None	
Khusomi (KSI)	Trench-4 Layer: 7 Depth: 180–201 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Oryza* cf. *sativa*, *M. uniflorum*, *Setaria* sp.	Charring
	Trench-4 Layer: 5/6 Depth: 148–162 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Vigna* sp., *M. uniflorum*, *Setaria* sp., *Echinochloa* sp., *Ziziphus* sp., *Bombax* sp.	Charring
	Trench-4 Layer: 5 Depth: 125–130 cm	Deposit	*O. sativa*, *M. uniflorum*	Charring
	Trench-2, Qdt. (E) Layer: 4 Depth: 99–105 cm	Deposit	*Echinochloa* sp.	Charring
	Trench-2/NW Layer: 4 Depth: 91–101 cm	Deposit	*O. sativa*, *Setaria* sp.	Charring
	Trench-2, Qdt. (W) Layer: 4 Depth: 66–96 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Echinochloa* sp.	Charring
	Trench-2/NW/W Layer: 3 Depth: 80 cm	Pot	*Setaria* sp.	Charring

(*Contd*)

Table 2. (*Contd*)

Site with code	Archaeological provenience	Context type	Botanical remains	Mode of preservation
	Trench-1 Layer: 3 Depth: 73–83 cm	Deposit	*Oryza* sp. (cf. *officinalis*)	Charring
Khezhakeno (KNA)	Trench-3 Layer: 6 Depth: 253–299 cm	Deposit	*Echinochloa* sp., *Setaria* sp.	Charring
	Trench-3 Layer: 5 Depth: 167–183 cm	Deposit	*Setaria* sp.	Charring
	Trench: 2 BR-1	Grave pit	*Setaria* sp., *M. uniflorum*	Charring
Movolomi (MLI)	Trench-1 Layer: 4 Depth: 158–198 cm	Deposit	None	
	Trench-1 Layer: 4 Depth: 120–132 cm	Deposit	*Gossypium* sp.	Charring
	Trench-1 Layer: 4 Depth: 107–120 cm	Deposit	None	
Phor (PHR)	Trench-2 Layer: 4 Depth: 232–271 cm	Deposit	Congealed mass of *O. sativa* and *Setaria* sp.	Charring
	Trench-2 Layer: 3 Depth: 200–203 cm	Deposit	*Oryza* sp. (cf. *officinalis*), *Setaria* sp., *Coix* sp., *V. unguiculata* cotyledon	Charring
	Trench-2 Layer: 3 Depth: 117–125 cm	Deposit	*Setaria* sp., *Ziziphus* sp.	Charring

size are comparable to *Paspalum scrobiculatum* L., an indigenous species commonly occurring wild in ravines and open spaces, often cultivated on a small scale and frequently appearing self-sown in other crops.

Setaria sp. (foxtail millet, Figure 4 *c*)

Caryopses in highly carbonized state have been encountered. The grains are elliptic in shape. The surface of the glume (lemma) is finely tubercled. On morphological ground these grains compare with *Setaria* sp. A large genus of annual or perennial grasses, distributed throughout India, ascending up to an altitude of 3300 m, some of the species are cultivated for grains and others for fodder[22].

Echinochloa sp. (wild millet, Figure 4 *g*)

The broadly elliptic grains with flattened dorsal side are comparable to *Echinochloa* sp. They measure 1.03–1.19 mm in length and 0.95–1.00 mm in breadth. This species grows as a weed in irrigated fields.

Vigna sp. (Figures 4 *i–k*)

The lot comprises a few complete and broken cotyledons. Reniform and curved cotyledons have morphological features similar to those of *V. unguiculata* (Figure 4 *i*). Cotyledons with rounded to angular ends, measuring 4.85–4.95 mm × 2.42–2.62 mm (L × B) have been assigned to *V. aconitifolia* (Figure 4 *j*) and cotyledons measuring 5.40 mm × 3.20 mm (L × B) have been identified as those of *V. radiata* (Figure 4 *k*) on the basis of their size.

M. uniflorum (Lam.) Verdcourt (horse-gram, Figure 4 *l*)

Seeds ellipsoidal to somewhat kidney-shaped, measuring 4.14–4.64 mm in length and 2.39–2.64 mm in breadth are comparable with *M. uniflorum*. Seed surface is smooth. The hilum is small and linear and located on the lateral margin of the seed. This pulse crop is widely cultivated in India, ascending up to 1000 m in Sikkim[23].

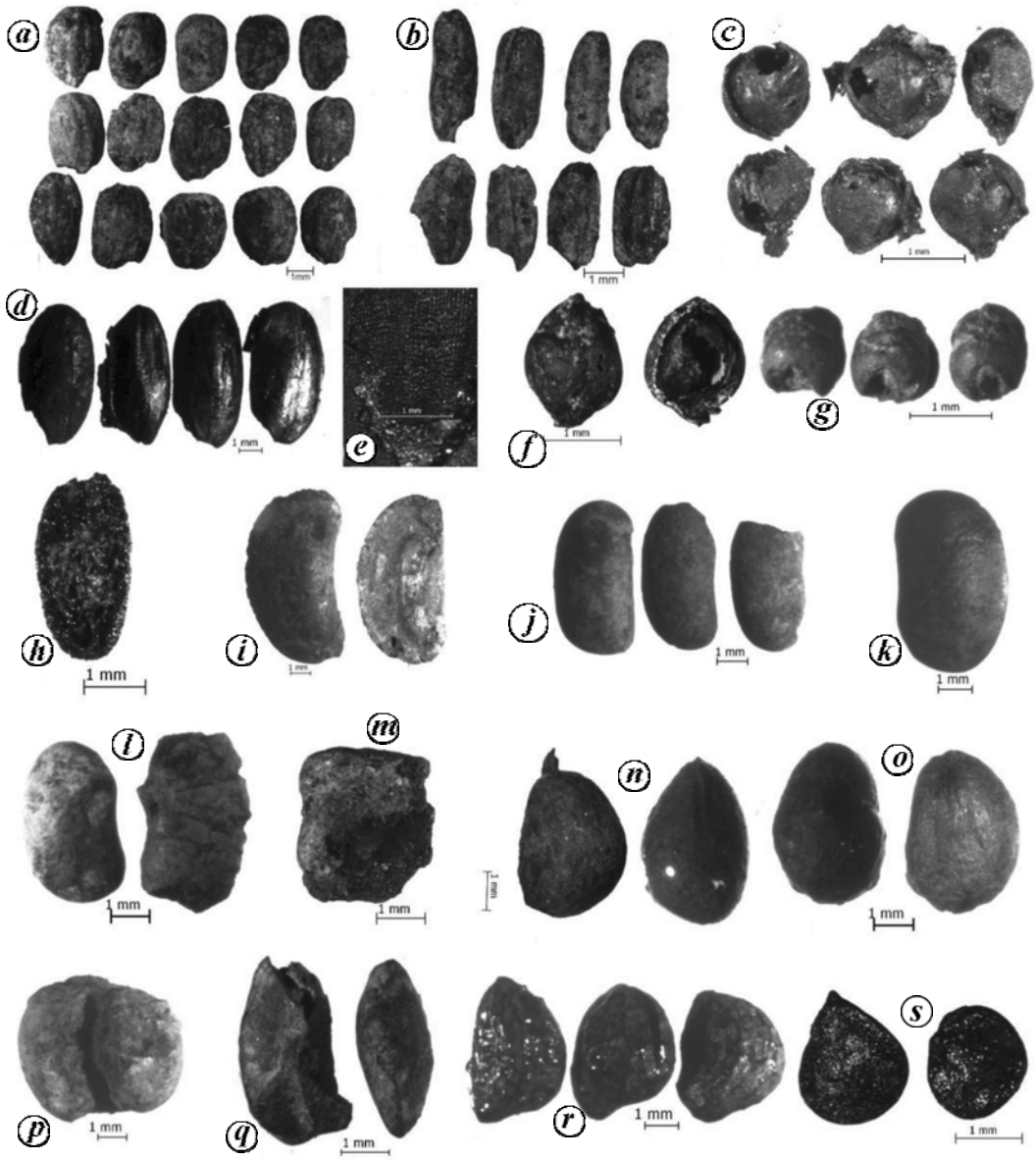

Figure 4. ***a***, *Oryza* cf. *officinalis*; ***b***, *Oryza* cf. *rufipogon*; ***c***, *Setaria* sp.; ***d***, *Oryza sativa*; ***e***, *O. sativa* husk showing granules alignment in horizontal wavy rows at places; ***f***, *Paspalum* sp.; ***g***, *Echinochloa* sp.; ***h***, *Triticum* cf. *aestivum*; ***i***, *Vigna unguiculata*; ***j***, *Vigna aconitifolia*; ***k***, *Vigna radiata*; ***l***, *Macrotyloma uniflorum*; ***m***, *Lathyrus sativus*; ***n***, *Gossypium* sp.; ***o***, *Bombax* cf. *malabaricum*; ***p***, *Coix* sp.; ***q***, *Emblica officinalis* seeds; ***r***, *Zanthoxyllum* sp. and ***s***, *Solanum* sp.

L. sativus L. (grass pea, Figure 4 *m*)

Only single, somewhat wedge-shaped broken seed has been recorded. On the basis of morphological features, the seed has been recognized as *L. sativus*.

Gossypium arboreum/herbaceum L. (cotton, Figure 4 *n*)

Seeds have one end rounded and the other end narrow and are slightly angular in cross section and compare with that of *G. arboreum/herbaceum*. They measure 3.85–4.35 mm in length and 2.80 mm in breadth. Ventral side of the seeds is somewhat flattened and dorsal side shows bulging.

Bombax sp. (silkcotton, Figure 4 *o*)

The ovoid seeds with smooth surface, measuring 4.06–4.14 mm in length and 2.82–2.85 mm in breadth are comparable to *Bombax* cf. *ceiba*. It is a deciduous tree widely distributed throughout India, including the Andamans, growing up to 1500 m or even higher[24].

Coix sp. (Job's tears, Figure 4 *p*)

The evidence of *Coix* is furnished by the remains of orbicular and ventrally furrowed seeds, measuring about 4.89 mm in length and 5.77 mm in breadth. *Coix* grows commonly in the wild, along water-courses, ditches, etc.

and is also cultivated by the hill-tribes for food and fodder in the eastern region of India[25]. The grains of wild as well as cultivated types are used as food. Hard-shelled and tear-drop shaped involucres with a porcelain-like surface are used by the Naga tribes for decoration of their dancing equipment. Necklaces and ear-rings are also made from the fruits[26–30].

E. officinalis Gaertn. (anwala, Figure 4 *q*)

Trigonous seeds measuring 3.74–3.98 mm in length and 1.60–1.95 mm in breadth have been found comparable with those of anwala fruit. Anwala occurs wild in the Siwaliks, and is found on hills[31] rising to 4000 ft. Owing to its use in subsistence economy and medicine, it is an important fruit.

Zanthoxyllum sp. (tumburu, Figure 4 *r*)

Seeds ovoid to subglobose, measuring 4.00–4.48 mm in length and 2.90–3.19 mm in breadth have been identified as *Zanthoxyllum* sp. Seed surface is coarsely reticulate. About 13 species are recorded from evergreen to semi-evergreen forests in India[32]. The plants are economically important and used in medicine, perfumery and spices and condiments.

Solanum sp. (Figure 4 *s*)

Seeds discoid in outline with a notch and marginal scar and pitted surface, measuring 1.74–2.00 mm in length and 1.53–1.63 mm in breadth, are comparable to *Solanum* species. It is a common weed in cultivated areas.

Radiocarbon chronology

In order to reconstruct the chronology of these sites, both charcoal and ash were collected and used for radiocarbon dating at the BSIP, Lucknow, and Beta Analytic Inc, Miami, Florida, USA. In all, 11 dates were obtained and they are expected to testify their cultural authenticity. Their calibrated values in BP, BC and AD are given in Table 3. Based on radiometric dating, the botanical remains from these sites are found to fall in the range of late first millennium BC to second millennium AD.

Discussion

The wide diversity of flora and favourable climatic conditions in this region are considered ideal for early plant domestication[33–35]. However, prehistory of agriculture in this region has been obscure till date. The study of plant remains in cultural deposits provides evidence to reconstruct the history of man–plant relationships in the past[36,37].

Analysis of floatation samples from the early Naga ancestral sites provides evidence for subsistence economy dominated by native wild/domesticated rice and millets. Remains of *Oryza* sp., *Setaria* sp., *Echinochloa* sp. and legume cotyledons from the 30 BC to 60 AD New Phor (NPHR) site (thus far the earliest Naga ancestral site), indicates earliest use of rice and millets in combination with legume either by collection or cultivation. Wild rice can be found in a broad belt from eastern India through SE Asia to South China[20,38]. Like rice, *Setaria italica* (L.) P. Beauv. has its origin in eastern Asia. Millets like *Setaria* and *Panicum* have been recorded in SE Asian archaeological records dating back to the second millennium BCE[39–41]. *Setaria* had been in use prior to the appearance of rice in SE Asia. Incorporation of rice during the first millennium BCE was possibly a supplementation strategy for subsistence of the growing population or as a consequence of wet tropical conditions that may not have suited the highly drought-resistant plants[41–43]. This new strategy might have involved more intensive forms of water management and labour[41]. In addition to rice (wild/cultivated) and millets (*Setari*a sp., *Echinochloa* sp., *Paspalum* sp.), remains of *T. aestivum*, *Hordeum vulgare* (got perished during floatation), *L. sativus*, *V. unguiculata*, *Vigna* sp. (cf. *radiata*, *aconitifolia*), *M. uniflorum* and *Gossypium* sp. have been recorded from the first millennium to second millennium AD. Grains of wild/cultivated rice (*Oryza sativa*) and foxtail grass (*Setaria* sp.) have been found to occur frequently at all the sites. The inclusion of job's tear (*Coix* sp.), native to South-East Asia has also been recorded. Like the foxtail grass, Job's tears is also a grass of common occurrence in the region. Grains of both the grasses are considered to be more wholesome by virtue of their higher carbohydrate and protein contents. *Setaria galuca* (L.) P. Beauv. is cultivated as a kharif crop in the uplands or hilly regions in India and is also common as a ruderal plant[44,45]. The settlers during the period of their occupation may have cultivated the rice and subsisted on these minor cereals which at present have become wild varieties. Rice in association with *Setaria* and *Coix* has also been reported from Neolithic deposits in Kaimur region, India and Khao Wong Prachan Valley in central Thailand[41,46]. Presence of grain/seed of West Asian *T. aestivum*, *H. vulgare* and *L. sativus* and African *V. unguiculata* indicates direct or indirect contacts with regions practising cultivation of these crops. At present with our small data, it is difficult to interpret observations and discuss the problems of diffusion of these crops in rice–millet-growing regions. Indigenous *Vigna* sp. and *M. uniflorum* are important in south Asian agriculture and widely cultivated in India. Origin of green gram (*V. radiata*) is not clear. It is closest to form *sublobata*, which is regarded as the progenitor and it grows wild in India[47–49]. The entire peninsula has both green gram and black gram, but the wild progenitor form *sublobata* is more concentrated in the Western

Table 3. Radiocarbon dates of archaeological sites from Nagaland (dated material is wood charcoal and ash)

Archaeological site	Archaeological provenience (trench/layer/depth)	Lab. ref. no.*	Radiocarbon age (BP)	Calibrated age (BC/AD)
New Phor (NPHR)	NPHR-08/TR-1 Layer: 5 Depth: 140–162 cm	Beta-265846	1980 ± 40	30 BC–AD 60
Chungliyimti (CTI)	CTI-08/TR-1/L1 Layer: 7 Depth: 89–101 cm	BS-2979	460 ± 170	AD 1493 ± 154
	CTI-08/TR-15/L3 Pit No. (19) Depth: 56–89 cm	BS-2976	480 ± 70	AD 1429 ± 70
	CTI-08/TR-2/L3 (N) Layer: 9 Depth: 204 cm	BS-2977	910 ± 70	AD 1118 ± 71
	CTI-08/TR-2/L3 Layer: 9 Depth: 203 cm	BS-2978	1020 ± 80	AD 1018 ± 98
Khusomi (KSI)	KSI-09/TR-4 Layer: 7 Depth: 180–201 cm	Beta-260239	310 ± 60	AD 1480–1650
	KSI-09/TR-2 Layer: 4 Depth: 66–96 cm	Beta-265844	530 ± 40	1400–1430 AD
Khezhakeno (KNA)	KNA-09/TR-3 Layer: 6 Depth: 206–299 cm	Beta-260238	500 ± 50	AD 1410–1440
Movolomi (MLI)	MLI-09/TR-1 Layer: 4 Depth: 120–154 cm	Beta-265845	410 ± 60	AD 1440–1500
Phor (PHR)	PHR-08/TR-2 Layer: 6 Depth: 320 cm	Beta-260241	230 ± 60	AD 1640–1680
Ranyak Khen (RYK)**	RYK-09/TR-1 Layer: 3 Depth: 111–126 cm	Beta-260242	5560 ± 40	4450–4350 BC

*BS, BSIP, Lucknow, India; Beta: Beta, Analytic Inc, Miami, Florida. **AMS date.

Ghats. *M. uniflorum* occurs widely in India, Sri Lanka and Myanmar[23]. Thus, the region covered in this study could be one in which it was domesticated.

Cotton (*Gossypium* sp.) and silk-cotton (*Bombax* cf. *ceiba*) may have been used as a source of fibre. Presence of few spindle whorls from the lower settlement (KSI-09/trench-4/layers 5–7) indicates this form of craft specialization. In addition to these remains, some weeds and wild taxa belonging to *E. officinalis*, *Zanthoxyllum* sp., *Ziziphus* sp. and *Solanum* sp. have been observed in the crop remains, which throw considerable light on the past vegetation around the settlements. The presence of *Zanthoxyllum* and *E. officinalis* suggests that the ancients were well aware about their medicinal properties. *Zanthoxyllum* is also used as spices and condiments. Fruit remains of *Ziziphus* sp. may have been collected by the inhabitants for consumption. The earliest hunter-gatherer cave site Ranyak Khen (RYK) in Kiphire District, dated at cal 4450–4350 BC (Beta-260242) having rich faunal diversity has not revealed any botanical remains.

Conclusion

The present archaeological and archaeobotanical research programme leads to preliminary understanding of prehistoric diet and origins of agriculture in Nagaland. Floatation of samples at the site itself would have yielded more botanical remains and also of better quality. Future excavations, interaction of archaeologists and archaeobotanists and direct dating of the plant remains will help improve our understanding of the earliest evidence of agriculture and the subsistence strategies that evolved in NE India.

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