# The State of Archaeobotanical Research in Ethiopia

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## Abstract

This article evaluates current knowledge on the beginning of early agriculture, the study of past environment, and past human-plant interactions. In the study, the regions of Ethiopia are geographically classified into four; North, North Central, South, and East, based on previous literature on past environment and early agriculture, and the availability of sites that bear botanical remains from archaeological sites, which were investigated employing proper archaeobotanical methods. A total of 13 sites were included in this review. The highest number of sites that provide plant remains from archaeological sites and insight into the types of cultivated crops belong to the northern part, with six sites, followed by the south (4 sites), and the least representation is the eastern part of the country with only one site. What is common in the review of the results of the archaeobotanical research in almost all the sites of the four regions is the availability of introduced Middle Eastern crops like wheat and barley starting from the Late-Holocene (ca. 1600 years BCE) to the medieval and post-medieval times ($14^{th}$- $18^{th}$ centuries A.D). The archaeobotanical record, until very recently, was devoid of sufficient data on indigenous C-4 crops like tef (*Eragrostis tef*), sorghum (*Sorghum bicolor)* and finger millet (*Eleusine coracana*). The uses of phytoliths and starch granules as an approach to recover microscopic plant remains from sediments and artefacts proved to be instrumental in recovering small seeded native cereals. This study observed that the agricultural economy of the southern half of the country was mainly on *ense*t, fruits and vegetables, and geophytes (root crops), and, thus, for their identification from archaeological sites shall integrate the study of phytoliths and starch granules. It was also possible to see that there is still a lack of data to clearly outline the beginning and evolution of early agriculture and portray human-environment interactions in almost all the regions. Furthermore, phytolith, anthracological and palynological studies are far from being topics of specialized research in the country.

**Keywords**: macro botany, micro botany, anthracology, early agriculture, environment, Ethiopia.

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## Introduction

Dorian Fuller (2013) in his book review work on "Windows on the African Past, Current Approaches to African Archaeobotany", edited by Ahmed G. Fahmy, Stefanie Kahlheber, and Catherine D'Andrea (2012), stated that in the study of past human-plant interactions and plant remains from archaeological sites, Africa is the least studied continent. Ten years after this review work, the position of the continent in archaeobotanical research has not changed much. This is particularly true in Ethiopia and the northern Horn of Africa, a region known for frequent new findings in the study of human biological and cultural evolutions.

More than two decades ago, D'Andrea *et al*., (1999) argued that the lack or limited nature of ethno-archaeological and archaeobotanical research in Ethiopia and Eritrea can be associated with the long years of political insecurity that the region had undergone than lack of scholarly interest. Although ethnoarchaeological research began in the Sahara in the late 1980s, the authors stressed that it is still in its early stages in Ethiopia and Eritrea. In the first two decades of the 20$^{th}$ century, there were archaeobotanical studies in well-documented sites of the two countries (Boardman 2000; D'Andrea 2008; Gebru et al., 2009). The attempts by the researchers to rectify the paucity of archaeobotanical and ethnoarchaeological data in Ethiopia and Eritrea were again interrupted by another phase of conflict and political unrest since 2019/2020 in most parts of the highlands of the Horn.

Positioned in a geographic interface between the African hinterland and the Near East and the Middle East regions, the highlands of Ethiopia possess an ideal location for the study of indigenously cultivated and domesticated crops and the most common introduced Middle Eastern crops like wheat and barley. The altitudinal disparity of the landscape from beneath sea level, 116 meters below sea level at Dallol, in Afar Regional State, and 4620 meters above sea level in the Semien Mountains, Amhara Regional State remains to be wonders for travelers, geographers, and geologists. Differences in elevation have also contributed for the emergence of local landraces and lowland, tropical, and temperate crop varieties to flourish. Despite the tremendous potential for the study of the evolution of crops and ancient agriculture, the attention given by researchers in the field of archaeobotany, and palynology is not satisfactory. Previous researchers and research findings have expressed the potential of the region in the study of African crops, dispersal of crops from the continent to

the near and far East and Middle Eastern crops (Diblasi *et al*., 2000; Harrower *et al*., 2010).

The Russian geneticist, Nikolai Vavilov, had categorized the highlands of Ethiopia as one of the eight centers in the world selected to be places of origin for agriculture (Vavilov 1951; 1957). The eight-center approach emanates from the observation that the selected geographic areas have high crop diversity for their cultivated edible crops. He had equated area of origin with crop diversity. Based on the crop diversity approach, Vavilov had even labeled the Abyssinian highlands as centers for the cultivation and domestication of wheat, barley, and other African indigenous grasses. Harlan (1971) later came up with his center and non-center/ secondary center approach and identified the same highlands as non-centers or secondary centers. Harlan, in the same article, argued that for an area to be considered as the origin for certain crop-based agriculture; the wild progenitor of that specific crop must be there. In such argument, the Abyssinian highlands were re-categorized as secondary centers for the cultivation of wheat and barley and centers for the cultivation of African grasses belonging to the Gramineae like *tef* (*Eragrostist ef*) and finger millet (*Eleusine coracana*).

As much as Vavilov and Harlan took initiatives for introducing the highlands of Ethiopia as a rich source of genetic diversity for edible crops and as the probable center and secondary center for the origin of agriculture, the inputs of the Italian agronomist Rafaelle Ciferri in the 1930s and 40s was even more significant, worth mentioning here are his five publications in the year 1942 (1942 a, b, c, d, and e). However, most works dealing with botany, archaeobotany, and the origin of ancient agriculture fail to acknowledge his contribution. Ciferri (1939) stated that the Ethiopian highland environment is exceptional in the globe for the study of crop diversity and the beginning of early agriculture. The highlands provided varieties of wheat, which makes them suitable for the study of the evolution of wheat. In his article entitled "Wheat and other grains indigenous to Ethiopia" (1939), he suggested a multi-disciplinary data collection mechanism to document the crop diversity of the region. He states that the information we have on Ethiopia before the 1930s was based on isolated reports of explorers' and travelers' accounts. He encourages the phyto-geography of Ethiopia to be documented and address the advantages of altitudinal ranges in crop diversity, climate, ecology, and soil formation processes (Cifferri 1939). Some of the early works of Ciferri were in the Italian language and dealt with the indigenous crops of the region and the introduced wheat plant including; *Il Neuch o Guizotia dell'Africa*

*Orientale Italiana* (1942) (to mean Noog, *Guizotia abyssinica* in Italian East Africa), *Frumenti e Grani coltura Indigena in Etiopia* (1939) (Indigenous wheat and grain farming in Ethiopia), *L'Istituzione del "Triticum abyssinicum" per i Frumenti Indigeni d'Etiopia* (1943) (*Triticum abyssinicum* as indigenous wheat in Ethiopia). One of the earliest studies on Sorghum by the Italian agronomist include, *I Sorghi o "Durre" dell'Africa Orientale Italiana* (1942) (The Sorghum or "Durre" of Italian East Africa) and *La cereali coltura in Africa Orientale: Generali botanico-agraria su isorghi* (1942) (Cereal cultivation in East Africa: botanical-agricultural summary on sorghum).

Themes included in this article within the scope of archaeobotanical research include phytogeography, landraces, wood charcoal, and the study of archaeological seeds and fruit stones. One of the most important focuses and common applications of archaeobotanical research is to understand the beginning of agriculture; transition from hunting and gathering lifestyle to food production; and understand and document the evolutionary processes of crops from cultivation to domestication. It is also in the methodological range of archaeobotanical research to reconstruct past environment, change and continuity in the environmental record, vegetation composition and distribution, and the like.

This article will focus on compiling and reviewing previous and ongoing studies that produced data by directly recovering botanical remains from archaeological sites. Sites previously known as "Neolithic" in relation to addressing the beginning of agriculture by recovering microlithic tools, potsherds, grinding stones, and granaries without recovering and analyzing seeds, fruit stones, and charcoals are not included in this study.

The need for a synthesis work on archaeobotanical research in Ethiopia arises from several reasons. These include observation of the regional distribution of archaeobotanical research, study methods used, and asses the data gathered so far in understanding the economic and environmental history of the regions, to understand the status of archaeobotanical research in Ethiopia and compare this with other areas in Africa and the Middle East, to outline and evaluate spatial and temporal gaps in the study of botanical remains from archaeological sites and forward recommendations about future trends. Besides the stated reasons, this work will introduce some important and detailed studies in anthracology and macro botany of seeds and fruit stones

undertaken by graduate program students that were not easily accessible to the scientific community.

## The Study Area and Geographic Scope

Ethiopia is geographically positioned in the Horn of Africa with proximity to the Arabian Peninsula. It is bordered by Eritrea in the north, Sudan in the northwest, South Sudan in the southwest, Kenya in the south, Djibouti in the east, and the Republic of Somalia in the southeast. The Great East African Rift Valley, which starts in Syria, crosses the country into two running from the northeast to the Southwest. The country possesses land masses with altitudinal ranges that span from below sea level (110 meters below sea level at Dallol, Afar) to as high as 4650 meters at Ras Dejen, the Semen Mountain chains. The range in elevation has created a unique platform for a variety of crop plants to grow in different altitudinal ranges. Lowland crops, mid-elevation crops, and highland-adapted crops grow with local variants of landraces (Fattovich 1996; Beldados 2012). This is basically why the Ethiopian highlands are seen as an "area of origin for early agriculture" (Vavolov 1951; 1957) and later as a "center of diversity" or as a "secondary center for the origin of agriculture" (Harlan 1971). The study areas covered in this review are selected for the presence of archaeobotanical research and reports within their geographic scope. Accordingly, in this study, four regions cover the majority of the land mass of Ethiopia. These are the Northern, North Central, Southern, and Eastern regions. In the study of each region, maps are provided to indicate specific areas of the sites discussed in the text.

## Northern Ethiopia

One of the earliest attempts to recover botanical samples from archaeological excavation was the report of the recovery of finger millet (*Eleusine coracana*), indigenous crop to the northern highlands, from the site of Gobedra. The site is located some five kilometers from the main stellae field of Aksum, a quarry area for Aksumite obelisks. Phillipson (1977) excavated a rock shelter in Gobedra where he reported an uncarbonized/uncharred finger millet. The millet seed was first attributed to a radiometric chronological context dated to 5180 B.C.±165. Later, however, the seed was re-examined to be intrusive and suggested to a context much younger than this date.

In Bieta Giyorgis hill, Aksum Archaeological survey and excavation were undertaken in the 1997 field Season. The Archaeological Mission was jointly run by Boston University (B.U.) and Oriental University of Naples by joint

leadership of Kathryn A. Bard and Rodolfo Fattovich. The archaeobotanical study of the 1996 and 1997 field season's excavated soil was undertaken by Catherine D'Andrea, Simon Fraser University, Canada. Flotation and screening of the samples gave emmer wheat, free-threshing grape, wheat, barley, teff, flax and legumes. In terms of chronological context, a grain of wheat was recovered dated to Middle Aksumite (ca. A.D. 500- 700) and three chaff remains of emmer wheat (*Triticumdicoccum*) were retrieved at Ona Nagast, dated to and Proto- to Early Aksumite times (90-70 B.C.). Two grains of free-threshing wheat (*Triticum durum/aestivum*) were identified from the site of Ona Nagast, which are dated to Early-Middle Aksumite period (ca. A.D. 400-500).Four pieces of hulled barley (Hordeum vulgare) were recoveredat the same site, and date to Middle Aksumite and Late-Post-Aksumite (after A.D. 700). The teff grain (*Eragrostis teff*) identified from Ona Nagast was dated to the end of the Early Aksumite period (ca. A.D. 350-380). The three flax seeds (*Linum usitatissimum*) from OnaNagast were dated Early to Middle Aksumite and Middle Aksumite phases. One piece of lentil (*Lens culinaris*) and domesticated grape seed (*Vitis vulgare*) were also dated to Middle Aksumite times. Weeds like clover, darnel, canary grass, dock, amaranth, and Chenopodium were also retried from the Middle Aksumite Context of OnaNagast (Bard and Fattovich 1997; D'Andrea 2008).

Sheila Boardman (2000) reported a total of 1057 charred plant remains belonging to the Pre-Aksumite period. A total of 29 separate contexts were sampled from four trenches D-13, D-23, D-19, and D-22. The identified botanical remains were categorized as cereals, legumes, oil and fiber crops and wild seeds and fruits. Accordingly, from D-13 trench the identified cereals include barley (*Hordeum* sp.), Emer (*Triticum dicoccum*), and wheat (*Triticum* sp.). From legumes, only *Vicieoe* and from oil and fiber crops flax (*Linum usitatissimum*) was reported. Under the last category, wild seeds and fruits, the identified botanical remains include Brassicaceae, Chenopodiacea/ Amaronthaceae, Compositae, Labiatae and, *Rumex* sp.

From the D-23 trench cereals that were identified were barley (*Hordeum* sp.), Emer (*Triticumdicoccum*), wheat and (*Triticum* sp.), wild seeds and fruits Brassicaceae, Fabaceae, Poaceae and Solanceae. The third trench investigated was D-19, which provided the following cereals; Teff (*Eragrastistef*), teff (*Eragrostis* cf. tef), barley (*Hordeum vulgare*), barley (*Hordeum* sp), Emmer (*Triticum dicoccum*) and Wheat (*Triticum* sp.). In the legumes category Lentil (*Lens culinaris*); and from the oil and fiber crop noog (*Guizotia abyssinica*);

Flax (*Linum usitatissimum*) and from wild seeds and fruits Fabaceae, Poaceae, Solanceae and Umbelliferae.

The most productive trench was D-22 which rendered Oat (*Avena* sp.), Teff (*Eragrastistef*), *tef* (E. cf. *tef*), barley (*Hordeum vulgare*), barley (*Hordeum* sp), Emmer (*Triticum dicoccum*) and Wheat (*Triticum* sp.). From Legumes;Lentil (*Lens culinaris*), and *Vicieae*, oil and fiber crops Noog (*Guizotiaabyssinica*), and Flax (*Linumusitatissimum*) and wild seeds and fruits Brossicaceae, Chenapodiaceae/Amaronthaceae, Compositae,Fabaceae,*Galium* sp., *Poaceae*; Polygonaceae; Rubiaceae; *Rumex*sp., Solanceae, *Trifolium* sp., and Umbelliferae. Direct dates on wheat and barley from the D-site (Kidane Mehret) provided 2485 ± 40; 2430 ± 50; 2190 ± 50 C-14 years and this is calibrated to be 773 - 112 years BC.

Late Aksumite period deposits were retrieved from D-16, D-19 and D-22 trenches. From these three trenches, the phases categorized as Late Aksumite are 4-13. 85 contexts were sampled and a total of 8024 botanical remains were recovered. Cereals identified from phase 4-13 were Oat (*Avena* sp.), Finger millet (*Eleusine coracana*), Teff (*Eragrostistef*), teff (E. cf. *tef*), Barley (Hordeum vulgare), Barley (*Hordeum* sp.), Sorghum (*Sorghum* sp.), Emmer (*Triticum dicoccum*), Bread wheat (*Triticumaestivum*), and Wheat (*Triticum* sp.).The identified legumes include Chickpea (*Cicerarietinum*), Grass pea (*Lathyrus sativus*), Lentil (*Lens culinaris*), Pea (*Pisum* sp.), Faba bean (*Viciafaba*) and Vicieae.

Oil and fiber crops recovered were Noog (*Guizotia abyssinica*), Flax (*Linum usitatissimum*) Cotton (*Gossypium* sp.) and Wild seeds and fruits; Brassicaceae, Caryophyllaceae, Chenopodiaceae/ Amaranthaceae, Compositae, Convolvulaceae, *Cordiaafricana*, Cyperaceae, Fabaceae, *Galium* sp., Labiatae, *Lepidum* sp., Malvaceae, *Mendicago* sp. *Plantago* sp., Poaceae, Polygonaceae, Resedaceae, Rubiaceae, *Rumex* sp., Solanceae, Umbelliferae, and *Verbena* sp. The largest proportion of the identification belongs to those fragments that are generally grouped as Poaceae.

Apart from macro seed remains wood charcoal were also investigated by Rowena Gale, from the D-site excavation in Aksum, as reported in Boardman (2000). Through the identification of the taxa, the prevailing vegetation composition was partially described. The study of the charcoal fragments indicated that *Aconkanthera*, *Combretum*, *Ficus* and *Olea* grew during the Pre-Aksumite period. Excluding *Combretum*, the rest three are currently growing

in the DAF (Dry afromontane forest) with an altitudinal range of between 2200 and 3200m. The DAF currently growing in the northwestern Ethiopian highlands are dominated by *Juniperus* and *Olea* and are considered as indigenous to the region (Friis and Demsew 2011). The late Aksumite charcoal sampleswere identified as *Aconkanthera*, *Rhus* type, *Ficus*, *Maesa* type, Ilex mitis type and *Pittosporum* type. These are also part of the Dry afromontane forest.

To investigate changes in vegetation, climate, land useand land cover, Gebru et al., (2009) studied buried charcoal and calculated the percentage of organic carbon from C-4 plants. Samples were taken from northeastern and central eastern parts of plateau. The specific localities from which the samples were taken include Adi Kolen (2171 m.a.s.l), Mai Maikden (2228m), and Adigrat (2493m). The charcoal retrieved from the soil samples was dated between 13,700 to 110 cal yrsBP. The result of the study indicated that *Juniperus procera* was present continuously, starting from the oldest samples to the youngest samples. It was also observed that the percentage of *Juniperus* assemblages was getting smaller in the younger assemblages. Though not a dominant vegetation type, *Juniperus* forest has been there in the highlands of the Tigray plateau at an elevation of above 2200m. Apart from *Juniperus procera*, the other identified charcoal taxa include *Podocarpus falcatus*, *Acacia abyssinica*, *Hygenia abyssinica*, *Allophyllus abyssinicus*, *Erythrin abrucei*, *Croton macrostachyus*, *Olea europaea* subsp. *Cuspidate* and *Ficus sur*. However, in this publication, the specific genus/species level identification of the charcoal fragment in the absence of comparative collections is questionable. It is particularly challenging in identifying the anatomical features of the two gymnosperm genera; *Juniperus* and *Podocarpus*.

With the objective of reconstructing ancient subsistence bases and study agricultural history of East Tigray, archaeobotanical investigations were conducted by analyzing excavated soil from the site of Mezber. This study was conducted within the framework of the East Tigray Archaeological Research Project led by Catherine D'Andrea. The soil samples were collected from nearly every unit level excavated over a period of five years of field seasons, 2009-2013. In the presence of secure stratigraphy each unit level in the excavation is measured 10 cms. The size of the soil samples ranges between 1.8 to 7.8 liter. From some unit levels with abundant artifacts, charcoals and some other unique features, duplicate soil samples were taken. From all period of the occupational sequence, 157 contexts were sampled for

flotation. The soil samples were processed using a locally arranged flotation apparatus and light fractions were recovered from a 250 microns mesh screen (Beldados, D'Andrea and Manzo 2015; D'Andrea et al., 2023).

A total of 3265 macrobotanical remains were collected from the light fractions. The preservation of the botanical remains from most of the contexts appeared to be excellent. The identified taxa include *Hordeum vulgare*, *Triticcum dicoccon, Lens culinaris, Linum usitatissimum, Eragrostis* cf. *tef, and Eleusine* type. Among these, the share of the two crops of African origin, *Eragrostis* cf. *tef*,and *Eleusine* cf. *coracana* is minimal. *Eragrostis*, *Phalaris* ,*Lolium*, *Echinocloa* and *Setaria* were among the remains identified as genera. Significant proportions of the recovered remains were also classified under family; Poaceae, Malvaceae, Astraceae and Paniceae. The largest share of the recovered botanical remains goes to Poaceae family. Poaceae seeds are recovered from all of the occupational phases of Mezber (D'Andrea et al., 2023; Beldados et al., 2023; Ruiz-Giralt et al., 2023).

The Mezber macro-botanical evidence dated from the 2nd to early 1st millennium BCE represents one of the earliest records today for the presence of agriculture in the highlands of the Horn of Africa by 1600-900 BCE. The AMS dates from barley and lentil provided 2780±30 and 2810±30 respectively, which further confirmed the persistent presence of Near Eastern crops in the ancient diet of the inhabitants (Beldados, D'Andrea, and Manzo 2015; Beldados et al., 2023).

Meresa (2017) undertook archaeobotanical investigations at the site of Ona Adi in Eastern Tigray on samples collected between the 2013-15 field seasons in connection with the Eastern Tigray Archaeological Project (ETAP). Occupation of the site spans the Pre-Aksumite to Aksumite transition and the following Aksumite period (ca. 400 BCE-CE700). The main objective of the study was to examine the agricultural economy in Eastern Tigray (Gulo Makeda) during the Late Pre-Aksumite period and its subsequent development during the Pre-Aksumite to Aksumite transition (PA-A) and Late Aksumite times. Recovered macrobotanical remains include *Hordeum vulgare* (hulled barley), *Triticum durum*/*aestivum* (free-threshing wheat), *Lens culinaris* (lentil), *Linum usitatissimum* (linseed), *Guizotia abyssinica* (noog), and wild/weedy plants including *Lolium* sp., *Galium spurium*, *Chenopodium* cf. *album* and *Rumex* cf. *crispus*. Results indicate that plants of both African and Near Eastern origin were present in the region from the mid-8th century BCE to 7/8th century CE. The study has also indicated that Late Pre-Aksumite

farmers had adapted Near Eastern crops which appear to have dominated the agricultural systems.

Anthracological study on wood charcoal samples from two archaeological sites in Tigray Regional State of north Ethiopia was undertaken for the purpose of understandinghuman-woodland interactions during the Pre-Aksumite and Aksumite periods. The two sites investigated were the Pre-Aksumite rural site of Mezber (ca.1600 BCE-1CE) and Ona Adi Urban Settlement occupied from the Late Aksumite period to the end of the Aksumite Kingdom (ca.600 BCE-700CE). 2,708 charcoal pieces were investigated and Twenty-three types of taxa were sorted, of which 21 belong to angiosperms and the remaining 2 were gymnosperms. Identification of the charcoal pieces include Acacia spp., *Carissa* spp., cf. *Boscia* spp., *Croton* spp., *Dodonaea gustifolia*, *Hagenia abyssinica*, *Juniperus procera* , *Maerua* spp., *Maytenus* spp., *Nuxia* spp., *Olea* spp., *Pittosporum* spp., *Podocarpus falcatus* Soft, *Rhamnus* spp., *Rhus* spp., Rubiaceae cf. Ixoroideae and *Ziziphus* spp. The study indicated that there is similarity on the environmental condition between Pre-Aksumite and Aksumite transition and the present time. It was also suggested that there was depletion of the landscape during the early to mid-millennium BCE as a result of anthropogenic impact and regeneration of the forest as of ca.1500 years. Distinction in fire use usage between the rural center of Mezber and the Ona-Adi urban settlement area was also deciphered (Giralt et al., 2021).


Map 1. Map of the main sites mentioned in this article in the Northern Region (Beldados et al., 2023).

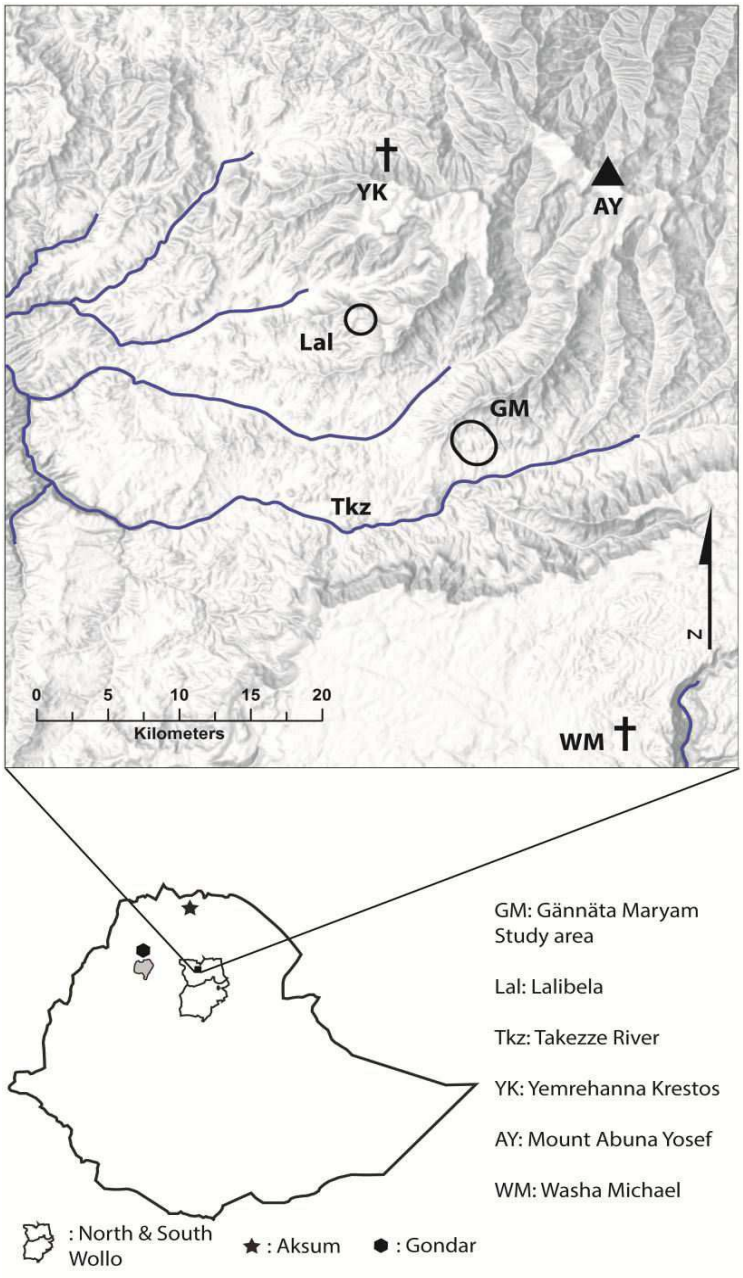
## North Central

In Lalibela and Natchabiet caves, in what is historically known as Begemeder province, Dombrowski (1971) excavated two caves intending to test a hypothesis which states "Ethiopia played a major role in the introduction of domesticated plants into the hinterland of Africa." This hypothesis was postulated because the country is situated in a geographic interface between African and near eastern crops. The excavated caves were located some five kilometers to the northeast of Hamusit, Begemeder/Gonder. Hamusit is a small town located some 35 kilometers north of Bahir Dar (capital city of Amhara Regional State) on the Bahir Dar-Gonder Road.

The study exposed cultural chronology ranging from 500 B.C. to the present time. The chronology/sequences were classified into phases and strata. In phase-I, according to the archaeological record, the subsistence patterns were on the basis of domesticated plants, like as barley and chick pea (legumes). In

the bottom layer of phase-I, which yielded a radio-carbon date of 520 B.C, the suggested economic livelihood was partly based on barley, chickpea, some legumes, and wild grasses together with percussion-flaked tools, probably used for cultivation purposes, like as scrapers, microlith lunates, backed blades, burins and adze bits. From the same context wild animals; different types of bovids, warthogs, and primates were also recovered. Despite the desire to test the hypothesis on which period of time did Ethiopia played a transitional role in the domestication of plants to the rest of Africa, the radio-carbon dates could not pass, the 500 B.C boundary. The research, however, indicated that near eastern crops and domestic cattle were present around Lake Tana as of the specified period.

The Solomonic-Zagwe encounter project (SolZag) under the Directorship of Tania Tribe (University of London, School of African and Oriental Studies, SOAS) has been undertaking archaeological researches in the medieval historic city of Lalibella and the surrounding areas of Amhara Regional State, north Ethiopia. One of its research objectives over the past two years was understanding food systems, the evolution of early agriculture and environmental contexts. Archaeobotanical investigations from excavated soil samples and ethnoarchaeological studies were the methodological bases in this study. The sites investigated are the Christian settlement areas of Yemrehane Kerestos, Gennete Mariyam and Washa Michael. Soil samples from excavations were floated to recover botanical remains. The recovered botanical remains were taxonomically classified into their family, genus and species levels. From the site of Gennete Mariam in particular, about 160 meters to the northwest of the Rock-hewn church excavation was undertaken and the soil from it was floated.The light fractions examined under a microscope provided a total of 624 carbonized and desiccated botanical remains. Out of these 570 were identifiable and the remaining 54 either belong to *Gramineae* (grass family) or difficult to identify. Identification include *Triticcum monococcum/dicoccum* (wheat), *Lolium* sp. (weed of cereals), *Hordeum* cf. *Vulgare* (barley), *Poaceae*, *Lens culinaris* (lentils), *Linum usitatissimum* (flax), *Setaria sp*. (millet variety), *Cicerarientium* (chick pea), *Ricinus communis* (castor bean), *Eragrostis* sp., *Chenopodium* cf. *Album*, *Podocarpus* cf. *falcatus* (*Zigba,* Amh.). The study indicated that the medieval inhabitants of Lalibella and the surroundings were using more Middle Eastern crops like wheat, barley, lentils rather than their own indigenously cultivated and domesticated crops (Firie 2023).




Map 2. Location map of most of the sites mentioned in the Central Region (after Clark 2015)

**Eastern Ethiopia**

Edengenet Zewdu (2017) compared macro botanical data from archaeological sites with environmental data from lake sediments. The soil samples for the archaeobotanical study were taken from three test excavation trenches in the Dire Dawa and Harari region of eastern Ethiopia. The samples were collected in the 2015 field season, by the project "Becoming Muslim: Conversion to Islam and Islamisation in Eastern Ethiopia", under the directorship of Timothy Insoll. The analyses of the findings indicate that the Dire Dawa archaeological sites are associated with the Harlaa culture (Insoll et al., 2016). Within a dated time framework of 12$^{th}$ to 14$^{th}$ centuries, a total of 169 plant remains (seeds and fruit stones) have been recovered out from 38 liters of soil samples. The identification of the macrobotanical remains include mix of woody plants, cereals and weeds; *Acacia nilotica, Adansonia digitata, Cordia cf. Africana, Poaceae, Oxalis stricta, Chenompodium album, and Amaranthaceae* family.

The lake sediment core was pulled from Lake Alemaya. It is a highland lake formed by marine transgression during the Mesozoic era (Lemma, 2003). It is situated near to Harari and Dire Dawa regions, on the shoulder of the rift valley. To understand the migration of hominids out of Africa, the lake was drilled by a research team of the CRC-806 "Our Way to Europe". The sites were selected due to its geographic proximity to finding fossil remains of anatomically modern humans (AMH). The lake core has a depth of 460 cm. The Carbon-nitrogen (C/N) composition of the core sediment was analyzed for the presence and the origin of organic material in the sediment. According to his study, there was a sudden increase of the nitrogen content around 30 cm depth which corresponds to low carbon presence. The high nitrogen signature can be understood by an increased erosion and input of organic material from agricultural settlement areas in nearby the lake. Employing fertilization in the soils might be the reason for the high nitrogen content. According to the radiocarbon dates, the 30 to 60 cms core sediment corresponds to the twelfth to fourteenth centuries in the cultural chronology. The sediments of the youngest phase of the Lake Alemaya core sediment demonstrated dry climatic conditions and indicated an increasing anthropogenic impact. The above two factors may have contributed to the deposition of sediments in the lake (Zewdu 2017).

The same project, "Becoming Muslim: Conversion to Islam and Islamisation in Eastern Ethiopia" make possible the production of another elaborated archaeobotanical research. Endris Hussien (2020), together with team members of the project, studied soil samples that were annually excavated

between the years 2016-2020. From the five-year excavation, a total of 230.04 liters of soil samples were floated. The goals of the study were to reconstruct the subsistence economy of the medieval inhabitants of the area, documenting the diversity and distribution of the vegetation, and understand the environmental history of the region. More than 718 macro botanical remains were recovered and were categorized as cereals, legumes, oil plants, weedy plants, and woody plants (Beldados *et al*., in Press).

The identified cereal crops include *H. vulgare*, *T. monococcum*, *T. dicoccum*, Genus *Hordeum* sp., *Triticum* sp., *Lolium* sp. and Sorghum sp.; and Legumes were represented by *L. culinaris*, C. *arietinum*,*P. abyssinicum* and *T. foenum*. Among the Oil plants *L. usitatissimum*, Families like Linaceae and Astraceae were recovered and in the weedy plants category *Lolium*, *Chenopodium*, *Persicaria* and *Carex* were identified. *A. moschatus*, *C. africana*, *C. macrostachyus*, *A. nilotica* and *A. digitata* were in the woody species list. The finding indicates that the historic Harlaa peoples had developed a well-specialized agricultural system from the mid-6$^{th}$ to early 15$^{th}$ centuries AD. The Archaeobotanical evidence from Harla suggests that the food crops identified are basically Middle Eastern, and are similar to the food crops that were under cultivation in the highlands of northern Ethiopia during the same period of time (Hussein 2020; see also Beldados *et al*., forthcoming).

Tarekegn (2021) studied anthracological remains excavated from four archaeological sites located in the Bale Mountains; Fincha Habera, Simbero, Fish Shelter and Marano. The archaeological trenches were all undertaken in caves and rock shelters. The samples were collected from the early Late stone age occupation phase to the early arrival of pastorals in the Bale Mountains (46.5 ka-1.2 ka). The study had the following goals to address: to reconstruct firewood collection in the region, understand the vegetation history of the mountain chains, to shed new light on the poorly understood environmental conditions during human occupation phases in the Bale Mountains, and to explain possible interactions between past humans and their environment in an African high-altitude ecozone. The Bale mountains possess one of the largest afro-alpine vegetation in Africa and as of recently, it is also known for providing the earliest evidence for human high altitude settlement, above 3200masl, during the last East African Glacial Maximum (42 to 28 ka) (Gotz et al 2019; Groos et al., 2021).

The analysis was conducted on a total of 485 charcoal macro-remains, from which, a total of 328 were identified into taxa and seven different plant species were recorded. The recorded taxa include *Erica arborea*, *Myrsine*type, genus

*Solanum*, *Artemisia cf. afra*, *Hageniacf. abyssinica*, *Hypericum* type, *Juniperus* type, *Rubiaceae* types dominated by *Pentasschimperiana*. The recovered taxa are associated with afromontane and dry afromontane forests. Based on ethnobotanical documentation, the study further asserted that the two varieties of Erica available presently in the Bale Mountains, *Erica arborea* and *Erica Trimmera*, are best selected for firewood. Erica was probably, the best source of fire for the mountain dwellers since the Terminal Pleistocene (14,600 years cal BP) as indicated through radiocarbon dates. According to the archaeological record, the distribution of similar taxa continued in subsequent periods and across the sampled four localities; in Simbero LSA I – 14.6 ka, LSA II – 8.1-5.0 ka, LSA III – 3.6-2.2 ka; in Fish Shelter LSA – 14.8-14.0 ka, LSA – 6.5-6.3 ka; Marano LSA/late Holocene – 4.7-2.6 ka and Late Pastoral – ca. 1.2 ka. (Tefera 2021).


Map 3. Eastern Region of Ethiopia (Adapted from Insoll et al., 2021)

**Southern Ethiopia**

Hildebrand *et al*. (2010), under their Kaffa Archaeological Project (2004-2006) excavated ten rock shelters and caves to understand the Holocene archaeology of Kaffa area and the South Ethiopian region. From the Kumali

cave excavation, with a preliminary identification of the botanical remains, the researchers reported leaves of Musaceae (though not yet confirmed whether or not wild or domestic *Enseteventricosum*, (enset) or domestic *Musa* (banana)). Kumali also provided two partial seeds of *Coffea arabica*, in a context dated back to about 1,740 BP.

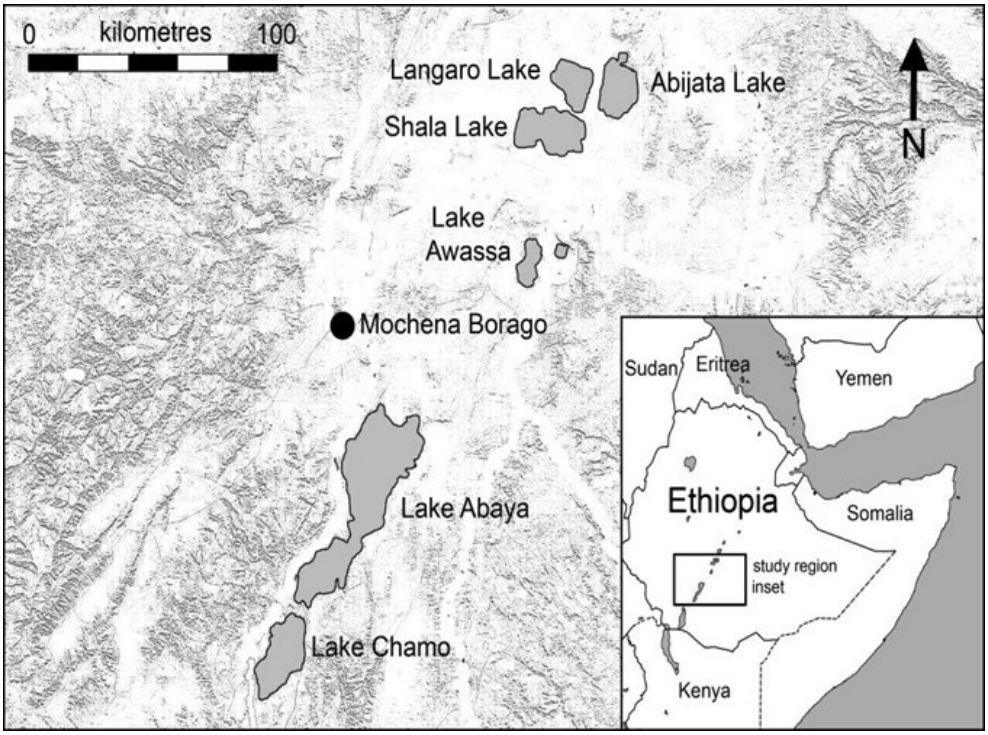
The Gamo Highlands of southern Ethiopia possesses different elevation ranging from 1,200m along the Rift Valley lakes of Abaya and Chamo to 4,000 m at the top of mountains to the south of Arbaminch. A research team led by Kathryn Arthur and John Arthur have undertaken field surveys for three consecutive field seasons between 2007 and 2012, and excavated three caves—*Mota*, *Tuwatey*, and *Gulo*—located at an average elevation of 2,084 m above sea level in the cool and moist BoredaGamo Highlands (Arthur 2014; Arthur *et al*., 2019). The cultural deposits in these caves date from the Middle to Late Holocene (ca. 6000 to 100 BP). The findings include artefacts, animal, plant, and human skeletal remains. Mota, Tuwatey, and Gulo caves are geographically positioned in columnar basalt formations behind waterfalls, which flow over and in front of them. Soil samples from the excavations were floated to recover botanical remains. Accordingly, the macrobotanical finds from Mota Cave include *Hordeum vulgare*, Parenchyma fragments (tubers), indeterminate seed/fragment, and indeterminate legume. Tuwatey cave flotations of soil samples provided *Hordeum* sp., Wheat cf. *Triticum* Grain fragment, *Sorghum* sp., Finger millet (*Eleusine coracana*), Cotton (*Gossypium* sp.), cf. *Rhamnus* sp. and Parenchyma tissue/tuber (Arthur *et al*., 2019).

Tamrat (2016) has undertaken archaeobotanical study on soil samples collected from 29 contexts from excavations of the rock shelter site of MochenaBorago, in Damote Mountain chains, in Wolayita, Southern Ethiopia. Damot mountain chain is geographically positioned between the lowland Rift Valley and Lakes Region to the East and Southeast and the southwestern Ethiopian highlands to the west. The Rock Shelter site of Mochena Borago is about 4 kilometers to the northwest of the city of Soddo. The samples studied were radiometrically dated between the mid to late Holocene. The main goals of the study were to reconstruct the subsistence patterns of the ancient inhabitants of the Rock Shelter, the history of early agriculture and to understand the local ecology during the Mid-late Holocene period. The AMS radiocarbon date from charcoal provided 2180±45 BP (485-55 cal. BC) for the earlier deposits. Samples from the later deposit were dated 1480± 60 BP (447-662 cal. AD). The investigated samples were formerly collected by the French Archaeological Mission in 2000 and 2001 field seasons (Gutherz et al., 2000).

A total of 112 seeds and fruit stones were identified which include *Sapindaceae* cf. *Deinbollia*type, *Myrtaceae* cf. *Syzigiumguineense* type *Plectranthusedulis*,*Euphorbiaceae Croton* sp., 2 *Cordia cf.africana*, Ebenaceae cf. *Diospyros*, *Oleaeuropea ssp.africana*. *Plectranthusedulis*, in particular, is an indigenous crop for the study area. According to the ethnobotanic and ethnoarchaeological field study conducted in the area, Plecthranthusedulis (locally known as Wolayita dinch/Wolayita potato) is part of the staple food for the local inhabitants. The identified woody plant varieties belong to the afro montane and dry afro montane forests, according to the vegetation classification by Friis and Demesew (2011). At present the major part of the natural vegetation of the Damota complex possesses the same forest population (Beldados and Tamrat 2020).

Macrobotanical, anthracological, and ethnoarcheological investigation was undertaken using research fund provided by Addis Ababa University Thematic Research Grant, of the year 2020. The field research was conducted in 2020 and 2021 field seasons in Konso Zone, southern Ethiopia. The Konso Zone is situated some 570 kilometers south of Addis Ababa on a plateau that blocks the northeast-southwest extension of the Rift Valleysystem. Thegoals of the research were set to reconstruct the human-plant interactions and understand the pathways for the beginning of early food production in the region. Trench excavations were undertaken in Koy-koyo Cave site (temporary refugee area for the local people in times of conflicts and wars) and Sohaito site (an abandoned agricultural field). The excavated soil samples from both sites were floated separately and a total of 0.676g of light fractions were sorted. 127 charcoal fragments (from Koy-koyo Cave); 909 botanical remains (from Sohaito site) and a totalof 1036 botanical remains were analyzed (Alemu 2022).

The Koy-koyo Cave is dated to 704 AD to 950 AD (As per the C-14 date, 1235±30 BP and 1195±30 BP, indicating that the cave was inhabited for some 8 to 9 hundred years) and out of the 127 charcoal fragments, 14 remain unidentified, while the remaining 113 fragments are identified as: *Acacia* (type 1 & 2), *Balanites Sp. Aegyptiaca, Cf. Maerua Sp., Canthium Sp.* and *Cf. Euphorbia*; the 909 botanical remains from Sohaito were identified as: *Chenopodiumpumilio type, Chenopodium cf. hybridum, Chenopodiumvulvaria type, Thalictrum type aquigiifolium, Camelinacf. sativa, Setariapumila, Amaranthusstandleyanus, Ziziphus cf. mucronata, Carexmuricata, Lens culinaris, Beta vulgaris* and *Moringa cf. stenopetala.*




Map 4. Location of the Southern Region of Ethiopia (adapted from Lesur et al., 2007)

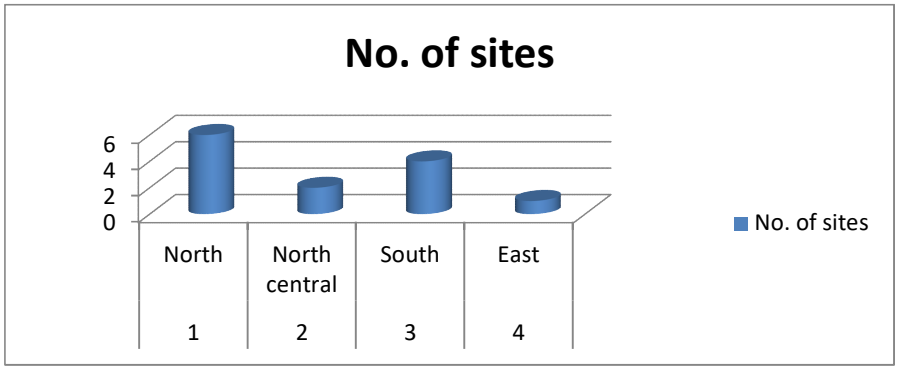
## Discussion and Conclusion: Understanding the Current State of Archaeobotanical Research

Thirteen Sites in total provided direct data on botanical remains for reconstruction of past human-plant interaction, the onset and development of early agriculture and subsequent developments, fire use history, past environment, vegetation distribution and on research themes which are in one way or another related to these objectives. In a country like Ethiopia, which is at the center of theoretical discourse ever since the 1920s, the available data is very far from sufficient. Based on the state of archaeobotanical research documented in the various regions of the country, we are not in a position even to partially understand and elucidate some crucial developments in association with human cultural and environmental/ecological evolutions. Comparing the meager data available, the region with a relatively higher number of sites is the north, possessing six sites with well-documented botanical remains from archaeological sites (see table 1 and graph 1). The Southern region has a share of four sites. The Eastern Region represented by

Harar and Dire Dawa has a share of one site. The western part of Ethiopia, which is not the subject of discussion in this paper, has no archaeobotanical study to date. In the north, in Tigray Regional State, the tradition of archaeological research and cultural heritage documentation has a longer tradition starting from the Dutche-Aksum Expedition (DAE) led by Enno-Littman in 1906 and developed further in the 1960s and 1970s by British, French and Italian research missions. The obelisks of Aksum and the cave churches in Tigray were pull factors for relatively more research in comparison with the other regions. The development of research interests in the south, on the other hand, is a recent phenomenon of the last two decades. Here, interest is triggered by the search for rock shelters and caves that can give evidence to the dispersal of hominids out of Africa and ethnoarchaeological and ethnobotanic research.

Table 1: Summary of the number of sites across regions

| No. | Regions | No. of sites |
|---|---|---|
| 1 | North | 6 |
| 2 | North central | 2 |
| 3 | South | 4 |
| 4 | East | 1 |




Graph 1. Summary of sites across regions.

The reviewed sites in this study range in time as far back as the Terminal Pleistocene (14.6 Ka) in the Bale Mountains, Eastern Ethiopia, and Adi Kolen, Mai Maikden, Adigrat (13.7 Ka) in the north and to the recently dated Harla site in the south-east (14$^{th}$ century AD). In terms of classifying the sites in geologic context, there is no record in the early Holocene (Table 2). There is

also a gap of data in post medieval period. Future studies focusing on the early Holocene will fill an important gap in the pre-history of the region. There is a tendency of concentration for most dates around the Late Holocene. This means that there is an increasing frequency of human interaction with the environment in most of the sites investigated.

Table 2. Sites discussed in this article in chronological and geologic context

| Site | Region | Dated sample type | C-14 chronology | Relative cultural chronology | Geologic Context | References |
|---|---|---|---|---|---|---|
| FinchaHabera (BM) | Southeast | Charcoal | 14.6 Ka | | Terminal pleistocene | Tafera (2023) |
| AdiKolen, Mai Maikden | North | Charcoal | 13,700 | | Terminal Pleistocene | Gebru et al., (2009) |
| Gamo highlands | South | Charred cereals/legumes | 6000-100 BP | | Mid-Late Holocene | Arthur et al., 2019 |
| Mezber | North | Charred wheat & lentil | 2780±30 2810±30 | Pre-Aksumite | Late Holocene | Beldados et al., 2023 |
| D-site (KidaneMihret) | North | Charred wheat & barley | 2485 ± 40; 2430 ± 50; 2190 ± 50 | Pre-Aksumite | Late Holocene | Boardman (2000) |
| OnaNagast (Beta Giyorgis) | North | Wheat, barley, flax, lentils | ca.AD 350-380, ca.AD 400-500, after AD 700 | Early Aksumite, Middle Aksumite, Late Akumite, Post Aksumite | Late Holocene | D'Andrea et al., 2008 |
| Lalibela &Natchabiet | North central | Wheat &lentil | 520 BC | | Late Holocene | Dombrowski (1971) |
| Ona Adi | North | Charcoal | 400 BCE-CE 700 | Aksumite/post Aksumite | Late Holocene | D'Andrea et al., 2008 |
| MochenaBorago | South | Charcoal | 2180±45/ 1480±60 | | Late Holocene | Beldados&Tamrat (2020) |
| Kumali | South | Charcoal | 1740 BP | | Late Holocene | Hildebrand et al.(2010) |
| Harla | East | Charcoal | $6^{th}$ CAD-$14^{th}$ CAD | Early medieval/ Medieval | | Endris (2021) |
| Lalibella | North central | Charcoal | $11^{th}$-$13^{th}$ CAD | Medieval | | Firie (2023) |
| Koy-koy | South | Charcoal | 1235±30-1195±30 BP | Medieval | | Amesias (2021) |

Anthracological study seems to be a recent phenomenon in the archaeobotanical study of the region. The first attempt was the work of Gebru *et al*., (2009) at Adi Kolen, Mai Maikden and Adigrat (Ruiz-Giralt *et al*., 2021). This is followed by the work of Tefera Tarekegn (2020) and Alemu (2022). In comparison with other regions of Africa, like South Africa and Egypt, Ethiopia is far behind in the study of charcoal remains from archaeological sites. The last two detailed works in anthracology was undertaken by graduate students, as part of their MA theses, in Archeology at Addis Ababa University with the collaboration of colleagues at CNRS-MNHN, France. In archaeological excavations the desire to collect charcoal remains is basically to acquire radiocarbon dates for secured chronology and obtain environmental information. The anatomical study of charcoal remains is, however, an important source of information for paleoenvironmental reconstruction and can give the necessary environmental context for human biological and cultural evolutionary studies. In the years to come, focus on anthracological study is imperative.

In the study to reconstruct ancient food systems and the history of the beginning of crop-based agriculture, one can see a similar trend of focus on introduced Middle Eastern crops like wheat, barley, and lentils. This is true in the north, north Central, south, and Eastern regions of Ethiopia. In this review work, this is observed starting from the Mid-Holocene epoch to the medieval period in Ethiopian history. It indicates a continuous preference to Middle Eastern crops during the Pre-Aksumite, Aksumite, ancient and Medieval periods. The staple indigenous crop of the highlands, *Tef* was reported only from Ona Nagast site of Beta Giyorgis, the D-site of Aksum, and the site of Mezber at Adigrat. Finger millet was recovered from the D-site and Gobedra, some 8 kilometers to the west of Aksum, and the site of Harla in the East (Endris 2021; Boardman 2000). The D-site is a domestic Occupation site on the northern outskirts of Aksum town on the right side of the road leading to the Tombs of Kaleb and Gabra Masqal and opposite the small tin-roofed shelter housing the trilingual inscription of King Ezana. Enset, the staple food plant in the Southern and Southwestern parts of the country, is only reported from Kumali site of Kaffa in the Southwest. Root crops were only represented by the identification of *Plecthrantus edulis* from Mochena Borago site of Southern Ethiopia (Tamrat 2015; Beldados and Tamrat 2020). Future research in archaeobotany and the study of early agriculture shall give us more data on indigenous crops of the region like *tef*, finger millet, pulses, enset, and geophytes, for a better understanding of their process of cultivation and domestication.

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