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RESEARCH ARTICLE

Radiocarbon dates from the archaeological site of Sakas, Bihar, India

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Abstract

Dates from recently excavated Gangetic site of Sakas in Bihar, India, place it at ca.1800–1100 BC. The ceramic and lithic chronologies have been interpreted as Early Farming, Transitional and Chalcolithic/Developed Farming in date. However, depending on where in the Ganges Plains is studied, the time frame of Early, Developed and Advanced Farming periods varies widely, from 7th millennium to 2nd millennium BC and beyond, making the chronological framing of absolute dates within a regional scheme highly complex. In this paper we report the new radiocarbon results from Sakas and note how while these are critical for cementing the absolute dating of the site, until such time as a more stable periodization linked not only to relative and absolute dates but also human lifeways within the different zones of the Ganges plains is created, there remains difficulties in understanding how Sakas and other sites of similar date fit into the changing social, cultural and economic systems in this region.

Introduction

The origins of agriculture are of critical importance in archaeology across the world. In South Asia there were multiple processes of agricultural development, including introduced agricultural species and systems such as at Mehrgarh, native domestications such as millets in the Southern Indian Neolithic alongside complex systems of pastoralism before crop cultivation, and indigenous developments in the Ganges (Bates 2023). Understanding these processes requires not only good archaeobotanical, zooarchaeological and archaeological data, but also a solid chronological foundation, both relative and absolute.

This has created challenges, as collecting absolute dates (primarily radiocarbon) from South Asian sites has often been difficult. This is either due to a lack of datable material collected or preserved, stratigraphic and contextual difficulties, and the "old wood" problem (see for example Petrie 2015 at Mehrgarh). Relative chronologies and the type site have therefore reigned supreme in chronology creation. This is no more so than in the Ganges during the Early, Advanced and Developed Farming Periods, where tying relative chronologies created through ceramic typing, type sites (such as Lahuradewa) to absolute chronologies and creating an overarching chronological scheme in the Ganges Plains has been an extremely complex endeavor (Begum 2010). There have been several radiocarbon dating programs at sites (e.g.: Lahuradewa—Pokharia 2011; Tewari et al. 2008, 2006, 2005, 2003;

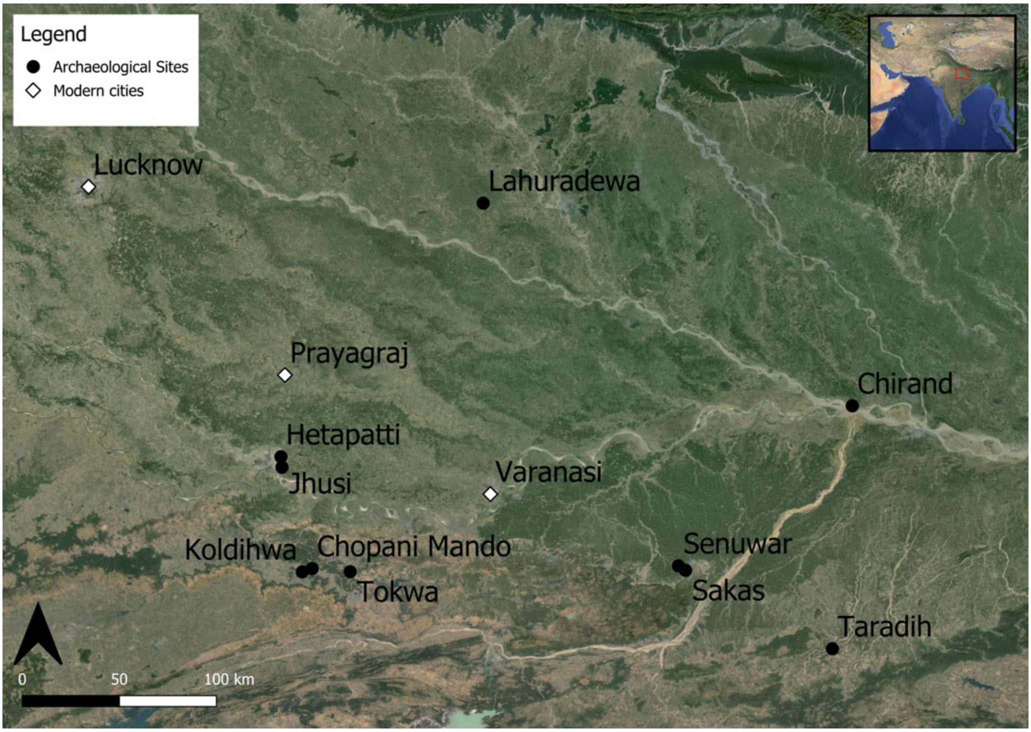

Figure 1. *Location of site of Sakas and additional sites mentioned throughout this text.*

Jhusi—Pokharia 2008; Pokharia et al. 2009; Koldihwa—Sharma 1985; Senuwar— Saraswat 2004), but the plains are wide with numerous environmental and cultural microniches, and as yet a comprehensive chronology across these pinned to absolute dates has yet to be established. This challenge is not unique to the Ganges nor South Asia, but a worldwide one, and in this paper we endeavor to highlight how the difficulties of relating an individual site to a regional framework has implications for interpreting not only the site itself but the wider processes around agricultural changes in the Ganges Plains.

Background

The sheer diversity of environmental niches in the Middle Ganges Plains (covering eastern Uttar Pradesh and Bihar) have made it an ideal locality for exploring issues around the origins of agriculture, and subsequent implications of agricultural developments (Figure 1). During the Mesolithic period it has been argued that most sites were focused on or near water. Scholars such as Pandey (1990) and Pal (2016) have gone as far as to term them the Mesolithic Lake Cultures, citing sites like Lahuradewa in the north and Chopani Mando in the southeast. Utilizing a broad-spectrum hunting strategy (see Joglekar 2006; Joglekar et al. 2003; Pal 2016) the Mesolithic lifeways were well adapted to exploiting the rich floral and faunal landscapes of the region. Over time though changes towards a more cultivation-centric lifeway is seen, and certainly by the second millennium BC across the entire plains what can be described as an agricultural culture or set of cultures is apparent, attested at numerous sites including Lahuradewa (north), Chopani Mando, Jhusi, Hetapatti, (southeast), Senuwar (southwest) to name only a few examples (Sharma and Misra 1980; Saraswat 2004; Singh 2004; Tewari et al. 2003, 2006, 2008; Pokharia et al. 2009; Pokharia 2011).

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The implications of these developments are important as the Middle Ganges Plains are an important region for political and cultural consolidation as well as site nucleation pre-urbanism in the 1st millennium BC. The problem though is understanding the chronology of the intervening period, the Neolithic.

The term Neolithic has often been deemed difficult to apply outside of European contexts. To avoid the Eurocentric baggage of the term, Tewari et al. (2008) attempted to re-periodize Gangetic sites and proposed that farming was a critical development that could be used to explain changes. As such they suggested that Early Farming could be used as terms to describe the changes seen after the Mesolithic, followed by a shift towards a Chalcolithic or more regionally a Developed Farming period, before the early Iron Age or Advanced farming that led into the 1st millennium BC.

These terms were framed around the periodization of Lahuradewa, a type site in the northern part of the Ganges plains. Lahuradewa is a small settlement on a lake edge that was excavated by Tewari and colleagues and showed five periods of occupation, three of which are foundational to the chronology debated here. Period I was dated to 7000–2000 BC and termed Early Farming, followed by Period II the Developed Farming between 2000–1200 BC and then Period III starting in 1200 BC as the Advanced Farming (Tewari et al. 2006). This regionalized chronology has been taken up in some instances, but not consistently (see Tokwa for example—Misra et al. 2000), but there are other problems besides terms to deal with.

While at Jhusi and Koldihwa there are Neolithic or Early Farming levels going back to the 7th millennium BC (perhaps earlier) similar to Lahuradewa, at Senuwar the date of Period IA, the Neolithic or Early Farming is 2200–1950 BC, with a Transitional phase in Period II between 1950–1300 BC before the Chalcolithic or as Tewari et al. (2006) term it Developed Farming at 1300–600 BC (Begum 2010; Pokharia 2008; Saraswat 2004). Other sites like Chirand also show a much later Neolithic or Early Farming period, while some like Tokwa sit halfway between, at roughly the 6th–5th millennium.

Given the different trajectories undertaken by sites like Senuwar compared with Lahuradewa (amongst many others), it is important to go back and reassess not only the chronologies, relative and absolute, but also the lifeways occurring in the Ganges Plains, to explore how and why different farming transitions occurred and how these narratives relate to the developments after these initial formative periods (see Begum 2010).

Dating in the Ganges Plains though has always been wildly controversial (Allchin and Allchin 1982; Pandey 1988; Kajale 1991; Mandal 1997; Singh 2001; Fuller 2002). The nature of the dates and materials used to build chronologies has been at the heart of this.

To begin with many of the dates available are older, using older radiocarbon dating methods or older calibration methods. While this can be corrected for to a degree, there is still a level of error to factor in. For example the dates at Koldihwa (Sharma et al. 1980) are widely seen as unreliable due in part to such issues (see Possehl and Rissman 1992; Bellwood 1996; Fuller 2002) yet are frequently cited in an early Early Farming/Neolithic boundary setting. More problematically though, the material used in many of these older dating programs are wood or wood charcoal, often done in bulk due to the high carbon requirements of the older machines. The "old wood problem" (Schiffer 1986; Kim et al. 2019) haunts much of the dataset and raises questions about the accuracy of dating seen across the region.

Beyond this are sample size issues—for example at Lahuradewa, the vital type site for much of the chronology building in the region, the lower levels of Period IA are dated by only 3 samples of bulk charcoal. This is supported by additional dates from the nearby lake (thus out of context in relation to the human habitation) and some confusingly described dates on rice husk (context not clear) (see Tewari et al. 2006) that have been used to push human action at the site back further but also used to extend the Neolithic/Early Farming despite not being linked to the period excavated.

This is a vital set of problems from which to build a chronology of a region. The periodizations used in the Ganges are, like many archaeological regions worldwide, based on a ceramic (or artifactual) assemblage and then tied into the absolute dates. For example, the presence of cord impressed pottery and burnished black and burnished red wares have been linked as markers of the Early Farming or

Neolithic period. When excavating a new site, the discovery of such wares along with distinctive forms are used to periodize the layers being dug, and comparisons made with type sites like Lahuradewa or Senuwar (for example) to assist in this. It is assumed that radiocarbon dating will eventually be done, but with funding restrictions this is not always the case, and assumptions that your site and the type site match in date because of ceramic assemblage similarities becomes a short hand way of assigning not only a period but also a date.

Given the problems outlined for the Ganges where we have no clear chronological horizons for our periods, these assumptions could be loading interpretative burdens on the archaeological data. What can be seen then is the complex challenge facing Gangetic archaeology, as we appear to have different dates for the Early Farming in the wider region. It is with this in mind that a new comprehensive program of dating was undertaken at the site of Sakas to explore what the absolute dates say in comparison with the ceramics, and what this implies for the overall Gangetic chronologies we currently have available.

Site Background

Sakas is an archaeological site in Sasaram (Rohtas) district of Bihar in the foothills of Vindhyan-Kaimurranges, India (24°54'27"N; 83°58'3"E) (see Figure 1) (Singh et al. 2020a, 2020b, 2020c, 2020d). In 2019 was excavated by Banaras Hindu University (Director of excavation Dr Vikas Kumar Singh) (Singh et al. 2020a, 2020b, 2020c, 2020d). It is being analyzed by a collaborative team from Banaras Hindu University (PI: Prof. Vikas Kumar Singh, Prof. RN Singh) and Seoul National University (PI: Prof. Jennifer Bates).

Initially the site was thought to be Early Farming to Northern Black Polished Ware (NBPW) in date, with Singh (1990) observing that "Sakas appears to be small hamlet of Neolithic and Chalcolithic phase which was possibly reoccupied during the NBPW phase. As such the remains of the first two phases are found from the main mound while the last is found slightly away where the present village is situated". During the 2019 excavation the earliest form of ceramics and lithics found look to similar to those found at nearby Senuwar, and as such the earliest period was determined to be of the Early Farming period. Singh et al. (2020a, 2020b, 2020c, 2020d) suggested that the latest phase of the site was Chalcolithic based also on ceramics. In order to test how the relative chronology links to absolute dates samples were sent for radiocarbon dating.

Methods

Sakas was excavated using a box-grid system, with four trenches, XA16, XA15, AB15 and AA15 placed at the highest point in the site to gain the best stratigraphic sequences. The trenches reached up to 5 m in depth (Figures 2–4). The site was excavated contextually—each new feature was dug as a separate context and sampled. This has resulted in hundreds of samples, and a detailed stratigraphic profile. In order to interpret the site these were amalgamated into larger layers in the profile drawings (Figures 2–4). Detailed contextual description will be published in due course.

Trench AA15 was not dug to a full depth of the site partially due to COVID19 restrictions during the later part of the season and also because of the discovery of (ancient) human remains which halted excavation due to both time and permit restrictions but also ethical concerns regarding the handling, removal and future storage of the bones. Samples for radiocarbon were not sent for dating from this trench as a full sequence could not be assured as a result.

Sampling for botanical remains (seed and charcoal) was done using a bucket-flotation system, with samples being initially sorted at BHU and then sent to SNU for further analysis. The seeds were found in almost all contexts and appear to form the background life use at the site (e.g.: food waste, crop processing burning). Analysis to understand the taphonomic pathways is underway. A preference for

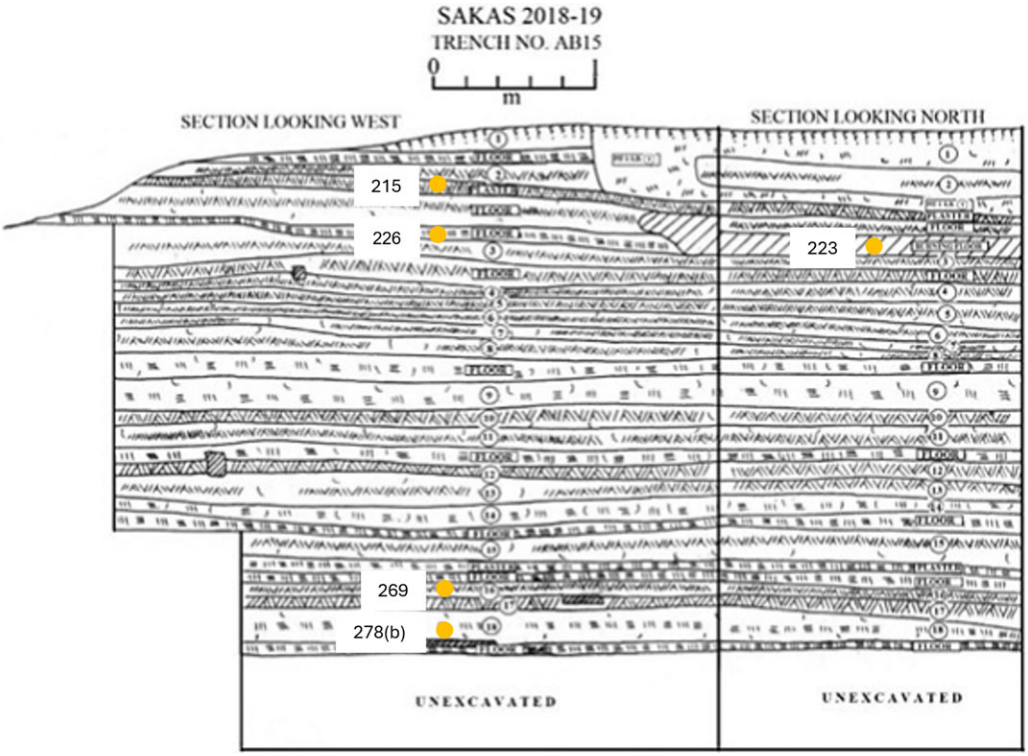

Figure 2. *Section drawing of Sakas Trench AB15. Symbolism follows Wheeler (1954).*

radiocarbon dating short lived seeds was made, though in one case a wood charcoal sample was submitted. The species of this wood sample could not be determined prior to submission. Work is ongoing to determine the species of the remaining charcoal samples. Despite the potential for the old wood problem (Schiffer 1986; Kim et al. 2019), the date for this sample (Beta-604685) aligns well with the other dates at the site.

Preservation of botanical material at Sakas is excellent, accounting for the 100% dating success on samples submitted to all labs. This was a surprise to the authors as usually during dating, even small-sample size AMS dating, samples submitted from South Asian sites are expected to have some failures. This is due to low carbon yield, caused typically by poor preservation (such as in Indus village sites see Petrie et al. 2016) but also by incomplete carbonization. This is the reason that multiple seeds per sample were submitted, to ensure a minimum sample weight of 3–5 g was met to increase the chances of success. However, it appears that given the preservation at Sakas this was unnecessary, and in future should more dates be required from Sakas and from other similarly well-preserved deep Gangetic sites single seed sampling is recommended.

23 samples in total were submitted—this was seen as sufficient to gain an understanding of the span of chronological change across the site. In future more dates are needed to see subtle changes in the many individual contexts and gain a deeper understanding of site usage over time. Three samples for radiocarbon from the other trenches to establish a baseline for the site were initially sent to Beta-Analytic for dating. As this was a limited number of dates it was realized that more were needed to establish the full sequence of the site occupation. A further 10 dates were submitted to IUAC (MoES/16/07/11(i)-RDEAS and MoES/P.O.(Seismic)8(09)-Geochron/2012). In addition to these dates focusing

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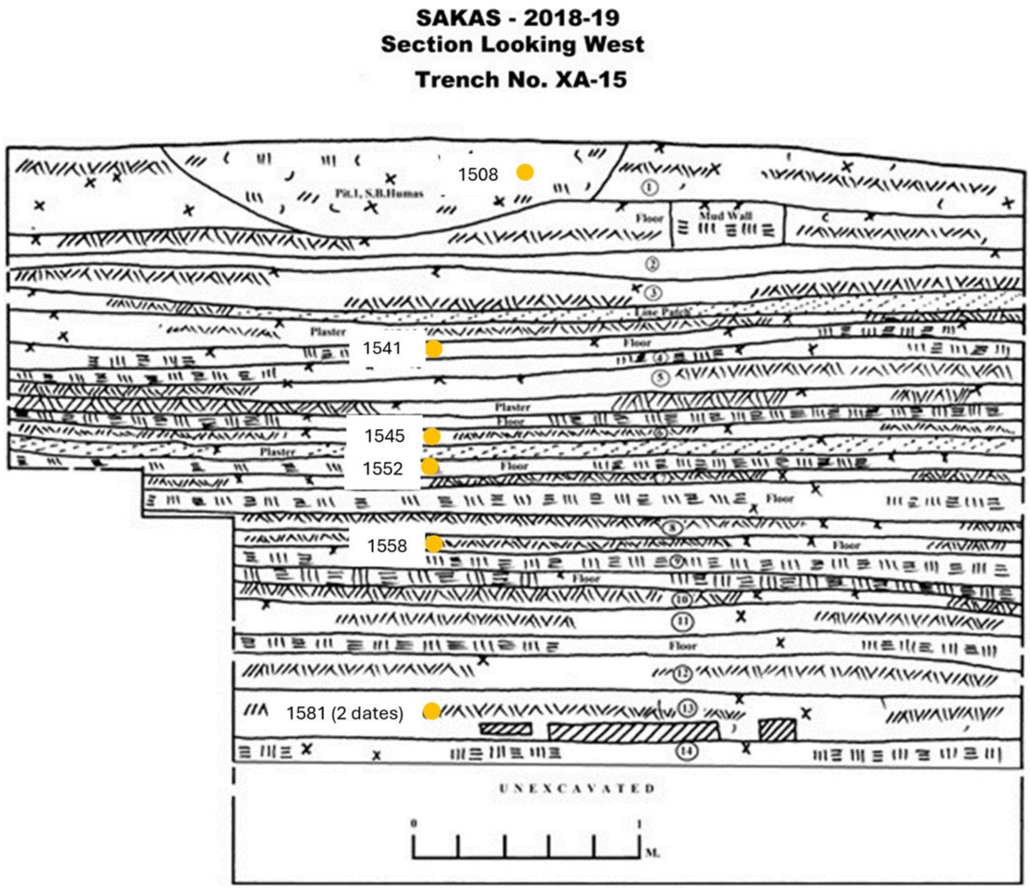

Figure 3. *Section drawing of Sakas Trench XA15. Symbolism follows Wheeler (1954).*

on rice and lentils were required for the Meso-Neo Rice Project (SNU Asia Centre project 0448A-20210070), a pilot study for the Indica Project (SNU Creative Pioneers Project 100-20220080), and a further 10 samples were sent to 14 Chrono Belfast with a specific focusing rice and lentils and stratigraphically contemporary materials.

Beta-Analytic provided the initial three dates submitted. Beta-Analytic provided ISO/IEC-17025:2017 accredited results. Analysis was carried out on their 4 in-house NEC accelerator Mass Spectrometers and 4 Thermo IRMSs. The results reported were calculated relative to NISTSRM-1990C and corrected for isotopic fractionation. The standard used was NIST SRM-4990C (oxalic acid).

IUAC dates were analysed on the 500kV Ion accelerator machine in-house. AMS $\delta^{13}C$ values were used for isotopic fractionation correction, and the standard for normalization was OX II. Data quality was monitored with a secondary standard sample (IAEA-C7).

14 Chrono Belfast analysed samples on a tandem accelerator Ionplus Mini Carbon Dating System (MICADAS). Standard normalization used OX2 standards. Dates were corrected for fractionation using AMS $\delta^{13}C$ values.

In all labs across all samples the AAA (acid-alkali-acid) pretreatment recommend in de Vries et al. (1958) and Fischer and Heinemeier (2003) for charred botanical materials was used.

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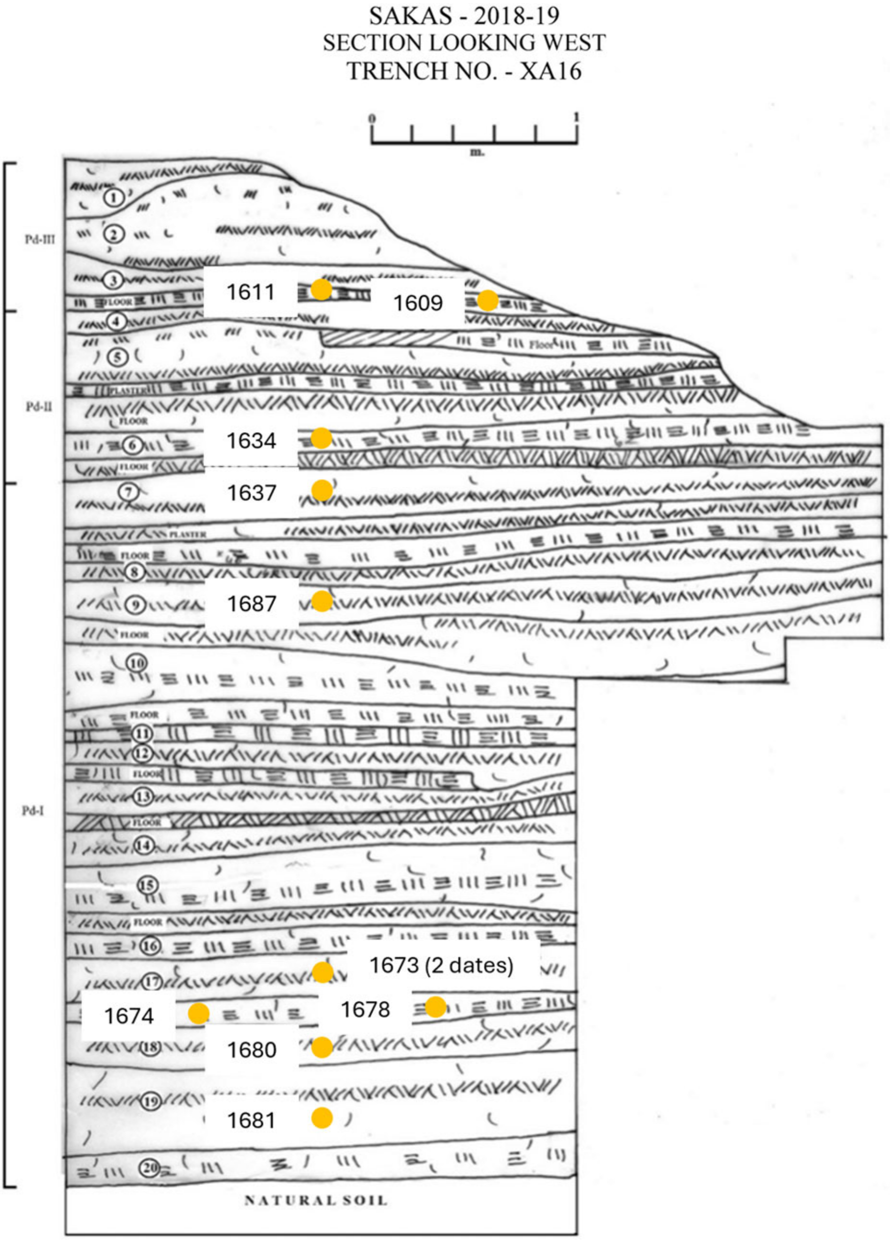

Figure 4. *Section drawing of Sakas Trench XA16. Symbolism follows Wheeler (1954).*

The raw reports from the labs including all data, lab-provided details, and additional information (e.g.: lab-calibrated dates) can be found in the SI, which is stored in an open repository (https://osf.io/ea46z/?view_only=bb15ce21f8dc4cb294f51ed115fc4f4b).

In order to standardize the calibrated results, the uncalibrated BP dates were put through OxCal 4.4 version 155 (Bronk Ramsey 2009). This is because the different labs provided calibrated results using different software and curves. To ensure better comparability the calibrated BC dates provided here use INTCAL20 (Reimer et al. 2020).

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Results by Lab

Beta Analytic

Lab code	Trench	Locus	Depth (cm below surface)	Sample no.	Material	BP	±	Calibration BC/AD from OxCAL 4.4 version 155
Beta-604683	XA16	1680	448 (posthole)	SKS1	Charred/burnt seeds	3230	30	Cal BC 1516: 1492 (29.6%) Cal BC 1483: 1450 (38.7%) [1σ] Cal BC 1540: 1425 (95.4%) [2σ]
Beta-604684	XA16	1678	443 (posthole)	SKS2	Charred/burnt seeds	3280	30	Cal BC 1607: 1580 (23.3%) Cal BC 1544: 1506 (44.9%) [1σ] Cal BC 1620: 1498 (93.7%) Cal BC 1472: 1462 (1.8%) [2σ]
Beta-604685	XA16	1687	240	SKS3	Wood charcoal	3300	30	Cal BC 1612: 1572 (37.1%) Cal BC 1566: 1532 (31.2%) [1σ] Cal BC 1628: 1502 (95.4%) [2σ]

Comments: The materials from Sakas submitted to Beta Analytic were collected by various trench supervisors in the field, sorted and identified by B. Mohan and submitted by V.K. Singh.

IUAC

Lab code	Trench	Locus	Depth (cm below surface)	Sample no.	Material	BP	±	Calibration BC/AD from OxCAL 4.4 version 155
IUACD#22C4516	XA16	1681	458–480 cm	SKS1681	Wood charcoal	3389	28	Cal BC 1733: 1720 (11.1%) Cal BC 1692: 1628 (57.2%) [1σ] Cal BC 1861: 1860 (0.1%) Cal BC 1751: 1611 (94.6%) Cal BC 1574: 1564 (0.8%) [2σ]
IUACD#22C4517	XA16	1637	172–194 cm	SKS1637	Wood charcoal	3174	28	Cal BC 1496: 1476 (22.3%) Cal BC 1458: 1420 (46.0%) [1σ] Cal BC 1503: 1407 (95.4%) [2σ]
IUACD#22C4518	XA16	1674	426–436 cm	SKS1674	Wood charcoal	3358	25	Cal BC 1728: 1724 (1.8%) Cal BC 1688: 1612 (63.8%) Cal BC 1572: 1567 (2.6%) [1σ] Cal BC 1736: 1716 (8.5%) Cal BC 1692: 1599 (69.4%) Cal BC 1590: 1542 (17.5%) [2σ]
IUACD#22C4519	XA16	1609	82–90 cm	SKS1609	Wood charcoal	3128	26	Cal BC 1436: 1398 (54.9%) Cal BC 1336: 1322 (13.4%) [1σ] Cal BC 1494: 1479 (2.6%) Cal BC 1454: 1373 (67.6%) Cal BC 1351: 1302 (25.3%) [2σ]
IUACD#22C4520	AB15	269	340–348 cm	SKS269	Wood charcoal	3377	25	Cal BC 1730: 1724 (4.6%) Cal BC 1688: 1623 (63.6%) [1σ] Cal BC 1744: 1611 (93.7%) Cal BC 1574: 1564 (1.4%) Cal BC 1552: 1550 (0.3%) [2σ]
IUACD#22C4521	XA15	1581	250–270 cm	SKS1581	Wood charcoal	3348	26	Cal BC 1682: 1652 (17.9%) Cal BC 1642: 1606 (27.4%) Cal BC 1581: 1544 (22.9%) [1σ] Cal BC 1734: 1718 (4.5%) Cal BC 1690: 1536 (90.9%) [2σ]
IUACD#22C4522	XA16	1673	404–426 cm	SKS1673	Wood charcoal	3413	25	Cal BC 1744: 1675 (59.0%) Cal BC 1654: 1641 (9.2%) [1σ] Cal BC 1866: 1852 (3.2%) Cal BC 1769: 1624 (92.3%) [2σ]
IUACD#22C4523	XA15	1541	88–106 cm	SKS1541	Wood charcoal	3157	23	Cal BC 1492: 1481 (10.1%) Cal BC 1451: 1411 (58.2%) [1σ] Cal BC 1498: 1396 (95.4%) [2σ]

(*Continued*)

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(*Continued*)

Lab code	Trench	Locus	Depth (cm below surface)	Sample no.	Material	BP	±	Calibration BC/AD from OxCAL 4.4 version 155
IUACD#22C4524	AB15	226	118–130 cm	SKS226	Wood charcoal	3138	23	Cal BC 1442: 1396 (66.3%) Cal BC 1332: 1329 (1.9%) [1σ] Cal BC 1494: 1476 (5.2%) Cal BC 1456: 1381 (76.8%) Cal BC 1342: 1310 (13.4%) [2σ]
IUACD#22C4525	XA15	1545	130–138 cm	SKS1545	Wood charcoal	3026	23	Cal BC 1372: 1354 (12.9%) Cal BC 1297: 1256 (38.0%) Cal BC 1248: 1226 (17.4%) [1σ] Cal BC 1390: 1336 (24.8%) Cal BC 1321: 1206 (70.6%) [2σ]

Comments: The materials from Sakas submitted to IUAC were collected by various trench supervisors in the field, sorted and identified by B. Mohan and submitted by V.K. Singh.

14 Chrono Belfast

Lab code	Trench	Locus	Depth (cm below surface)	Sample no.	Material	BP	±	Calibration BC/AD from OxCAL 4.4 version 155
UBA49352	AB15	223	118–130 cm	84	*Oryza* sp. (5 whole grains, 1 embyro end)	3071	27	Cal BC 1396: 1366 (20.4%) Cal BC 1360: 1288 (47.9%) [1σ] Cal BC 1416: 1261 (95.4%) [2σ]
UBA49353	AB15	215	106–118 cm	78	*Oryza* sp. (5 whole grains)	3047	23	Cal BC 1382: 1342 (31.5%) Cal BC 1310: 1264 (36.7%) [1σ] Cal BC 1396: 1332 (40.3%) Cal BC 1327: 1224 (55.1%) [2σ]
UBA49354	XA15	1552	144–152 cm	41	*Oryza* sp. (5 whole grains, 1 apex end)	3069	24	Cal BC 1394: 1334 (40.5%) Cal BC 1324: 1287 (27.8%) [1σ] Cal BC 1411: 1264 (95.4%) [2σ]
UBA49355	XA15	1508	5–48 cm	5	*Oryza* sp. (4 whole grains)	2983	23	Cal BC 1260: 1196 (52.8%) Cal BC 1172: 1162 (6.6%) Cal BC 1142: 1130 (8.8%) [1σ] Cal BC 1366: 1360 (0.6%) Cal BC 1284: 1121 (94.9%) [2σ]
UBA49356	XA15	1558	180–186 cm	47	*Oryza* sp. (4 whole grains)	3083	30	Cal BC 1408: 1372 (25.9%) Cal BC 1354: 1298 (42.3%) [1σ] Cal BC 1421: 1266 (95.4%) [2σ]
UBA49357	XA15	1581	250–270 cm	61	*Lens* sp. (3 whole, 1 cotyledon, 1 hilum fragment)	3085	26	Cal BC 1408: 1375 (26.4%) Cal BC 1351: 1301 (41.9%) [1σ] Cal BC 1420: 1273 (95.4%) [2σ]
UBA49358	AB15	278(b)	358–378 cm	131	*Oryza* sp. (5 whole grains, 1 apex end)	3312	24	Cal BC 1612: 1573 (40.6%) Cal BC 1566: 1540 (27.7%) [1σ] Cal BC 1624: 1512 (95.4%) [2σ]
UBA49359	XA16	1673	404–426 cm	205	*Oryza* sp. (7 whole grains)	3286	24	Cal BC 1606: 1581 (25.7%) Cal BC 1544: 1510 (42.6%) [1σ] Cal BC 1614: 1505 (95.4%) [2σ]
UBA49360	XA16	1634	148–162 cm	161	*Oryza* sp. (2 whole grains), Lens sp. (2 whole)	3048	24	Cal BC 1382: 1341 (31.9%) Cal BC 1311: 1264 (36.3%) [1σ] Cal BC 1398: 1224 (95.4%) [2σ]
UBA49361	XA16	1611	82–90 cm	141	*Cajanus* sp. (1 whole), *Vicia* sp. (2 cotelydons), *Lens* sp. (2 whole, 1 cotelydon), Fabaceae (2 fragments).	2924	24	Cal BC 1194: 1174 (12.2%) Cal BC 1161: 1144 (11.3%) Cal BC 1130: 1054 (44.7%) [1σ] Cal BC 1214: 1046 (92.9%) Cal BC 1030: 1019 (2.5%) [2σ]

Comments: The materials from Sakas submitted to 14 Chrono Belfast were collected by various trench supervisors in the field, sorted by B. Mohan, and identified and submitted by J. Bates.

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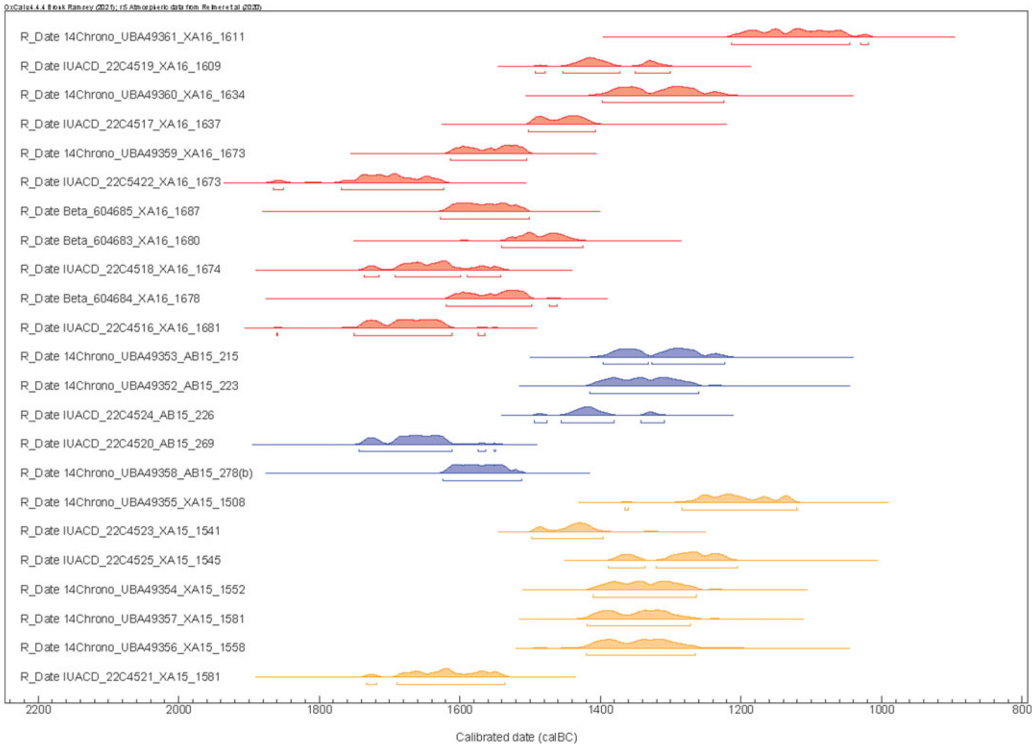

Figure 5. *Dates plotted in OxCal using INTCAL 20. Each trench is plotted in a different color.*

Plotted Dates

Dates have been plotted by trench using OxCal 4.4 version 155 (Bronk Ramsey 2009) (Figure 5). Full raw data and the data logs can be found in the SI stored in the open repository, Open Science Framework: https://osf.io/ea46z/?view_only=bb15ce21f8dc4cb294f51ed115fc4f4b.

Discussions on the Implications of the Sakas Dates

The overall date range for the site is 3413±25 BP (1744–1675 cal BC) to 2924±24 (1130–1054 cal BC). This date range is consistent across the trenches. This is critical as the 1–2 ha occupation area has a deep stratigraphy (up to 5 m), implying that over a roughly 600 year period we see multiple layers of repeated and dense use.

The dates interestingly suggest two phases of use at the site, one between 1100–1400 BC and the other between 1500–1700 BC. The excavated materials (ceramics, lithics, artifacts) suggested three periods of use: Early Farming/Neolithic, Transitional, and Developed Farming/Chalcolithic. There is some overlap in the radiocarbon dates which may account for a transitional phase, which fall into Period II according to typo-chronological and stratigraphic work. These have less dates taken from them, partly due researcher bias (interest in the earlier period) and partly due to less dateable (charred seed) material available. The reduced (though not lacking) seeds could imply less intensive occupation, and more work is needed therefore on the Transitional/Period II layers to explore their cultural implications, particularly as they are not devoid of life-makers. Numerous floors, both packed dirt and plastered, are seen, as well as human burials (in trench XA15 below plaster layer 5). Ceramics and lithics as well as other artifacts (e.g.: bone point, beads, bangles) continue to be found. This 100 years between the

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radiocarbon phase I and II therefore needs further work to refine alongside the other markers of time and cultural activity.

There are no apparent disparities in dating caused by using different labs for the dating of the 23 samples. Indeed, the use of multiple labs providing the same chronological range supports the dates gained—they are consistent across labs and throughout the stratigraphy. The absolute dates provide a strong chronology for Sakas with no "odd" results that would need to be explained either by checking lab protocol differences or checking the stratigraphy against the new dates for aspects of possible contamination. Checking of the stratigraphy was of course done multiple times, and indeed when looking to the stratigraphy the consistency in chronology implied by the radiocarbon dates lines up with the site formation—there is little to no evidence of bioturbation, cutting or contamination.

The relative chronology for Sakas was created through comparison with Senuwar. At Senuwar period IA was determined to be an Early Farming type settlement based on the similarities of its ceramics and lithics to sites like Chirand and Taradih. At Senuwar there are four dates, all from period IB, the overlap between the Neolithic and Chalcolithic (ca. 1800 BC), while at Chirand the Early Farming period has dates that put the Early Farming period into the 1800–1200 BC bracket (see Vishnu-Mittre 1972). Taradih has no radiocarbon dates. This means that the new dates from Sakas, which are more comprehensive in number (23 versus the 3 from Tokwa for example—see Misra et al. 2000) and precise in analytical method (AMS), tally well with the chronological framework established at other sites in the area.

A new challenge therefore arises—how do we fit this sub-regional framework in with the larger pan-Gangetic chronological periodization? Returning to the earlier debate however, if one were to take the term "Early Farming Period" at face value without interrogating what it meant at this site and why it was chosen (comparison with Senuwar's ceramics and the absolute and relative dating framework in the Vindhyan region it sits in), one might be fooled into thinking this site was contemporary with (at worst) or had similar agricultural process to (at best) sites in other parts of the Gangetic plains.

As established at other sites, we can see different chronological time spans for "Early Farming" being used at sites like Lahuradewa putting it the 7th millennium BC, Jhusi in the 5th millennium BC and the Vindhyan sites like Sakas and Senuwar placing it firmly in the 2nd millennium BC. Similar ceramics and lithics are seen at all, such as corded ware, black-and-red-ware, microliths, bone points, even feature types like distinctive shaped hearths (see discussions in Pal 2016). It is the radiocarbon dating frameworks that appear to be out-of-sync yet creating new patterns to explore.

The question that arises then is what exactly was the Early Farming period? While some work has been done to explore what Early, Advanced and Developed Farming meant in terms of cultural phases rather than ceramic/radiocarbon chronologies, much of this is based on the data from a limited number of sites.

While at Lahuradewa and Tokwa for example there is good archaeobotanical evidence, this remains elusive at many other sites (see Pokharia 2011; Pokharia et al. 2009; Tewari et al. 2008, 2006, 2005, 2003). At Lahuradewa the archaeobotanical data for example suggests that Early Farming should be seen as a period of incipient agriculture perhaps even just the cultivation of semi-wild local crops. The Developed Farming shows the introduction of non-local crops, long distance contact and the establishment of more secure farming practices, and Advanced farming was fully agrarian and yield-focused systems. At Senuwar and Tokwa though we see a different pattern, with Early Farming levels having non-local crops already present, but still grown in a low-intensity system (see discussion in Kingwell-Banham 2019; Pokharia 2008).

To this end, if we were to compare Sakas with these different "Early Farming" socio-economic schemes, it would appear Early Farming, potentially even Developed Farming at Tokwa or Senuwar but Developed or Advanced Farming at Lahuradewa. This is because of the presence of established non-local crops (wheat, barley, lentils, peas) alongside domesticated local crops (rice, millets, tropical pulses) grown across a complex two season (*rabi* winter and *kharif* summer monsoon) system. The animal remains are still to be studied but could complicate things further.

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Thinking in such ways might require us to rethink the periodisation of Gangetic sites away from pan-plains chronological schemes and more towards human behavioural markers. Further work is needed then to disentangle not only the sub-regional nuances in when Early, Developed, Advanced periods began but what these actually *mean* in terms of cultural systems at each site of the Ganges plains.

Data availability statement. All the raw data provided by Beta Analytic, 14 Chrono Belfast and IUAC as well as the OxCal logs can be found on the OSF: https://osf.io/ea46z/?view_only=bb15ce21f8dc4cb294f51ed115fc4f4b

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