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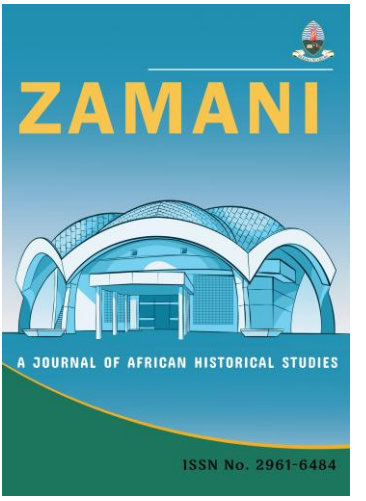

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Research Article: New Chronology for Neolithic Cultures in the Lake Eyasi Basin, Northern Tanzania.

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New Chronology for Neolithic Cultures in the Lake Eyasi Basin, Northern Tanzania

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Abstract

There have been several studies on Neolithic Cultures in the Serengeti National. The recovered archaeological materials include domestic and wild fauna remains, potsherds and lithic artefacts, ochre, and stone enclosures, dating between 7200 and 4900 BP. In the East African Rift System (EARS), conventional ages for Neolithic Cultures are inferred from the most extensively researched Neolithic sites in Kenya, where the oldest Nderit ware, cattle and caprine in the Lake Turkana Basin, northern Kenya, date ca. 5200 BP. Studies on the Neolithic of EARS have been structured to fit into the migration or diffusion models that consider the spread of herders and their domesticates as a practice from Northern to Southern Africa. Subsequently, the succession of Neolithic Cultures in northern Tanzania is linked to the demic migration of the "moving frontiers" from Northern Africa with domesticates and Narosura ware who inhabited the Eyasi Basin and its vicinity after 3000 BP. This article employs a non-probabilistic sampling technique to select the excavation units and datable samples from the Lake Eyasi Basin. It presents new Accelerator Mass Spectrometry (AMS) radiocarbon dates from the Eyasi Basin. The AMS radiocarbon results from this study indicate that Neolithic Cultures have existed in the basin since the late fifth millennium BP, hence pushing back the timing of the introduction of a herding economy in the region to at least a millennium.

Keywords: Chronology, Neolithic Cultures, Lake Eyasi Basin, Northern Tanzania

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Introduction

Existing radiometric dates suggest that Pastoral Neolithic (PN) Cultures were introduced into Eastern Africa about 5000, before the present time (BP).[1] This time represents the early and formative PN period in East Africa, with a few site reports showing that pastoralism was practiced in the region.[2] Early Neolithic settlements have been recognized in the EARS and adjacent regions, particularly Ethiopia, Kenya, and northern Tanzania.[3] By ca. 3000-2000 BP, later PN sites with consolidated (specialized) pastoralism became ubiquitous in the Rift Valley and the adjacent areas, as far south as the Serengeti plains and the Lake Eyasi Basin in northern Tanzania and Tsavo in Kenya.[4]

Studies on Neolithic Cultures in Tanzania were conducted in the Serengeti National Park.[5] They were followed by other reports of a similar culture at the Nasera rock shelter, from which Mehlman recovered Nderit,

[1]Katherine M Grillo *et.al*, "'Nderit Ware' and the Origins of Pastoralist Pottery in Eastern Africa", *Quaternary International,* 608–609 (2022): 226–242; David K Wright and C Smith, "East and Southern African Neolithic: Geography and Overview", In *Encyclopaedia of Global Archaeology* (New York: Springer, 2014): 2281-2298.

[2]Paul Lane, "The 'Moving Frontier' and the Transition to Food Production in Kenya", *Azania: Archaeological Research in Africa* 39 (2004): 243–264; Fiona Marshall and Elisabeth Hildebrand, "Cattle before Crops: The Beginnings of Food Production in Africa', *Journal of World Prehistory* 16, no.2 (2002): 99-143; Stanley H Ambrose, "Chronology of the Later Stone Age and Food Production in East Africa," *Journal of Archaeological Science* 25 (1998): 377–392.

[3]David K Kay *et al*., "The Archaeology of South Sudan from c. 3000 BC to AD 1500", *Azania: Archaeological Research in Africa* 54(4), (2019): 516–537; Paul Lane *et al.,* "The Transition to Farming in Eastern Africa: New Faunal and Dating Evidence from Wadh Lang'o and Usenge, Kenya," *Antiquity* 81(2007): 62–81; Lane, "The 'Moving Frontier'"; David Collett and Peter Robertshaw, "Pottery Traditions of Early Pastoral Communities in Kenya", *Azania: Archaeological Research in Africa* 18, (1983),107–125; John R Bower *et al*., "The University of Massachusetts' Later Stone Age/Pastoral Neolithic Comparative Study in Central Kenya: An Overview", *Azania: Archaeological Research in Africa* 12 (1977):119–146.

[4]David K Wright, "Frontier Animal Husbandry in the Northeast and East African Neolithic: A Multiproxy Paleoenvironmental and Paleodemographic Study," *Journal of Anthropological Research* 67, no.2 (2011): 213-244; Fiona Marshall, "Origins of Specialized Pastoral Production in East Africa," *American Anthropologist* 92 (1990): 873–894.

[5]John R Bower and Thomas J Chadderdon, "Further Excavations of Pastoral Neolithic Sites in Serengeti," *Azania: Archaeological Research in Africa* 21, no.1 (1986): 129-133; John R Bower, "Seronera: Excavations at a Stone Bowl Site in the Serengeti National Park, Tanzania," *Azania: Archaeological Research in Africa* 8, no.1 (1973): 71–104.

Kansyore, Narosura, and Akira wares.[6] Other artefacts include lithic, domesticated and wild animals, and the Kansyore potsherd, dating to 5000 bp. Nasera dates range between 5000 and 3000 bp and appear contemporary with most PN sites in Kenya. Neolithic Cultures have been reported in several parts of Tanzania. For instance, Chami and Chami[7] discovered the Narosura ware at the Tendaguru dinosaur site in the Lindi region on the southern coast of Tanzania. At Tendaguru, a Narosura bowl characterised by a slightly everted rim with two bands of incised crosshatching was reported. Similar pottery traditions were discovered at the Narosura site by Odner[8]. The discovery of the Neolithic pottery at Tendaguru suggests that Neolithic Cultures were widely distributed, from the Rift Valley to the coast of East Africa.

Chami and Kwekason report on the occurrence of Neolithic Cultures on the coast of Tanzania and in the Rufiji delta. At the Machaga cave in Zanzibar, Neolithic Cultures are dated between 4800 to 2000 BP.[9] The findings include animal bones (domestic fowls and cats), stone and bone tools, pestle, and potsherds. Archaeological evidence shows that the coast of East Africa and its interior south of the Mozambican border acquired agriculture and pottery from about 3000 BC. However, earlier scholars denied the presence of Neolithic Cultures on the coast of East Africa.[10]

Another PN study by Mturi was conducted in West Kilimanjaro.[11] His study yielded remains of stone bowls, grinding stones, pestle rubbers, obsidian artefacts, Narosura pottery, and wild and domestic animal remains. Archaeological evidence from West Kilimanjaro suggests that PN people settled on the western slope of Mount Kilimanjaro. The results from Maua Farm are of special interest to studies of PN because of the plentiful

[6]Michael J Mehlman, "Later Quaternary Archaeology Sequences in Northern Tanzania" (PhD Thesis, University of Illinois, 1989)

[7]Felix Chami and Remigius Chami, "Narosura Pottery from the Southern Coast of Tanzania: First Incontrovertible Coastal Later Stone Age Pottery," *Nyame Akuma* 56 (2001): 28–35.

[8]Knut Odner, "Excavations at Narosura, a Stone Bowl Site in the Southern Kenya Highlands," *Azania: Archaeological Research in Africa* 7, no. 1 (1972): 25-92.

[9]Felix Chami and Amandus Kwekason, "Neolithic Pottery Traditions from the Islands, the Coast and the Interior of East Africa," *African Archaeological Review* 20, no.2 (2003): 65–80.

[10]John G Sutton, "Research and Interpretation in Eastern African Archaeology," *Journal of African History* 43, no.3 (2002): 503–505.

[11]Amini A Mturi, "The Pastoral Neolithic of West Kilimanjaro", *Azania: Archaeological Research in Africa* 21, no.1 (1986): 53–63.

pottery (Narosura) and domesticates (cattle and caprine) at all levels (Mturi, 1986). The calibrated radiocarbon dates show that Maua Farm at (30-45 cm) was dated to 5280-4006 BP, while at (15-30 cm) it was dated to 2703-1633 BP, and at (15-30 cm) to 1724-1094 BP. The last two dates have been accepted for the Savannah Pastoral Neolithic (SPN) Cultures in West Kilimanjaro, while the former dates have been ignored for no apparent reason. Despite the stratigraphic inconsistency, the dates from Maua Farm correspond with those of other PN sites in the EARS, such as the Narosura site in Kenya. The findings from Maua Farm show a cultural connection between West Kilimanjaro and Narosura sites in Kenya, separated by 200km.

In the Ngorongoro Crater, numerous stone cairns containing stone bowls, pestle rubber, personal ornaments, and ochre were discovered and assigned to the Neolithic by Leakey[12] and later by Mturi.[13] The date for stone cairns was 2260 BP, although this date should be taken cautiously since some cairns contain cowrie shells, iron objects, and recent radiocarbon dates.[14] Other dates in this region are dubious due to post-depositional mixing or possible taxa misidentification.[15] Additional high-quality dates are needed to document the earliest herding instances in northern Tanzania.[16]

The complexity of the formation of communities in the EARS during the Holocene, coupled with the chronological gaps in the Neolithic sites of the Lake Eyasi Basin and EARS, has limited our understanding of

[12]Mary D Leakey, "Excavation of burial mound in Ngorongoro Crater", *Tanzania Notes and Records* 66 (1966): 1-12.

[13]Amini A Mturi, "Food Production and the Transition from the Terminal Stone Age to the Iron Age in Tanzania", Conference of the *International Union of Prehistoric and Protohistoric Sciences,* Nice, France, (1976).

[14]Charles Rubaka, "Pastoral Neolithic Settlement and Subsistence Patterns in the Mang'ola Graben, Tanzania," (MA Dissertation, University of Dar es Salaam, 2002).

[15]Kennedy K. Mutundu, "An Ethnoarchaeological Framework for the Identification and Distinction of Late Holocene Archaeological Sites in East Africa," *Azania: Archaeological Research in Africa* 45, no.1 (2010): 6–23; Mary E Prendergast, "Diversity in East African Foraging and Food Producing Communities," Azania: Archaeological Research in Africa, 45 no.1 (2010): 1–5.

[16]Mary Prendergast, "Hunters and Herders at the Periphery: The Spread of Herding in Eastern Africa," In *People and Animals in Holocene Africa: Recent Advances in Archaeozoology* edited by Hélène Jousse: Joséphine Lesur 43–58, (Kiel: Africa Magna Verlag, 2011)

the trajectories of the spread of animal herding and a farming economy in the area. As such, this study was undertaken to unravel issues related to the chronological events associated with multistep/multiple frontiers in the area.[17] Overall, factors such as unreliable dating techniques, bioturbation of deposits and sediments, and unmatched stratigraphic contexts for most of the Neolithic sites in the EARS have all been proposed for the lack of a formal chronological framework on the Neolithic Cultures of the region.[18]

Material and Methods

We studied the Mang'ola graben in the Lake Eyasi Basin, Karatu District, northern Tanzania (Figure 1). Lake Eyasi is a shallow alkaline lake located along the EARS. It is situated at Universal Transverse Mercator (UTM) 746058 E and 9608875 N. We employed a purposeful sampling procedure to select all three archaeological excavation units in the Lake Eyasi Basin open-air sites. The excavation history of the sites guided the excavations, precisely locating the areas with dense scatters of archaeological materials. Since the Laghangasimjega and Jangwani sites have been researched for a long time, it was reasonable to use purposeful sampling to avoid re-excavating the points/areas previously excavated by other researchers.[19]

[17]Mary Prendergast et al., "Ancient DNA Reveals a Multistep Spread of the First Herders into Sub-Saharan Africa," *Science* 365, no.6448 (2019): 1-10.

[18]Musa S. Mwitondi, "Neolithic Chronological Settings, Settlement Patterns and Mobility in the Lake Eyasi Basin," (PhD Thesis, University of Dar es Salaam,2022); Prendergast et al., "Ancient DNA" 1; Mary Prendergast et al., "New Dates for Kansyore and Pastoral Neolithic Ceramics in the Eyasi Basin, Tanzania," *Journal of African Archaeology* 12, no.1 (2014): 89–98.

[19]Mwitondi, "Neolithic Chronological Settings, Settlement Patterns and Mobility"; Musa S. Mwitondi et al., "Mollusc Shells from Neolithic Contexts in the Lake Eyasi Basin, Northern Tanzania," *Tanzania Journal of Science* 47, no. 3 (2021): 1086–1101.

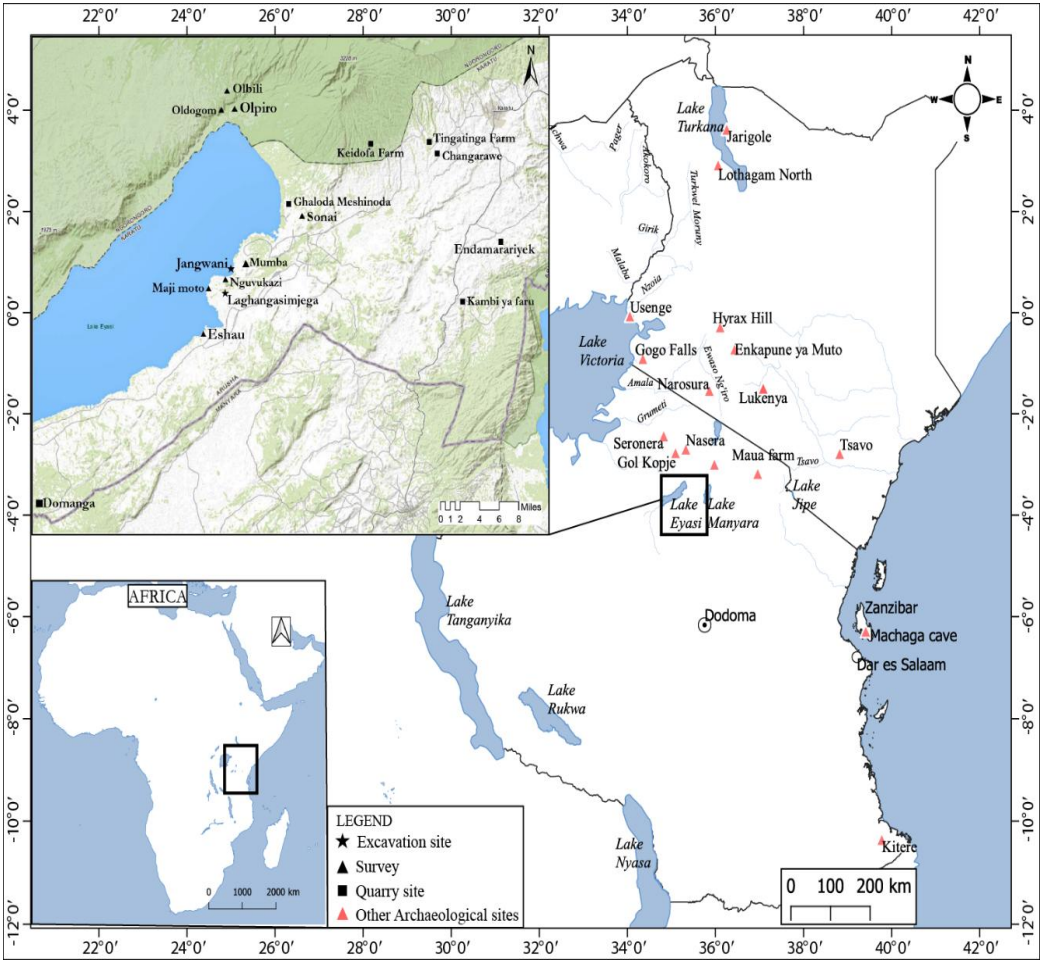

Figure 1: Location of the Study Area and Some Archaeological Sites and Places in the EARS. ***Source:*** *Musa Mwitondi (2022)*

At Jangwani 3, a 2x1 square meter (m^2) excavation unit was established at 0750897 E and 9607421 N, and 1027 meters (m) altitude. Excavation Unit 1 at Jangwani 3 was subdivided into two grids of 50 centimetres (cm) each. Excavation proceeded at an arbitrary level of 10 cm, since transparent beds were hard to distinguish due to the sandy and silt soils characterising the Jangwani floodplains. We established two excavation units At the Laghangasimjega site. We located Excavation Unit 1 on the bank of the River Barai, and excavation followed natural beds. Excavation Unit 1 lies at

0751510 E, 9605509 N, and 1030 m altitude. We further subdivided the unit into five quadrants of 50 cm squared: A, B, C, D, and E. Other recording and excavation procedures followed the protocols applied at Jangwani 3 Unit 1.

Unit 2 at Laghangasimjega followed the excavation procedures applied at Jangwani 3 Unit 1 and at Laghangasimjega Unit 1. Excavation Unit 2 measured $2m^2$ and is located at 0751463 E and 9605570 N, at 1038 m. Excavation Unit 2 is located 50 meters northwest of Excavation Unit 1. It followed the arbitrary level of 10 cm. Most archaeological materials were confined to between 0 cm and 65 cm, and the materials slowly decreased to 100 cm sterile. We used the Leica Total Station machine to plot the excavated materials. The excavation procedures followed at Laghangasimjega Unit 2 were the same as in the previous excavations.

We recorded stratigraphic sequences and the spatial distribution of archaeological artefacts in quadrants and levels. With assistance from Danielson Kisanga, we provided soil descriptions (wet/dry), such as colour, texture, colour mottles, structure, consistency, and boundaries. The pottery attribute analysis included vessel forms, decorative techniques and motifs, rim shape/style, inclusion, surface finishing, and soot analysis. This categorisation of pottery was aimed at establishing various pottery traditions and uses.[20]

We adopted the number of identified specimens (NISP) from Prendergast.[21] We sent samples of the identified skeletal elements to fauna specialists Gabriel Mbassa and Claudius Luziga of Sokoine University of Agriculture in Morogoro, Tanzania, to determine the composition of the species. Further, we processed data using the Statistical Package for Social Sciences (SPSS). Prendergast has discussed the subsistence patterns of Neolithic people extensively.[22] Thus, this study set out to identify species which could increase our understanding of the commencement of animal

[20]Odner, "Excavations at Narosura, a Stone Bowl Site in the Southern Kenya Highlands" 60; Bower, "The Pastoral Neolithic of East Africa," 49–82.

[21]Mary Prendergast, "Forager Variability and Transitions to Food Production in Secondary Settings: Kansyore and Pastoral Neolithic Economies in East Africa", (PhD Dissertation, Harvard University, 2008).

[22]Ibid.

domestication in the Lake Eyasi Basin which has been ill-understood due to a lack of reliable dates from excavated sites.[23]

We produced radiocarbon dates from charcoal, mollusc shells, and ostrich eggshell (OES) beads using the AMS dating technique at the Poznan Laboratory in Poland. The laboratory deemed samples of cattle bones and teeth containing 0.1%N and 3.9%C unsuitable for AMS radiocarbon dating. The other dates are shown in calibrated (cal.) years BC with a 95.4% probability (confidence interval), which is based on OxCal software versions 4.2.3 and 4.4.2 by Reimer et al.[24] We calibrated all dates using the southern hemisphere curve (SHCal13/20 atmospheric curve) by Hogg et al[25] (Figure 2a, 2b). The AMS radiocarbon dating results are summarised in Table 1.

Previous Pastoral Neolithic Studies in East Africa

In East Africa, around 5000 BP, PN culture predominated in the Lake Turkana Basin.[26] Evidence from the Koobi Fora region on the north-eastern shore of Lake Turkana indicates a gradual and continuous loss of the frequencies of harpoons for fishing and an increase in the number of livestock intensified in the riparian foraging.[27] The period also shows shared stylistic attributes in making ceramics, particularly the Nderit

[23]Rubaka, "Pastoral Neolithic Settlement and Subsistence Patterns", 200. Prendergast et al., "New Dates for Kansyore and Pastoral Neolithic Ceramics," 93.

[24]Paula Reimer et al., "IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP," *Radiocarbon* 55, no.4 (2013): 1869–1887; Paula Reimer et al., "The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve", (0–55 cal kBP)". *Radiocarbon* 62, no.4 (2020):725-757.

[25]Alan G Hogg et al., "SHCal13 Southern Hemisphere Calibration, 0–50,000 Years cal BP," *Radiocarbon* 55, no.4, (2013):1889–1903; G. Hogg et al., "SHCal20 Southern Hemisphere Calibration, 0–55,000 Years cal BP," *Radiocarbon* 62, no.4 (2020): 759–778.

[26]Katherine Grillo, Zachary M McKeeby and Elisabeth A Hildebrand, "'Nderit Ware' and the Origins of Pastoralist Pottery in Eastern Africa", *Quaternary International*, 608–609, (2022): 226–242; David K Wright and C Smith, "East and Southern African Neolithic: Geography and Overview", in *Encyclopaedia of Global Archaeology (*New York: Springer, 2014); Katherine Grillo and Elisabeth A Hildebrand, "The Context of Early Megalithic Architecture in Eastern Africa: The Turkana Basin c. 5000-4000 BP," *Azania: Archaeological Research in Africa* 48, no.2 (2013): 193–217.

[27]Grillo et al, "'Nderit Ware' and the Origins of Pastoralist Pottery."

tradition (Turkana) and the Shaheinab tradition (Sudanese Nile).[28] Shared attributes are also apparent in the subsistence patterns[29] and linguistic reconstructions.[30] The shared attributes inform the social network and inter-regional migration of Sudanese (Afro-Asiatic/Cushitic) pastoralists to the Lake Turkana Basin.

Currently, the ancient Deoxyribonucleic Acid (aDNA) evidence suggests that the admixture responsible for forager-related ancestry in the PN region may have occurred between the people of North-eastern Africa (Cushites/Nilotes and the Levant) at around 6000-4000 BP.[31] This time marks the beginning of the PN period in Eastern Africa.[32] However, as Wright[33] argues that it is not easy to point out the arrows of diffusion for PN culture, as many areas in East Africa remain unexplored.

The oldest Neolithic sites across the region date from 5000 to 4500 BP.[34] The early Neolithic pastoralists in Eastern Africa were less mobile and had a broad-based subsistence than later pastoral groups.[35] For approximately 1000 years (5000-4000 BP) after the initial introduction into the Lake Turkana Basin, livestock stalled in Eastern Africa. The reason the Neolithic people stayed longer at the Lake Turkana Basin instead of moving down south is linked to the presence of diseases, such as the East Coast Fever (ECF) and the wildebeest-derived malignant catarrhal (WD-MCF) fever.[36] Currently, "the disease-challenge hypothesis has been falsified

[28]John W Barthelme, *Fisher-Hunters and Neolithic Pastoralists in East Turkana, Kenya*. (Oxford: British Archaeological Reports, 1985).

[29]Wright and Smith, "East and Southern African Neolithic."

[30]Wright and Smith, "East and Southern African Neolithic"; Christopher Ehret, *An African Classical Age: Eastern and Southern Africa in World History, 1000 B.C. to A.D. 400* (Charlottesville: University of Virginia Press, 1998).

[31]Prendergast et al., "Ancient DNA."

[32]Prendergast et al., "Ancient DNA", 9; Wright and Smith, "East and Southern African Neolithic", 2281; Wright, "Frontier Animal Husbandry ", 240; Prendergast, "Forager Variability"; Lane, "The 'Moving Frontier'" 247; Bower, "The Pastoral Neolithic of East Africa",63, Bower et al., "Later Stone Age/ Pastoral Neolithic", 120.

[33]Wright and Smith, "East and Southern African Neolithic".

[34]Elisabeth A Hildebrand et al., "A Monumental Cemetery Built by Eastern Africa's First Herders Near Lake Turkana, Kenya," 115, no.36 (2018): 8942–8947; Prendergast et al., "New Dates for Kansyore and Pastoral Neolithic," 93; Lane, "The 'Moving Frontier'," 247.

[35]Wright and Smith, "East and Southern African Neolithic"

[36]Lane, "The 'Moving Frontier'," 243-264; Fiona Marshall and Elisabeth Hildebrand, "Cattle before Crops: The Beginnings of Food Production in Africa," *Journal of World Prehistory* 16, no.2 (2002): 99-143; Diane Gifford-Gonzalez, "Animal Disease Challenges to the Emergence

by discovering considerable cattle remains south of Lake Turkana between 4000 and 3000 BP"[37] at sites such as Wadh Lang'o in Kenya and Luxmanda in Tanzania.[38]

After 3000 BP, evidence shows that the pastoralists on the grassland plateaus and in the Rift Valley were seasonally mobile and had restricted their diets to meat, animal by-products, and probably other foods, which do not have traces in archaeological records.[39] There were only small "trickles" of pastoralists south of 3°N before 3000 years BP.[40] There were only four published archaeological sites with domesticated animals south of the Lake Turkana Basin before 3000 years BP: Enkapune ya Muto in the central Rift Valley,[41] Gogo Falls,[42] Usenge 3 near Lake Victoria,[43] and Kahinju in the Kenyan coastal plains.[44] These sites have evidence for minimal reliance on domesticated animals but show foraging-based adaptations in which domesticated animals played a minimal part in the subsistence component.[45]

of Pastoralism in Sub-Saharan Africa," *Archaeological Review* 17, no. 3 (2000): 95–139; Bower, "The Pastoral Neolithic of East Africa," 49–82.

[37]Diane Gifford-Gonzalez, "'Animal Disease Challenges' Fifteen Years Later: The Hypothesis in Light of New Data," *Quaternary International* 436 (2017): 283–293.

[38]Katherine Grillo et al., "Pastoral Neolithic Settlement at Luxmanda, Tanzania", *Journal of Field Archaeology* 43, no.2 (2018), 102–120.

[39]David K Wright, "Accuracy vs. Precision: Understanding Potential Errors from Radiocarbon Dating on African Landscapes", *African Archaeological Review* 34, no.3 (2017), 303-319; Wright, "East and Southern African Neolithic"; Fiona Marshall, "The Origins and spread of domestic animals in East Africa," in *The Origins and Development of African Livestock: Archaeology, Genetics, Linguistics and Ethnography* edited by R Blench and KC MacDonald (London: University College London Press, 2000).

[40] Bower, "The Pastoral Neolithic of East Africa", 49–82.

[41]Ambrose, "Chronology of the Later Stone Age and Food Production."

[42]Peter Robertshaw, "Gogo Falls: A Complex Site East of Lake Victoria," *Azania: Archaeological Research in Africa* 26 (1991): 63-195.

[43]Paul Lane et al., "The Transition to Farming in Eastern Africa: New Faunal and Dating Evidence from Wadh Lang'o and Usenge, Kenya," *Antiquity* 81 (2007), 62–81.

[44]Wright and Smith, "East and Southern African Neolithic."

[45]Wright and Smith, "East and Southern African Neolithic"; David K Wright, "Frontier Animal Husbandry in the Northeast and East African Neolithic: A Multiproxy Paleoenvironmental and Paleodemographic Study," *Journal of Anthropological Research* 67, no.2 (2011): 213-244; Lane, "The 'Moving Frontier'"; Bower, "The Pastoral Neolithic of East Africa", 49–82.

Furthermore, domesticated animals are found in small numbers relative to wild taxa during this period (5000-4000 BP) at the sites outside the Lake Turkana Basin and the Horn of Africa. It is possible that the livestock in these settings was stolen from established herds elsewhere and not kept for a long time before being slaughtered.[46] In that case, the domesticated animals in equatorial Africa before 3000 years BP represented an additional resource within the broad-based foraging complex of those who possessed them and were neither culturally transformative nor necessarily permanent.[47] By contrast, the period between 3000 and 2000 BP is known as the "splash" of pastoralism into equatorial East Africa.[48] Right after 3000 BP, PN sites are widely distributed across the Rift Valley and the East African highlands.[49]

The "southern frontiers" from the Northern and Horn of Africa moved into the Lake Turkana Basin and later spread into other parts of the EARS, including the Lake Eyasi Basin.[50] Such migration theory has predominated Neolithic studies in East Africa for decades. The predominance of the population movement and the diffusion of the idea was also associated with the late Neolithic Cultures in the EARS region until about 3000 BC and later into other Eastern and Southern African regions at the beginning of AD.[51]

It is debatable whether the local people took up domestication as the idea spread rather than immigrants bringing the domesticates from

[46]Marshall, "Origins and Spread of Domestic Animals."

[47]Wright and Smith, "East and Southern African Neolithic"; Wright, "Frontier Animal Husbandry"; Marshall, "Origins and Spread of Domestic Animals."

[48]Bower, "The Pastoral Neolithic of East Africa."

[49]Wright, "Frontier Animal Husbandry."

[50]Lane, "The 'Moving Frontier'".

[51]David W Phillipson, *African Archaeology,* 3rd Edn. (Cambridge: Cambridge University Press, 2005); Felix Chami and Amandus Kwekason, "Neolithic Pottery Traditions from the Islands, the Coast and the Interior of East Africa," *African Archaeological Review* 20, no.2 (2003): 65–80.

outside.[52] For instance, Chami and Kwekason[53] respond to the migration theory by arguing that "these theories can no longer be sustained. On the Coast of Tanzania, its immediate hinterland, and the deep-sea islands of Zanzibar and Mafia were settled by people who knew about agriculture and pottery making probably from 3000 BC"[54]. New findings by this study from the Lake Eyasi Basin support the earlier synthesis regarding the introduction and spread of the animal herding economy in northern Tanzania.

Stratigraphy and the AMS Dating Results

The charcoal samples from Laghangasimjega Unit 1 range between 3085 ±30 and 3555 ± 35 BP (Table 1, Figure 2a, 2b, and Figure 3). These dates match the stratigraphy and are associated with the densest Narosura pottery. In addition, the remains of cattle and goats are apparent (Figure 3). Conversely, Laghangasimjega Excavation Unit 2 produced mixed AMS radiocarbon results; some align with the stratigraphy, while others do not (Table 1, Figure 4). Overall, the dates are associated with Neolithic materials, such as Narosura pottery, cattle, and domesticated goats, and fit within the range of the known Neolithic period in the EARS. The OES beads at Jangwani 3 Unit 1 are inconsistent with the stratigraphy (Figure 5), while the dates on *Achatina fulica* fit well with the stratigraphy (Table 1). These dates are all directly associated with the Neolithic pottery of the Narosura tradition and the remains of domestic cattle and goats. Besides, dates from Jangwani 3 and Laghangasimjega sites fall within the range of the Savannah Pastoral Neolithic (SPN) in the EARS.

[52]Felix Chami and Christowaja Ntandu, "Eastern Africa in Classical Times Reconstructing Past Networks between the Coast and Interior", In *The Resilience of Heritage: Cultivating a Future of the Past: Essays in Honour of Professor Paul JJ Sinclair* edited by A. Ekblom., C. Isendahl., Kahl-Johan Lindholm, (Uppsala: Uppsala University Press, 2018), 291–306; Felix Chami, *The Unity of African Ancient History:3000 BC to AD 500* (Dar es Salaam: E&D Limited, 2006); Emanuel T Kessy, "The Transition from the Later Stone Age to Iron Age in Kondoa, Central Tanzania," *African Archaeological Review* 30, no.3, (2013), 225–252; Emmanuel T Kessy, "The Relationship between the Later Stone Age and Iron Age Cultures of Central Tanzania" (PhD Diss., Simon Fraser University, 2005); Chami and Kwekason, "Neolithic Pottery Traditions."

[53]Chami and Kwekason, "Neolithic Pottery Traditions", 65.

[54] Ibid.

Site Name/Unit	Bed/Level	Cultural Tradition	Site Description	Dated Material	Dating Method	Lab no	Radiocarbon Dates (BP)	Date Range (cal. BC)
Laghangasimjega Unit 1	Bed 5 (60.51cm)	Narosura sherds with domestic animals.	Open-air	Charcoal	AMS radiocarbon	Poz-116972	3085 ± 30 BP	1412-1207
Laghangasimjega Unit 1	Bed 5 (60.61cm)	Narosura sherds with domestic animals	Open-air	Charcoal	AMS radiocarbon	Poz-116973	3555 ± 35 BP	1944-1741
Laghangasimjega Unit 2	2 (10-20 cm)	Neolithic	Open-air	OES Bead	AMS radiocarbon	Poz-124126	3025 ± 35 BP	1314-1077
Laghangasimjega Unit 2	4 (30-40 cm)	Neolithic	Open-air	OES Bead	AMS radiocarbon	Poz-124129	3130 ± 35 BP	1440-1257
Laghangasimjega Unit 2	6 (50-60 cm)	Neolithic	Open-air	OES Bead	AMS radiocarbon	Poz-124131	4205 ± 35 BP	2888-2623
Laghangasimjega Unit 2	8 (70-80 cm)	Neolithic	Open-air	OES Bead	AMS radiocarbon	Poz-124133	3685 ± 35 BP	2141-1896
Laghangasimjega Unit 2	10 (90-100 cm)	Neolithic	Open-air	OES Bead	AMS radiocarbon	Poz-124138	3060 ± 30 BP	1399-1188
Laghangasimjega Unit 2	11 (100-110 cm)	Neolithic	Open-air	OES Bead	AMS radiocarbon	Poz-124139	3530 ± 30 BP	1926-1737
Jangwani 3 Unit 1	Level 16 (154 cm)	OES beads, Narosura	Open-air	OES Bead	AMS radiocarbon	Poz-116242	3315 ± 30 BP	1632-1491
Jangwani 3 Unit 1	Level 17 (170 cm)	OES beads, Narosura	Open-air	OES Bead	AMS radiocarbon	Poz-116243	3075 ± 30 BP	1408-1192
Jangwani 3 Unit 1	Level 16 (154 cm)	Land snail shell, Narosura	Open-air	*Achatina fulica* shell	AMS radiocarbon	Poz-116244	2845 ± 30 BP	1048-845
Jangwani 3 Unit 1	Level 16 (160 cm)	Land snail shell, with Narosura	Open-air	*Achatina fulica* shell	AMS radiocarbon	Poz-116245	3395 ± 30 BP	1699-1531

Figure 2: AMS Radiocarbon Dating Results from Laghangasimjega Unit 1, Laghangasimjega Unit 2, and Jangwani 3 Unit 1
***Source**: Authors' Reconstruction*

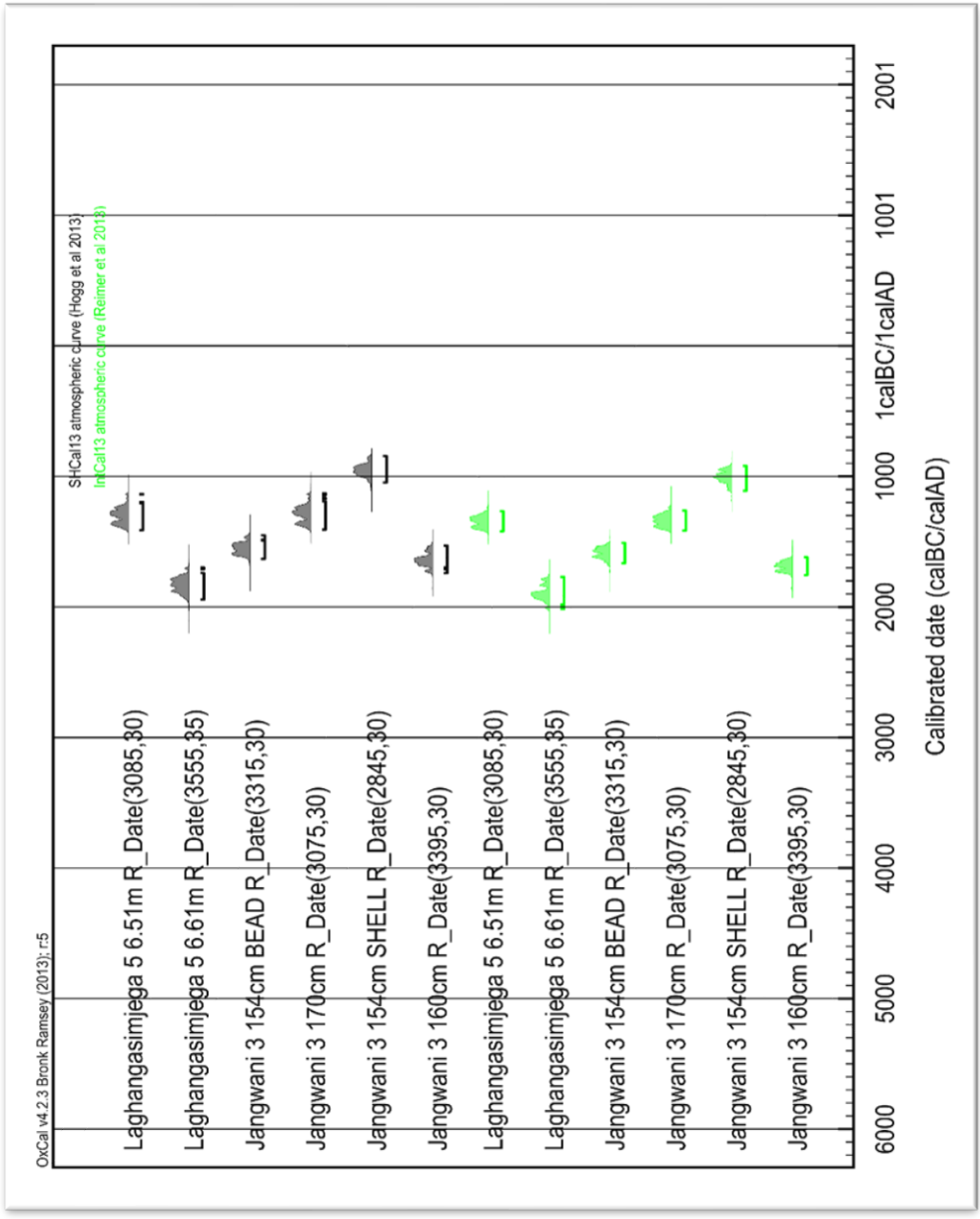

Figure 3a: Calibrated AMS Radiocarbon Dates from Lake Eyasi Basin
Source: *Authors' Reconstruction*

Citation: Mwitondi, Musa Said and Pastory Magayane Bushozi. "New Chronology for Neolithic Cultures in the Lake Eyasi Basin, Northern Tanzania." *Zamani* 1, no. 2 (2024): 203-236. DOI: 10.56279/ZJAHS1122

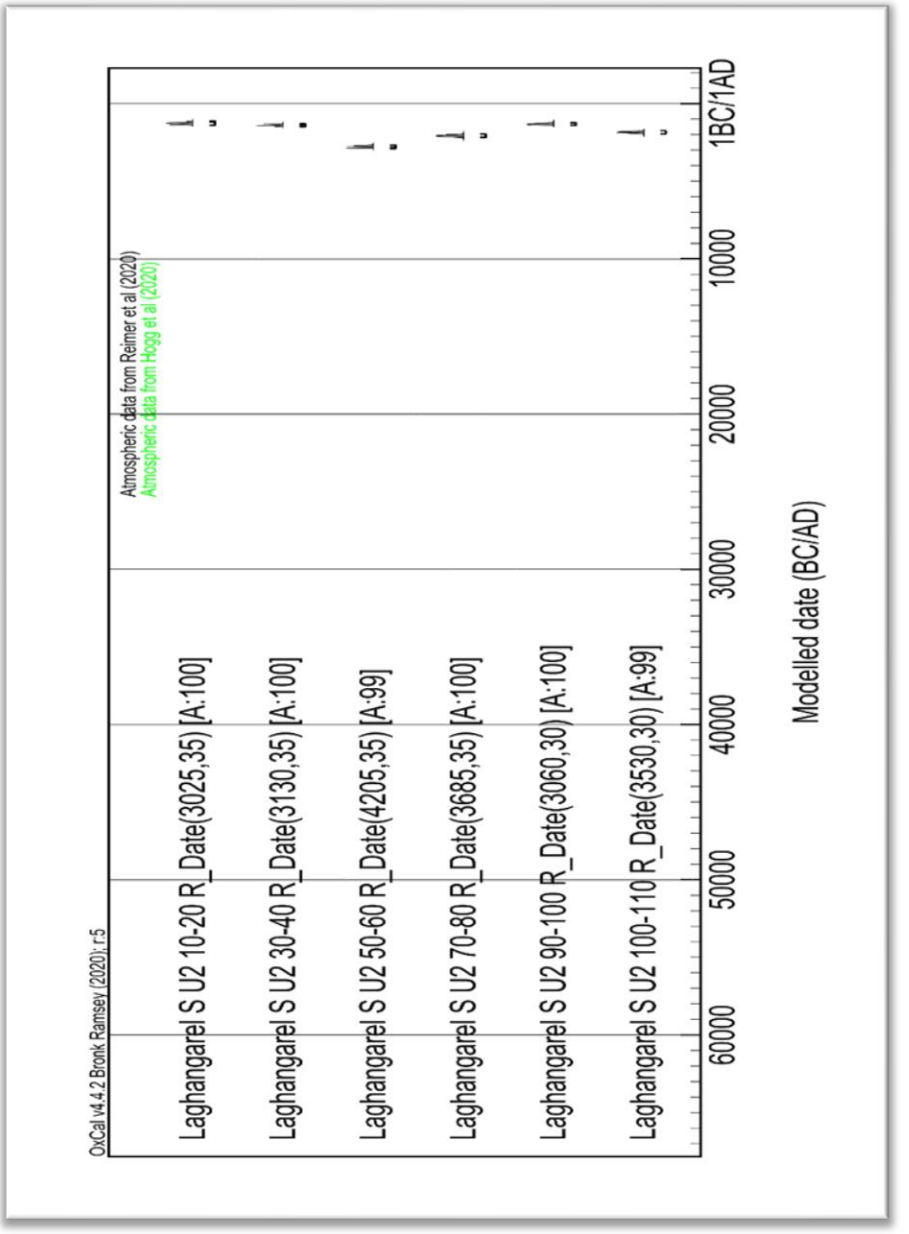

Figure 3b: Calibrated AMS Radiocarbon Dates from Lake Eyasi Basin
***Source**: Authors' Reconstruction*

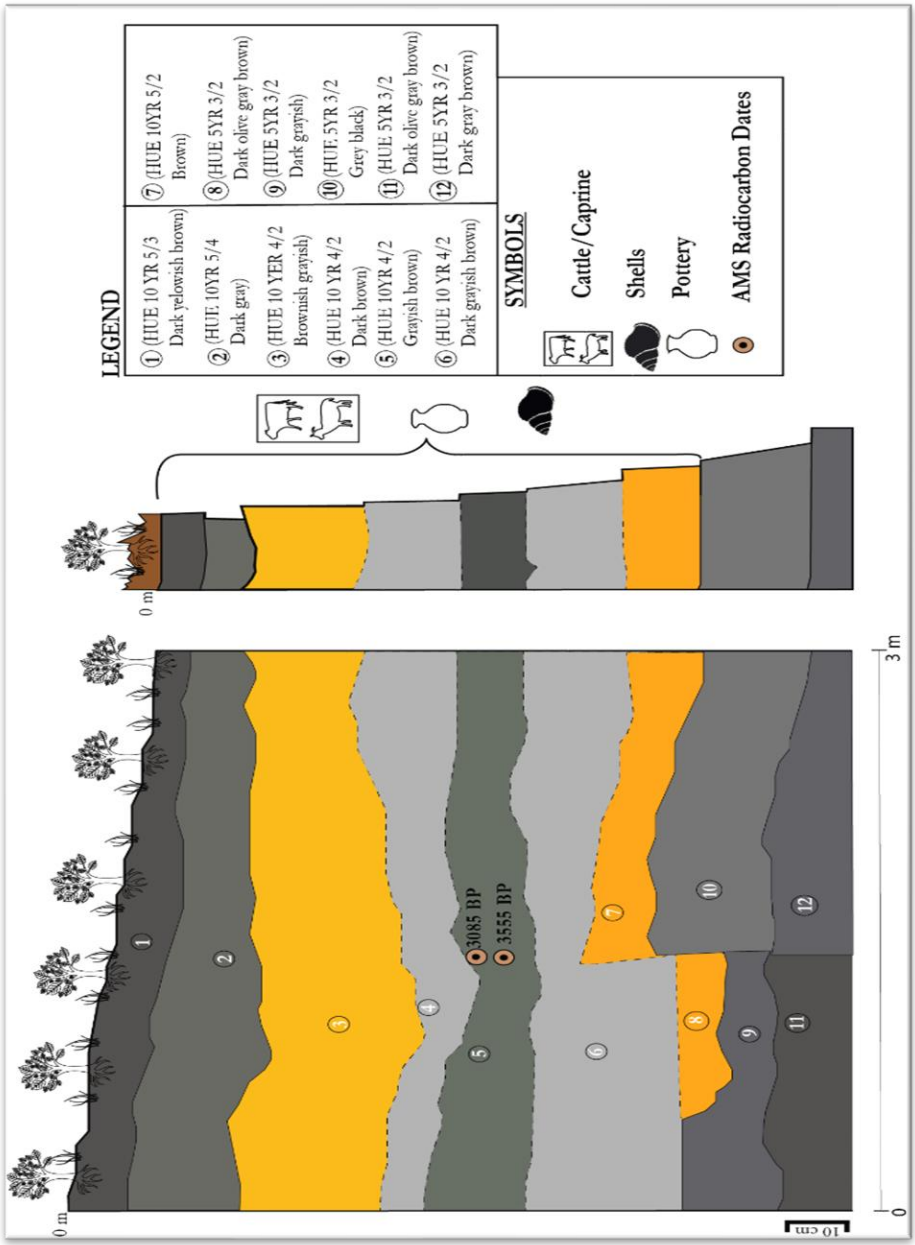

Figure 4: Stratigraphy of Laghangasimjega Unit 1 (northern wall)
***Source**: Authors' Reconstruction*

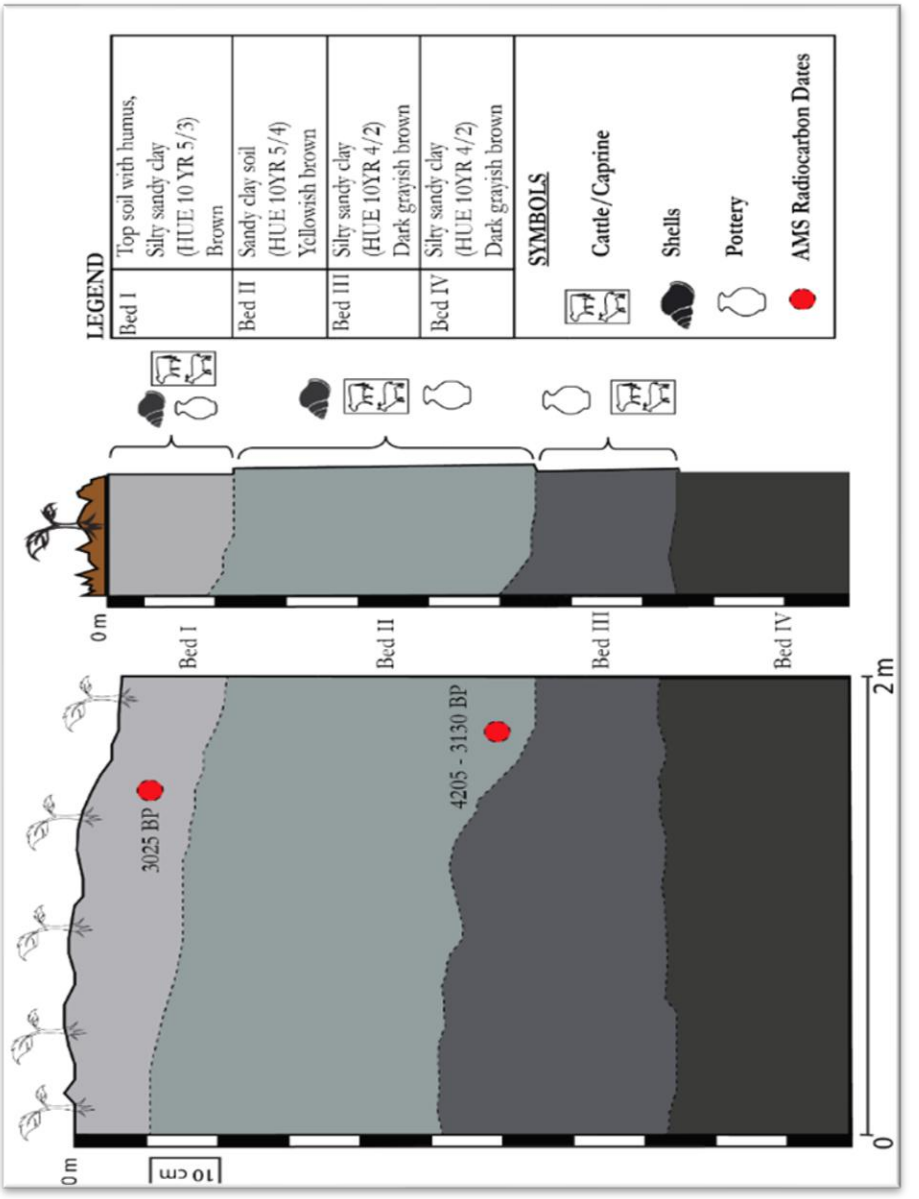

Figure 5: Stratigraphy of Laghangasimjega Unit 2 (northern wall)
***Source**: Authors' Reconstruction*

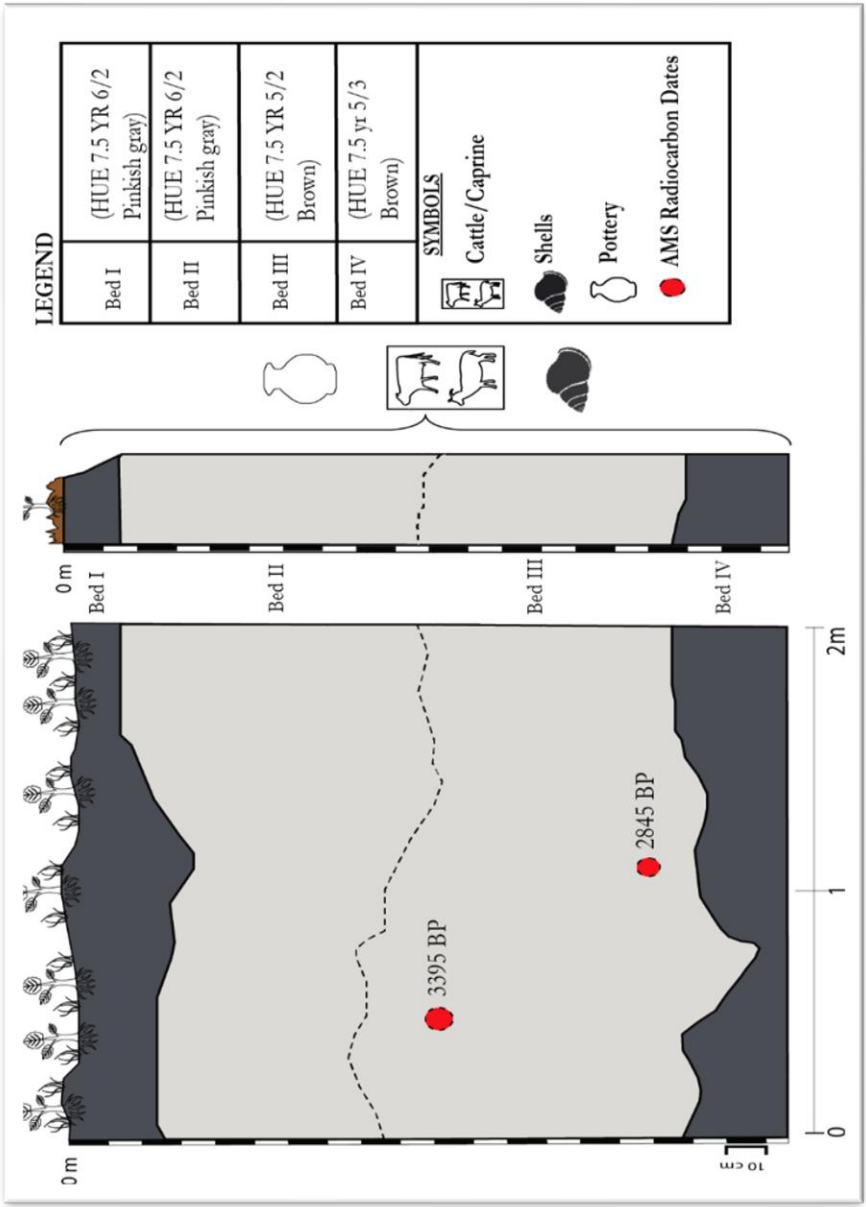

Figure 6: Stratigraphy of Jangwani 3 Excavation Unit 1 (northern wall): Fauna Assemblage ***Source**: Authors' Reconstruction*

This study analyzed a total of 386 bones from the excavated sites at Laghangasimjega and Jangwani 3 in the Lake Eyasi Basin. The bone assemblage in the Lake Eyasi Basin is mainly dominated by domesticated animals (cattle, and caprine) over wild and aquatic species (see Figure 7, 8, 9). Laghangasimjega Unit 2 produced the largest amount of bone assemblage (61%), while Jangwani 3 Unit 1 had the smallest number of bones (7%) compared to the other sites. The post-deposition shows that bones were poorly preserved, and that most of the bones were coated with carbonate concretion (see Figure 10). Despite using Hydrochloric acid (HCl) to clean the surface of the bones, most of the bones remained unclear and undiagnostic. Both Mehlman[55] and Prendergast[56] report a similar scenario of bone concretion at most Neolithic sites across the Lake Eyasi Basin.

[55]Mehlman, "Later Quaternary Archaeology Sequences in Northern Tanzania."
[56]Prendergast, "Forager Variability."

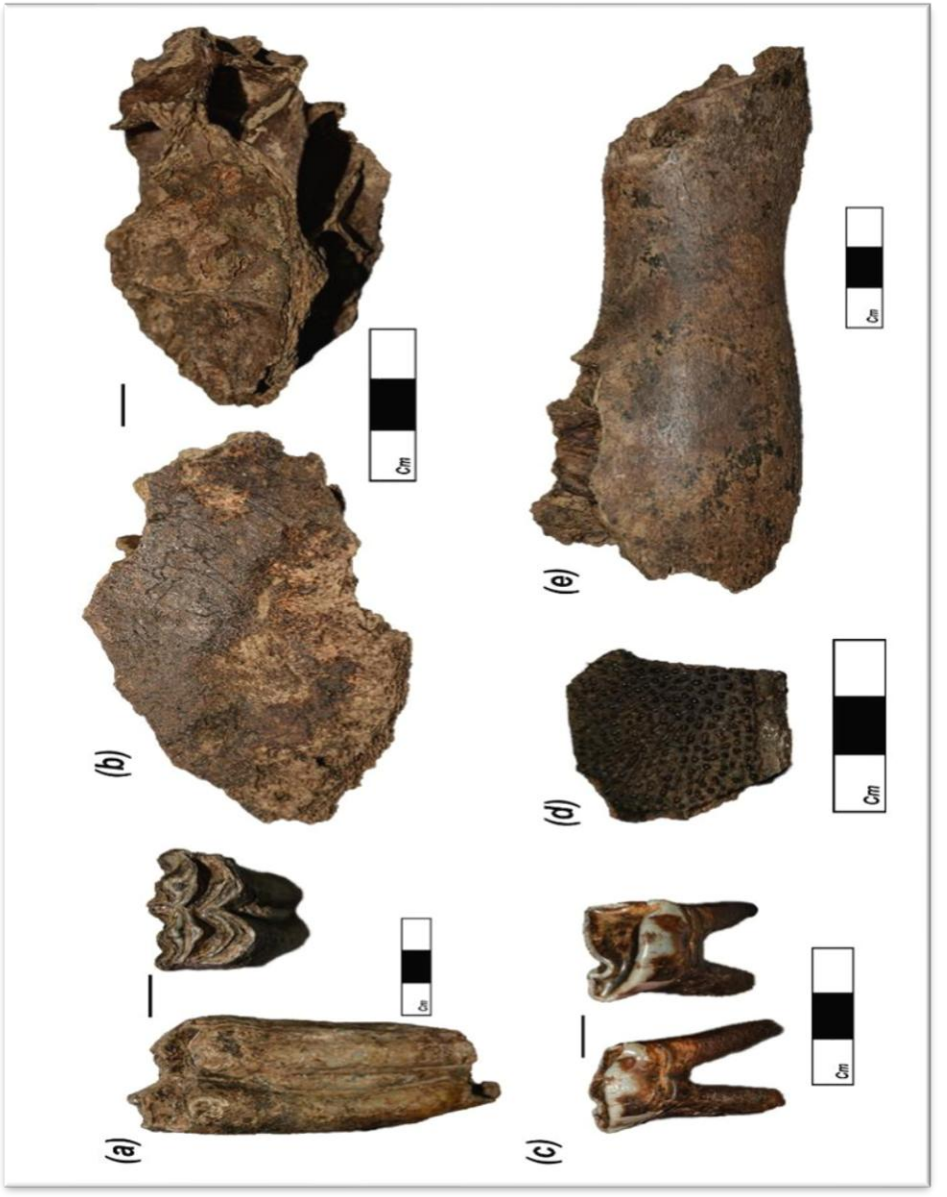

Figure 7: Bone Parts at Laghangasimjega Unit 1
(a) Molar tooth-cattle, (b) Frontal bone-cattle, (c) Premolar tooth-cattle, (d) Flat skull-catfish, (e) Mandible-cattle
***Source**: Authors' Reconstruction*

Figure 8: Bone Parts Identified at Laghangasimjega Unit 2
(a)Talus-cattle, (b-c) Molar tooth-cattle, (d) Skull bone-catfish, (e) Phalanx-human
***Source**: Authors' Reconstruction*

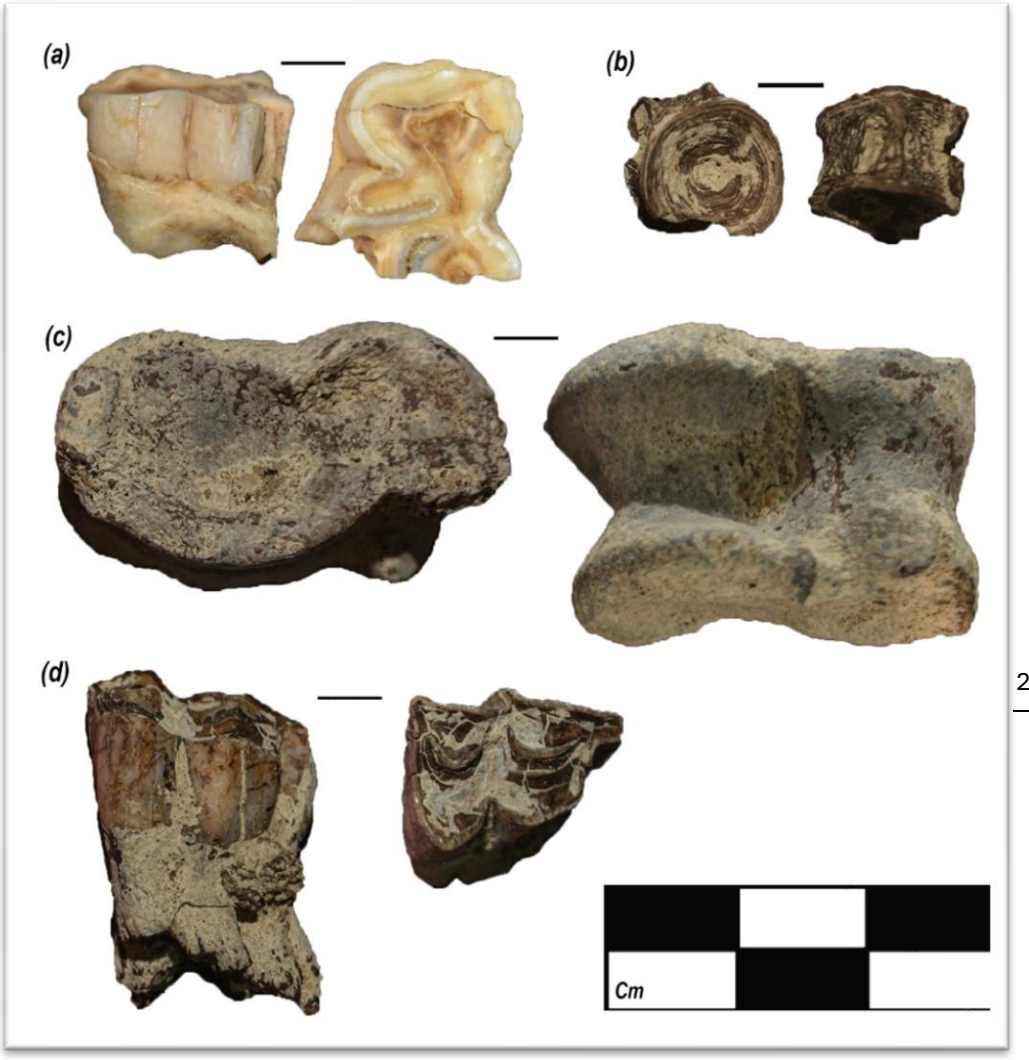

Figure 9: Bone Parts Identified at Jangwani 3 Unit 1
(a) Premolar tooth-human, (b) Fish vertebra, (c) Talus-sheep/goat, (d) Molar tooth-cattle
***Source**: Authors' Reconstruction*

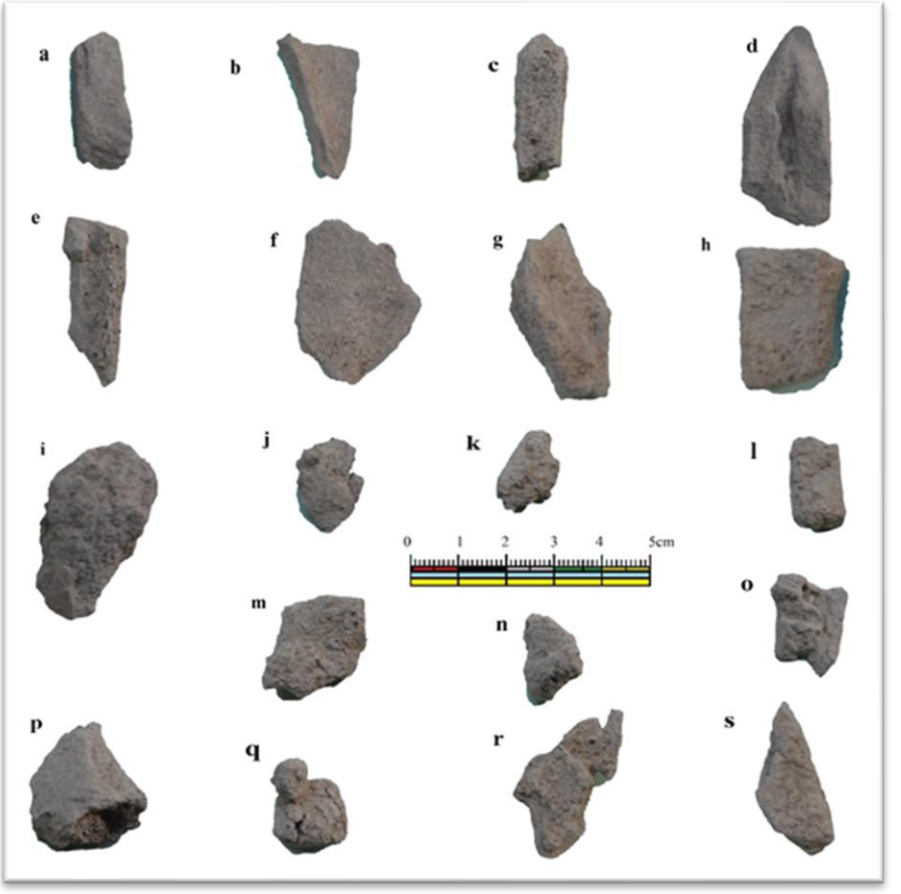

Figure 10: a-s, bone surface with carbonate concretion at Jangwani 3 Unit 1: Pottery Assemblage
***Source**: Authors' Reconstruction*

The Laghangasimjega site yielded a total of 1041 potsherds: 763 from Excavation Unit 1 (38%) and 251 potsherds from Excavation Unit 2 (12%). Jangwani 3 Unit 1 produced 878 potsherds (43%); the largest pottery assemblages retrieved from a single excavation unit. At all the open-air sites at Jangwani 3 and Laghangasimjega, the pottery assemblage is exclusive to the Narosura tradition (Figure 10, Figures 3, 4, 5). The analysed Narosura pottery from Jangwani 3 and Laghangasimjega has slight variations in terms of decorative techniques and motifs.

Compared to the Laghangasimjega site, Jangwani 3 Unit 1 represents the deepest level (170 cm) with a high representation of Narosura potsherds (Figure 5). In the Lake Eyasi Basin, Narosura potsherds are widely represented in the Neolithic sequences.[57] They are evenly distributed throughout the sequences from levels 8 to 13. Level 10 (90-100 cm) marks the densest Narosura level at Jangwani 3 Unit 1 (Figure 5).

Figure 11: Narosura Pottery with Varied Decorative Techniques and Motifs at Laghangasimjega Site
***Source**: Authors' Reconstruction*

[57]Odner, "Excavations at Narosura", 69.

Figure 12: A Conical Lid Handle at Laghangasimjega Unit 1
***Source**: Authors' Reconstruction*

The pottery assemblage at Laghangasimjega included a single conical lid handle (Figure 12). Furthermore, at Jangwani 3 Unit 1, only 15.4% of the sherds contained soot. About 37.6% of the sherds at the Laghangasimjega site had soot remains. As proposed by Teetaert et al.,[58] soot that remains on pots represents a carbonised material on the outside of a pot, derived from the smoke of a cooking fire.

[58]Dimitri Teetaert et al., "Food and Soot: Organic Residues on Outer Pottery Surfaces", *Radiocarbon* 59, no.5 (2017): 1609–1621.

Neolithic Cultures in the Lake Eyasi Basin and the EARS Region

The AMS radiocarbon dates from Laghangasimjega Unit 2 Bed III and Jangwani 3 Unit 1 suggest a possible palimpsest of taphonomic biases and processes, which may explain such inconsistent dates. It is not unusual for radiocarbon dates to produce varied dates from similar contexts. At Laghangasimjega Unit 2 Bed III, we ran multiple dates on Bed III, and the results were varied. Some possible explanations for such variations include (1) the whirlwind may have deposited cultural materials from elsewhere around the Lake Eyasi Basin (both old and younger materials), and (2) the Hard Water Effects (HWEs) which carried beads/ostrich eggshells to the site from different areas affected the beads/ostrich eggshells differently. The Pliocene and Pleistocene volcanic sediments influence the Lake Eyasi Basin in the escarpments, highlands, and flood plains.[59] In that case, the geological and hydrological setting of Lake Eyasi could have chiefly contributed to such date inconsistency. At both Jangwani 3 Unit 1 and Laghangasimjega Unit 2 Bed III, the variations in dates ranged from a few hundred years (see Table 1). This is not a very unusual margin of error for radiocarbon dates.[60] With regard to Luxmanda, Grillo et al. acknowledge post-depositional mixing up of materials from distinct mid-late, third-millennium BP occupational episodes.[61] A similar pattern of material mixing up may account for the AMS radiocarbon date variations in the Lake Eyasi Basin.

The AMS radiocarbon dates at the basin show that for nearly a millennium and a half (4205 ± 35 and 2845 ± 30 BP), Neolithic Cultures, based on a specialised herding economy (cattle and caprine), prevailed at the Lake Eyasi open-air sites at Jangwani 3 and Laghangasimjega (Table 1). Thus, the AMS radiocarbon dates in the Lake Eyasi Basin push back the timing of the emergence of a specialised herding economy in the EARS to the late fifth millennium BP. Subsequently, new dates for the Lake Eyasi Basin open-air sites occur at the same time as the other SPN sites in the

[59]Manuel Domínguez-Rodrigo et al., "The Archaeology of the Middle Pleistocene Deposits of Lake Eyasi, Tanzania," *Journal of African Archaeology* 5, no.1 (2007), 47–78.

[60]Personal Communication with W Farley, January 10, 2022.

[61]Grillo et al., "Pastoral Neolithic Settlement at Luxmanda."

EARS which contain fully-fledged evidence for animal domestication.[62] The evidence from this study contributes significantly to a better understanding of the spread and adaptation of Neolithic cultural processes across the East African region. The key conclusion that could be drawn here is that the Lake Eyasi Basin should be regarded as the *terminus post quem* for the evolved or specialized animal economy in the EARS.

The above-mentioned dates support recent evidence from Gileodabeshta 2 and the Luxmanda sites, south of Lake Eyasi, where the Neolithic assemblages were radiocarbon dated to 3100 BP.[63] The fauna assemblage from Laghangasimjega, a site close to the Barai Riverbank, suggests the area was also a seasonal hunting site. The site may have been used strategically for ambush hunting when animals went to a river to drink water. The Jangwani 3 site was predominated by domestic animals in which cattle outnumbered goat remains. A similar pattern was reported at Jangwani 2, where Prendergast [64] observed that there was the predominance of domesticated animals over wild animals, which implies that there was specialised pastoralism in the EARS.[65]

One notable feature of Jangwani 3 and Laghangasimjega sites is the presence of a *Homo sapiens* premolar tooth and a phalanx, the first evidence of the herder retrieved from the open-air site in the Lake Eyasi Basin. A single human phalanx 1 documented at the Laghangasimjega site was AMS radiocarbon dated to 3025 BP. A few Neolithic sites bear evidence of human remains during the Neolithic period. Jarigole and Lothagam North in the Lake Turkana Basin in Kenya are a few examples of the Neolithic sites in the EARS with evidence of human remains from Neolithic contexts.[66] However, the data from the Lake Turkana Basin represent an early/generalized

[62]Mary Prendergast et al., "New Dates for Kansyore and Pastoral Neolithic Ceramics in the Eyasi Basin, Tanzania," *Journal of African Archaeology* 12, no.1 (2014), 89–98.

[63]Grillo et al., "Pastoral Neolithic Settlement at Luxmanda", 102–120.

[64]Prendergast, "Forager Variability."

[65]Fiona Marshall, "Origins of Specialized Pastoral Production in East Africa*," American Anthropologist* 92, no.4 (1990): 873–894; Bower, "The Pastoral Neolithic of East Africa", 49–82; Prendergast, "Forager Variability."

[66]Elizabeth A. Sawchuk et al., "The Bioarchaeology of Mid-Holocene Pastoralist Cemeteries West of Lake Turkana, Kenya," *Archaeological and Anthropological Sciences* 11, no.11 (2019): 6221–6241.

herding economy in the EARS. Interestingly, no sign of intentional human burial at Laghangasimjega or Jangwani 3 was recorded.

A specialized herding economy in the Lake Eyasi Basin between 4205 and 2845 BP is associated with the production and use of the Narosura pottery tradition (Figure2, Figure 11).[67] The pottery assemblage at Laghangasimjega includes a single conical lid handle. The presence of pot lids, lid handles, and lug handles is associated with a food-processing culture. The AMS radiocarbon dates indicate that the Laghangasimjega site was first inhabited by herding communities before they moved into the Jangwani areas. The presence of pot lids, lid handles, and lug handles is associated with a food-processing culture. The occurrence of a conical lid handle at Laghangasimjega Unit 1 (Figure 12) is indicative of such culture.[68] As suggested by Grillo et al.,[69] lug handles are essentially a characteristic feature of Elmenteitan ceramics. Interestingly, the occurrence of conical lid handles is now reported alongside Neolithic Cultures in the Lake Eyasi Basin. On the contrary, the presence of soot on potsherds implies that the potsherds of the Lake Eyasi Basin were exposed to fire either during the roasting of meat, the boiling of milk, or during any other activity related to wood combustion. Conversely, the lack of soot in the majority of potsherds suggests that pots served other functions, such as storage of dried food/milk or medicine.[70]

Conclusion

The new AMS radiocarbon dates (4205 and 2845 BP) from the Lake Eyasi Basin challenge the timing of the introduction of SPN cultures in northern Tanzania and push it back to almost a millennium. New evidence from Jangwani 3 and Laghangasimjega sites in the Lake Eyasi Basin suggests that there is a need to refine the chronology of Neolithic Cultures in East Africa using reliable dating techniques and technologies to develop a comprehensive database of Neolithic events in the EARS. New dates from

[67]Mwitondi, "Neolithic Chronological Settings, Settlement Patterns and Mobility".

[68]Bower, "The Pastoral Neolithic of East Africa", 62; Ambrose, "Chronology of the Later Stone Age", 380.

[69]Grillo, "Nderit Ware" and the Origins of Pastoralist Pottery," 608–609.

[70]Prendergast et al., "Ancient DNA", 9.

the Lake Eyasi Basin suggest a possibility that multiple frontiers were responsible for the emergence of a specialized herding economy in the area. The late fifth millennium BP should now be regarded as the *terminus post quem* for evolved SPN cultures in the EARS in general and in the Lake Eyasi Basin in particular. Future studies must aim to expand research on Neolithic topics, especially in northern Tanzania, where research is sparse, and Neolithic chronology is enigmatic. Moreover, phytolith studies and pollen, aDNA, lipid, and residue extraction from stone tools, sediments, and potsherds should be carried out to establish past environments, human settlement and food-processing strategies during the Neolithic period.

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Conflict of Interest
The authors declare that they do not have any conflict of interest with individuals, groups or organizations.

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