An Ethnoarchaeology of Animal Use in Classical Bagan, Myanmar

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Abstract

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The aim of this thesis is to explore the human/animal relationship at the walled and moated shwe myo taw, or "royal golden city," at the ancient Burmese capital of Bagan, Myanmar, which flourished from the 11th – 14th centuries CE, in the ecological area known as Myanmar's Central Dry Zone. This thesis achieves its objectives by applying an ethnoarchaeological based research strategy, examining the human/animal relationship within ten contemporary yet traditional villages, and house compounds, surrounding the remains of the ancient capital city. The traditional villages include Thae Pyin Taw, Shwe Hlaing, Zee Oo, Kon Sin Kyi, Kon Tan Gyi, Minnanthu, Hpauck Sein Pin, Thuhtaykan, East Pwa Saw, and West Pwa Saw. The premise of this thesis is that through a better understanding of the material correlates of human/animal relationships in the traditional villages of today can help settlement archaeologists interpret specific aspects of the archaeological record that may relate to these same types of relationships in the past. This study is part of the broader Integrated Socio-Ecological History for Residential Patterning, Agricultural Practices, and Water Management at the Medieval Burmese Capital of Bagan, Myanmar project (IRAW@Bagan).

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Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

This thesis explores the human/animal relationship, with emphasis on animal husbandry, at the ancient Burmese capital of Bagan, which flourished from the 11th-14th centuries CE, in the ecological area known as Myanmar's Central Dry Zone. Specifically, this thesis achieves its objectives by applying an ethnoarchaeological based research strategy to examine the human/animal relationship within ten contemporary yet still traditional villages, and house compounds, surrounding the remains of ancient Bagan's walled and moated shwe myo taw, or "royal golden city." The traditional villages include Thae Pyin Taw, Shwe Hlaing, Zee Oo, Kon Sin Kyi, Kon Tan Gyi, Minnanthu, Hpauck Sein Pin, Thutaykan, East Pwa Saw, and West Pwa Saw. The premise of this thesis is that, because there appear to be some similarities with respect to the animal species, animal uses, and material culture and architecture relating to animals, observations made in the traditional villages, and house compounds existing in the area today, may inform on the human/animal relationship in ancient Bagan. Put another way, it is believed that a better understanding of the material correlates of animal/human relationships in the traditional villages of today can help settlement archaeologist's interpret specific aspects of the archaeological record that might relate to these same types of relationships in the past.

This study is part of the broader Integrated Socio-Ecological History for Residential Patterning, Agricultural Practices, and Water Management at the Medieval Burmese Capital of Bagan, Myanmar project (IRAW@Bagan). The aim of IRAW@Bagan is to look beyond the temples and monumental architecture, which have

been documented in detail, in our effort to provide a more comprehensive understanding of what life was really like within the suburban and peri-urban (mixed urban-rural) settlement zones surrounding the remains of Old Bagan's royal epicenter (Iannone et al. 2019:2).

Research Questions

To provide structure for the thesis, the nature of the human/animal relationship will be observed in several contexts. The most significant and comprehensive observations will be based on the findings of the ethnoarchaeology-based surveys conducted in traditional house compounds in the ten study villages surrounding "Old Bagan" by IRAW@Bagan team members in 2017 and 2018. This involves assessing what can be viewed in photographs that point to material culture, or related structures, that is reflective of animals, and/or animal use. The second set of observations emanate from information collected from translations of retrospective chronicles and temple inscriptions. The written records will be augmented by consideration of temple murals and museum pieces dating to the Bagan period that have some relevance to understanding the human-animal relationship. These provide insights into the human/animal relationship closer to the time that Bagan served as the capital of the Burmese empire, which is the era of archaeological interest. The third will be a set of observations derived from zooarchaeological finds encountered by IRAW@Bagan researchers while conducting archaeological excavations at the sites of Shwe Creek and Otein Taung in 2019.

The primary research questions guiding the data collection and analysis for the thesis include:

1) What are the material correlates of human/animal relationships in traditional house compounds in the area of Old Bagan?

2) What are the material correlates of human/animal relationships in traditional villages in the area of Old Bagan?

3) What might these look like many years from now?

4) How can these be used to inform future settlement archaeology in the area encompassing the ancient capital city?

Paired with these larger questions, it is also necessary to address a series of smaller subsidiary questions. These include:

1) How are animals procured?

2) Who owns them?

3) Who is involved with their care?

4) What is involved in their care?

5) How, and for what purposes, are animals used?

6) How, and where, is animal refuse disposed?

What? Where? When?

This thesis explores the nature of the human/animal relationship in ancient Bagan. Specifically, it is concerned with what can be observed that may point to archaeologically relevant behavioral residues. Based on past visits and research, as well as photographs and notes taken by IRAW@Bagan researchers while conducting fieldwork, animals today are a relatively common presence on the Bagan plain. Not only are animals merely present, but they are seen to be working, cohabitating with humans, and contributing to many aspects of daily life, in both the contemporary context, and observed in artistic and literary representations of Bagan's past. An important aspect of these various relationships with humans are the various material components associated with animals or animal use. These can include tools that require animals to be driven, like plows, carts, or grinding devices, as well as the structures that correspond to archaeologically relevant features, such as kitchens, cowsheds, constructions relating to feeding, such as troughs, and areas for the deposition of refuse, such as manure piles.

Data for this case study was collected from ten tradition villages and house compounds surrounding the remains of the walled and moated royal epicenter of ancient Bagan, Myanmar. Also known as Pagan, Pokam, Pukam, Armaddana, and Arimaddanapura, Bagan was once the socio-economic and spiritual center of an expansive Buddhist empire which came into existence in the 11th century CE. That said, Bagan likely existed as a political entity from the 9th century to early 14th century CE (Miksic 2017:361). At its height, the Bagan empire controlled an area that bordered China to the north, Thailand to the east and south, and India to the west.

Geographically, Bagan is situated in the center of modern-day Myanmar, within the Ayeyarwady River basin. The Ayeyarwady River itself directly borders the north and west of the city, while dry, flat plains extend to the east and south (Aung-Thwin 1990:2; Hudson 2004:44). East of Bagan is the Tuyin Mountain range, and further to the east is the spiritually significant volcano Mount Popa, while to the west of the Ayeyarwady lies the Arakan Mountains (Hudson 2004:45; Moore et al. 2016:295).

Located in the center of Myanmar, Bagan sits within an ecological region known as the "Central Dry Zone," which contrasts with the wetter and more humid climate characteristic of southern Myanmar, and much of Southeast Asia (Stadtner 2005:12). The Dry Zone only sees an average of 200 mm of rainfall annually, with much of it falling during the summer monsoon, from June-September, with many water ways drying out later in the year (Aung-Thwin 1990:5; Hudson 2004:45). Despite this, the Dry Zone was, and remains, the agricultural heart of Myanmar (Aung-Thwin 1990:5).

Remnants of the geopolitical landscape of "Old Bagan" consists of two zones. The first is the epicentral zone within the old city walls of Bagan. This area was once home to the palaces, temples, and pagodas associated with the ruling royal elites of Bagan's society, occupying around 1-1.5 km² (Daw Thin Kyi 1966:180, 187; U Kan Hla 1977:21). The second zone consists of the suburban area beginning immediately outside of the city walls, and the surrounding peri-urban (mixed uran-rural) area, which is now home to nearly 3,000 brick monuments, including temples and monasteries, which stretches out over 13 x 7 km² of the Bagan plain. Today, the area beyond the city walls is home to the traditional villages of Bagan, consisting of clustered settlements surrounded by agricultural farmland (U Kan Hla 1977:21). In terms of this thesis, it is important to

note that much of the available data from past research has been focused on the monumental architecture, and elite inhabitants of Old Bagan, with little information having been generated concerning the commoner settlements and lifeways. This thesis, as part of the larger IRAW@Bagan project discussed further below, aims to contribute to the understanding of Bagan's commoner population, specifically the heterogeneous citizenry that lived in the urban zone outside of the walled and moated royal epicenter.

Given the harsh climatic conditions seen today in the Central Dry Zone, researchers have suggested that during its rise and period of florescence, Bagan may have benefited from a climatic event referred to as the "Medieval Climate Anomaly" (hereafter referred to as MCA). This period, most notably documented in Europe, saw a warming trend effect areas from the North Atlantic to Russia, lasting from approximately 900/1000 CE to 1250/1300 CE (Lieberman 2003:102). In much of Europe, this initiated a colder era with much wetter summers, creating markedly less favorable conditions for cereal crop cultivation, and growth of human population, which contrasts with the warm, relatively dry summers and autumns contributing to rapid demographic and agricultural growth in the high Middle Ages (Lieberman 2003:102). The effects of the MCA may have magnified the northern reach and intensity of Indian Ocean monsoon flows, benefitting mainland Southeast Asia. In Myanmar, the MCA seems to have contributed to higher summer rainfall, and by extension, more reliable wet-rice agriculture (Lieberman 2003:103). In Bagan, this may not only have changed the physical landscape around the ancient city, but also increased its agricultural capacity and thus positively impacted the city's growth, and the empire's expansion (Lieberman and Buckley 2012:1052). The end of this climatic event corresponds to periods of drought, reduction in agricultural yield,

and in some cases, political collapse, including the decline of Bagan as a regional capital (Aung-Thwing 1985:42-43; Lieberman and Buckley 2012:1053).

Ethnoarchaeology by IRAW@Bagan

As outlined by Iannone et al. (2022:4), initial visitations to two traditional villages situated in the vicinity of Old Bagan in 2013 suggested that examples of house lots, building materials, and rest areas indicative of those discussed in earlier ethnographies could still be found. Thus, the goal of the IRAW@Bagan project's subsequent ethnoarchaeological research in 2017 and 2018 was to explore traditional house lots and villages in order to provide some insights into what material correlates or behavioural residues might be encountered during forthcoming settlement archaeology projects, keeping in mind that significant environmental, economic, social, and political changes have occurred at Bagan over the past eight centuries.

The ten traditional villages selected for examination by IRAW@Bagan researchers during the 2017 and 2018 field seasons were chosen because they had seen limited urban build-up, largely adhered to a small-holder agrarian economy, had maintained traditional construction methods, and were situated inside what is presumed to have once been the ancient capital city's suburban and peri-urban (mixed urban-rural) zone. In other words, the villages were selected precisely because of their perceived adherence to a more "traditional" lifeway, based on the faithful passing on of key social,

economic, and ideological aspects of the culture from one generation to the next (Iannone et al. 2022:4 citing Muckle 2012:74-76).

The formal ethnoarchaeological research conducted by the IRAW@Bagan team consisted of village visitations, written and photographic record taking, semi-structured interviews with residents (using indigenous IRAW@Bagan team members as interpreters), and the measurements of relevant features such as house perimeters and house posts (Iannone et al. 2022:5). The specific goals of the ethnoarchaeological project were to obtain information relevant to the IRAW@Bagan project's interests in ancient residential patterning, agricultural practices, and the management and ritual use of water (Iannone et al. 2022:8).

Aside from the formal ethnoarchaeology research strategy, information gained through informal ethnoarchaeology – by being invited to a number of traditional village ceremonies, or simple meals – and spontaneous ethnoarchaeology, where landowners and villagers visiting IRAW@Bagan excavations and commented on findings, or during lunches at simple outdoor restaurants, greatly enhanced the IRAW@Bagan researcher's interpretations of the archaeological record.

Thesis Outline

This thesis is organized into six chapters. The following Background Chapter will provide contextual information pertaining to the environment and history of Southeast Asia, with particular focus on Myanmar. It will detail the geography, climate, hydrology,

flora, fauna, and domestic animals of both the broader region of Southeast Asia, and specifically that of Myanmar's Central Dry Zone. The historical context will look at the Protoclassic (1-600 CE), Early Classic (600-900 CE), Middle Classic (900-1200 CE), and Late Classic (1200-1400 CE) periods, examining what the archaeology and historical records of Southeast Asia tell us about the goings on through time, throughout the region, and the role Myanmar has played through this history. This chapter will also discuss what we do, and do not know, about human-animal interactions in Southeast Asia.

Chapter 3 will outline the theoretical approach for conducting ethnoarchaeological research, as well as the methodology behind this research project itself in its application of an ethnoarchaeological based research strategy to achieve its goals. This chapter will also discuss the beginnings of the ethnoarchaeological based approach within the discipline of archaeology and examine its use in interpreting the archaeological past. As part of this overview, the chapter will also explore the use of analogies in archaeology, while also discussing the strengths and weaknesses of an ethnoarchaeological based research strategy. Finally, this chapter will discuss the use of ethnoarchaeology in the current thesis.

Chapter 4 will be a presentation of the data. The primary data will come from observations of ethnoarchaeological surveys undertaken by the IRAW@Bagan project of traditional villages and house compounds, highlighting the information pertinent to the human-animal relationship, and presented in a case study format based on the ten selected traditional villages in and around the area of Old Bagan. Ancillary data will comprise information gathered from retrospective historical chronicles, and translations of temple

inscriptions. Finally, this chapter will also discuss the faunal remains recovered by the IRAW@Bagan team during their excavations at Shwe Creek and Otien Taung.

Chapter 5 will present an analysis of the data. The aim of this chapter will be to point to what is within the data that my be archaeologically relevant to the human-animal relationship observed within the traditional villages and house compounds, along with the material correlates associate with them, such as structures and tools. This chapter will also discuss what can be discerned of the human-animal relationship in Old Bagan from what is described within the retrospective historical chronicles and inscriptions, as well as what the faunal remains already recovered by the IRAW@Bagan settlement archaeologists may point to, with regards to their cultural significance, and the nature of their archaeological deposition.

Chapter 6 will conclude this thesis. It will address the research questions guiding this thesis directly with the information from the analysis of the data, discussing how the human-animal relationship as observed in the ethnoarchaeological surveys conducted of traditional villages and house compounds may inform future settlement archaeology in and around the area of Old Bagan.

Conclusion

This chapter has introduced this thesis, defining its goal as providing further insight for future settlement archaeology by applying an ethnoarchaeological based research strategy with emphasis on the human-animal relationship as observed in the

traditional villages located in and around the area of Old Bagan. It has outlined the research questions and general background information guiding this thesis, along with the goals of the IRAW@Bagan project, and its utilization of ethnoarchaeological based research. Finally, this chapter provided an overview and outline of the remaining chapters forming this thesis.

Chapter 2: Background

This chapter provides contextual background information pertaining to the environment and history of Southeast Asia, with particular focus on Myanmar. Looking at the environmental make-up of Southeast Asia, we will view the interrelations between the geography, climate cycle, and hydrological nature of the region and their overarching effects and influence on plants and animals living in the region's diverse ecosystems. However, we will also see how, in relation to the rest of Southeast Asia's environment, the arid Central Dry Zone of Myanmar differs considerably. Also considered in relation to the environment is its role in the lack of preservation of the material that could inform the Southeast Asian archaeological record, adding to the difficulties associated with retracing and interpreting the lifeways of past peoples and cultures in this part of the world. This will lead into a discussion of what we know of past Southeast Asian civilizations, and what we understand through the archaeological and historical record, with emphasis on four chronological periods ranging from the 1st century to the 14th century CE. We will also look more specifically at the social progression of Myanmar through these periods. Particularly significant for this thesis is the florescence and expansion of the ancient capital and Buddhist spiritual epicenter of Bagan from the 11th century CE to its decline and apparent collapse beginning in the late 13th, early 14th centuries. We will also look at what we do and do not know about the nature of human-animal interactions through space and time, mainly how archaeology as a discipline has provided insights concerning this realm of study. Finally, the chapter will conclude by demonstrating how, by looking at the socio-cultural landscape of Southeast Asia and

Myanmar through this lens, one can contribute to the IRAW@Bagan project, providing insights useful for its settlement archaeological investigations in Bagan's suburban and peri-urban settlement zones.

The Environment of Southeast Asia

Geography

Positioned between the Indian and Pacific Oceans to the south and east respectively and the rest of the Asian continent to the north (Chuan 2005:80), the region of Southeast Asia sits on the equatorial belt between the tropic of Cancer, latitude approximately 23°N, and the tropic of Capricorn at 23°S, with the region itself having a latitudinal extent extending between 20°N and 10°S. Within this broad latitudinal extent, Southeast Asia is separated into two sub-areas: continental (mainland) and insular (island) Southeast Asia (Chuan 2005:80).

Comprising of the countries of Myanmar, Thailand, Laos, Cambodia, and Vietnam, continental Southeast Asia connects with the rest of Asia via mountainous regions towards the northwest, including the Tibetan Plateau, eastern Himalayas, Assam in India, and Yunnan in China (Chuan 2005:80; Gupta 2005:38). From these highland regions originate multiple extensive river systems flowing from north-south or northwest-southeast, which will be discussed later. Traversing the landscape east-west, these large

river valleys are separated by plateaus or mountain chains. To the south and east, the region is demarcated by several peninsulas and partially enclosed seas, thus becoming more archipelagic (Gupta 2005:38)

Insular Southeast Asia comprises Malaysia, Singapore, Indonesia, and the Philippines. The landscape of this region is heavily influenced by geological and volcanic activity with steep volcanic slopes, intermontane basins, and flat coastal plains of varying size (Gupta 2005:38). Sitting within the Pacific Ring of Fire, most of this geological activity is observed around the arcuate insular part of the region at the margins of the Indo-Australian, Eurasian, and Philippine Sea tectonic plates (Hall 2017:335; Whelley et al. 2015:1). There are approximately 750 active or potentially active volcanoes in Southeast Asia, and of these, around 70 have erupted in the last century (Whelley et al. 2015:1, 3).

Climate

Situated within the inner/humid tropics (0°- 5° north and south of the equator), and outer/wet-dry tropics (5°- 23° north and south of the equator), Southeast Asia's climate is governed by high levels of solar radiation, translating to relatively high temperature year-round, with varying degrees of seasonal fluctuation and precipitation brought on by the monsoons (Hutterer 1985:60). The annual southwestern monsoon from May-September carries moist air from the Indian Ocean to the Southeast Asian mainland, with seasonal heating and cooling over continental Asia subsequently moving the

northeast monsoon over the region bringing dry air masses from October-June (Volker 1983:128).

Much of Southeast Asia receives around 1,500 mm of rainfall annually, with most precipitation corresponding to the onset of the monsoons (Endo et al. 2009). Annual precipitation decreases in volume and is distributed across more seasons moving away from the equator (Hutterer 1985:60). Important to note, however, in Southeast Asia's environmental history are the effects of the Little Ice Age and the preceding Medieval Climate Anomaly, from the mid 10th to early 19th centuries, on seasonal monsoon oscillations, perhaps creating a wetter environment in the past than seen in parts of Southeast Asia today (Lieberman 2003:103-108, 2011:945-947; Lieberman and Buckley 2012:1096).

Hydrology

Both climate and geography effect the hydrology of Southeast Asia. These play an important role in the precipitation regime and dictate the variability of water in the region's river systems. Five major river systems drain mainland Southeast Asia, largely from north to south: the Ayeyarwady, Salween, Chao Phraya, Mekong, and Red rivers. The Mekong is the longest river in Southeast Asia, and flows through the entirety of the mainland, over 4000 km, before flowing into the expansive Mekong Delta and discharging into the South China Sea.

Groundwater resources are equally important to the region's hydrology. Major subterranean aquifers are spread throughout the region and are used by urban and rural

communities for crop irrigation, food production, industry, and domestic purposes, accounting for a quarter of total water used (Lee et al. 2018:111). Besides its socio-economic uses, groundwater provides a valuable base flow supplying water to rivers, lakes, and wetlands.

Flora

Southeast Asia's inner/humid tropics see relatively rapid breakdown of organic matter under the influence of high temperature and humidity, making favorable conditions for nutrient leaching out of the soil (Hutterer 1985:61). Tropical soils are rich in metal oxides, poor in mineral nutrients, high in pH, and thus relatively infertile (Hutterer 1985:61). Nutrient leaching occurs more slowly in the seasonally wet-dry outer tropics, with the availability of water being the main controlling factor (Hutterer 1985:61). Southeast Asia still sees incredible floral diversity despite its relative lack of soil nutrients, with an estimated 50,000 flowering plant species across both continental and insular Southeast Asia, constituting 96% of the region's vascular plants (Middleton et al. 2019).

Southeast Asia's plant species are categorized into two broad vegetation groups, tropical-evergreen equatorial lowland forests and open monsoon zones, and tropical-deciduous forests in seasonal drought areas (Hutterer 1985:62). Rainforests are the dominant ecosystem featuring a diverse array of floral species. These are characterized by clinging or climbing *epiphytes* thriving off either parasitic or mutualistic relationships with other plants (Hutterer 1985:62), as well as many *dipterocarpaceae*, which constitute half of all tree species (Middleton et al. 2019). Decreasing forest height tends to correlate

with a decrease in floral and faunal species diversity, breaking up into open woodland, scrub forest, savannas, steppe environment, and eventually desert environments (Hutterer 1985:62).

Fauna

The Wallace line, situated between Asia and parts of Australia, acts as a faunal boundary line, formed following the last glacial maximum, with the islands of the Philippines and Indonesia acting as a transitional zone (Boomgaard 2016:33). Species of birds and reptiles diverge considerably on either side of the Wallace line, with exceptional species diversity occurring in both continental and insular Southeast Asia. Mammalian fauna on the northeastern Asian side is characterized by placental mammals, including large ungulates such as elephants, rhinos, Asiatic buffalo, deer and pigs, as well as predators like tigers and leopards (Higham and Kijngam 1982:17), while mammalian life towards Sahulland (Australia and New Guinea), the southeast side of the Wallace line, is void of large terrestrial mammals and primarily characterized by marsupials (Boomgaard 2016:33).

Species and populations of large mammalian fauna are less diverse relative to Southeast Asia's floral diversity (Hutterer 1985:63). It should be noted that knowledge of the region's biotic diversity is everchanging with new species of animals (Meijaard and Groves 2006) and plants (Middleton et al. 2019) frequently discovered and researched.

Domestic Animals of Southeast Asia

The introduction of domestic animals has had a considerable effect on Southeast Asia's natural environments. Archaeological evidence suggests dogs were the earliest domesticate in the region, common in Thailand around 4,000 BCE (Oskarsson et al. 2012:968), and quickly thereafter spreading through insular Southeast Asia around 4,000-3,000 BCE (Oskarsson et al. 2012; Sacks et al. 2013). Domestic pigs also emerged in Indonesia around this time (Oskarsson et al. 2012), with archaeological evidence of independent domestic origins found in the Mekong River basin (Larson et al. 2010:7686). Chickens were also possibly domesticated in the region, with their origin in a Southeast Asian subspecies of the Red Jungle Fowl. Genetic evidence taken from modern chickens in Southeast Asia suggest these diverged from wild populations approximately 9,500 years ago, though archaeological evidence points to chickens becoming fully domesticated around 3500 BCE (Wang et al. 2020:695).

Today, Southeast Asian domestic cattle are dominated by the zebu (*Bos indicus)*. Archaeological evidence posits the zebu's introduction into Southeast Asia around 3,500-3,000 years ago (Chen et al. 2010:5). That said, remains of cattle dated to between 4,000-2,500 years ago are more closely related to *Bos taurus*, which is more commonly found in Europe, Northern China, and the Near East (Siripan et al. 2020). Water Buffalo also show evidence of independent domestic origin, first occurring in Southeast Asia between 7,000-3,000 years ago (Zhang et al. 2020). Finally, the goats found in Cambodia and Myanmar have a different genetic lineage to other domestic goats hailing from Near Eastern ancestors, with a different wild ancestor originating in the Himalayan region (Lint et al. 2012).

The Environment of Myanmar's Dry Zone

Geography

Myanmar's land area is 676,553 km², extending north to south 2,056 km, and stretching east to west 933 km, making it the second largest country in Southeast Asia (Drury 2017:1; Kraas et al. 2017:38). Situated within the outer (5°-23°N) tropics, Myanmar's geography can be divided into five physiographic regions: the northern mountains; western ranges; eastern plateau; the central basin; and coastal lowland plains (Drury 2017:13). Nay Pyi Taw serves as the capital of seven administrative regions and seven states. The regions include Ayeyarwady, Bago, Magway, Mandalay, Sagaing, Tanintharyi, and Yangon, along with the Chin, Kachin, Kayah, Kayin, Mon, Rakhine, and Shan states (Drury 2017:1). Ultimately, the wide plains of central Myanmar and the Ayeyarwady Basin form the agricultural heartland of the country, which also comprises much of what is referred to as the Central Dry Zone (Drury 2017:13; Kraas et al. 2017:38).

The Central Dry Zone sits in an elongated sedimentological basin between latitudes 19°-23°N and longitudes 94°-96° 30'N, covering a total area of over 75,700 km². It is located within the regions of Sagaing, Mandalay, and Magway (Drury 2017:1). The Dry Zone is surrounded by large mountain ranges on three sides, with the Rakhine Yoma and Chin Hills to the west and north, and the abrupt rising of the Shan Plateau forming the eastern boundary (Drury 2017: 13). Rising in the central part of the Dry Zone, the Bago Yoma range spans 480 km north-south, dividing the basin into two

almost equal valley systems (Drury 2017:13; Kraas et al. 2017:38). The extinct volcano of Mount Popa forms a prominent local topographic feature rising 1,518 m on the otherwise flat terrain (Drury 2017:13).

Climate

The Dry Zone itself is not an administrative boundary, but a climatic geographical location defined as the area where rainfall is less than 1,000 mm per year, a result of its location within the rain shadow of the Rakhine Yoma mountains (Drury 2017:1). There are two distinct seasons in Central Myanmar, a dry season that stretches from mid-November to May, and a wet season from May to October, during which over 90% of the annual rainfall occurs (Drury 2017:14). The average number of rainy days within the Dry Zone varies though, between 30 and 52 days a year (Drury 2017:14).

With mountain ranges to the north, east, and west acting as barriers, entry of cold-air masses from Central Asia are blocked (Kraas et al. 2017:44). Rainfall comes with the south-westerly monsoons that move in from the Indian Ocean and the Bay of Bengal. Moisture precipitates over the western Rakhine Yoma, Chin Hills, and northern mountains bordering India (Drury 2017:14). Annual precipitation in these parts ranges from 2,000 mm to more than 5,000 mm (Drury 2017:14). The lee of the Rakhine Yoma and Chin Hills generate a rain shadow over Central Myanmar. This results in lower and more irregular rainfall irregular ranging from 380 to 1,500 mm annually occurring as light showers with occasional heavy downpours (Drury 2017:14). Annual averages of

precipitation in Mandalay over a 20-year period from 1991-2011 steadily increased from 837 mm from 1991-2000, to 962 mm from 2001-2011.

Levels of annual rainfall do not alone explain the "Dry Zone's" increased aridity. Other factors include high evaporation potential, low humidity, consistently high temperature, sandy and thin soil, erosional landscape, sparse vegetation, tectonically complex geology, and in some areas, scarcity of shallow groundwater, all of which, in combination give the Dry Zone its semi-arid, barren appearance.

Hydrology

Geography and climate play a critical role in the hydrology of Myanmar in general, and the Dry Zone more specifically. Connected to the eastern Himalayas and the Tibetan Plateau, Myanmar has three main river systems connected to the larger Ayeyarwady River and Ayeyarwady River Corridor. These are the Chindwin, Salween, and Sittaung rivers (Drury 2017:13). Together, the Ayeyarwady River Corridor drains 81% of surface flow in Myanmar and contains 82% of assumed groundwater resources.

The Ayeyarwady River flows south along the north south Sagaing fault line to Mandalay where it turns west, and then south to occupy the western valley. Many tributaries join with the Ayeyarwady within the Dry Zone, including the Sindewa, Thinban, Mandaing, Yin, Kadaung, Pin, Pyinma and Changmaggi chaungs, a Burmese word for a peaceful or pleasant stream, and associated drainage systems (Drury 2017:13).

The primary source of domestic water utilized by most towns comes from groundwater, with large numbers of private wells found throughout the region. These wells are also used by those with surface water as their primary supply, as much as those without (Drury 2017:8). The ratio of groundwater to surface water is likely to be considered higher in the Dry Zone, with much of Central Myanmar sitting on two major aquifers; the lower Mekong River Aquifer and the Salween River Aquifer (Drury 2017:29; Lee et al. 2018:111). Slow moving groundwater is generally free of pollution and contamination and relatively unaffected by droughts.

The Bagan plain sits within the Nyaung Oo – Kyaukpadaung hydrogeological area, forming part of the Ayeyarwady River Corridor, which is the hottest and driest part of the Dry Zone, with an average annual rainfall below 50 cm and temperatures exceeding 37.5°C during the dry season (Drury 2017:150). The intermittent watercourses are the Pyinma, Chaungmagyi, Seikkwa, Nalataw, and Yeosin chaungs which flow towards the Ayeyarwady during the wet season, causing short but intense flooding along their courses (Drury 2017:150).

Flora of the Dry Zone

The Ayeyarwady River Corridor and its tributaries are gently sloping alluvial flats that characterize the morphology of Central Myanmar. The corridor's hydrology greatly influences the soil makeup of the region, with the most fertile alluvial soils expanding along them. This, paired with varying landscapes produced through climatic cycles and

Myanmar's topography, allows for some of the most abundant floral diversity in all Southeast Asia.

Much of Myanmar's total land area is dominated by a diverse array of plant species. Land cover spatial analysis data show that 39.39% can be classified as evergreen/broadleaf forests, which mostly appear in mountainous regions, 23.96% is woody savannah, 13.78% is a mosaic of cropland and natural vegetation, and a further 9.12% is classified as mixed forest (Kraas et al. 2017:40).

Myanmar's forests are also extremely rich in their species diversity. Broadly speaking, they contain evergreen deciduous trees and are divided into three forest types determined by altitude, geography, and precipitation (Kraas et al. 2017:40). Tropical forests are primarily below 1,070 meters above sea level with subtropical forest between 1,070-2,130 meters, mainly in the Shan and Kachin states, and temperate forests above 1,830 meters in northern Myanmar (Kraas et al. 2017:40). These forests have also been the source of commercially important species for centuries such as teak and iron wood, with other plant species like padauk, in, kangyin, thitka, thitkado, thingan, thitsi (taped for lacquerware resin), and various species of pine and fir also in demand.

Drury (2017:16), provides some characteristics of the Dry Zones environment. Tree felling to provide fuel for cooking, heating, and brick making over time has resulted in its greatly denuded landscape. Serious soil erosion has also occurred over large areas, and is particularly dominant in areas of thin, sandy soil cover, forming a "badland" topography in its most intense areas. Re-forestation of these denuded areas using eucalypt (*Eucalyptus camaldulensis*) and other native trees under a re-greening policy has seen success in remedying soil erosion in many parts of the area.

Topsoil is very sandy in the watercourse areas, with small surface runoff, high percolation to the subsurface, and little retention of water in the soil's upper layers to support plant growth. During the dry season, a saline groundwater base flow commonly occurs in water courses (Drury 2017:16). Native vegetation includes several scrub plants typical of semi-arid environments. Toddy palms (palmyra) grown for tapping juices, fermenting alcoholic drinks, making sweets, and providing shade and construction material are widespread where low-salinity groundwater is near the surface, with degree of growth strongly influenced by soil type and moisture availability (Drury 2017:16). Large native trees such as tamar, tamarind, kokko, tanaung, mango, and plum are spread sparsely throughout the area. Rice, millet, bean, pulse, chilli, cotton, groundnut, maize, onion, pea, plum, sesame, sugarcane, watermelon, allspice, and sunflower form the main agricultural crops, with grazing of cattle, sheep, and goats occurring in most villages (Drury 2017:16).

Fauna of the Dry Zone

The climate, geography, hydrology, and flora of the Central Dry Zone all play an intrinsic role in the species of animals present in the ecoregion. Faunal life in the region has, however, perhaps been equally affected by human impact. Most large mammals once found here have been extirpated, with the majority of what remains now confined to protected areas (Tordoff et al. 2012). Small to medium sized animals form the primary species make-up, including deer species like barking deer, Eld's deer, and sambar deer, and medium sized predators including golden jackal, jungle cat, and on rare occasion

leopards. Also present along the course of the Ayeyarwady is the extremely rare and critically endangered Ayeyarwady River dolphin.

The natural conditions of the Central Dry Zone make it an ideal habitat for small and large reptiles, such as the Burmese python and the saltwater crocodile. The Dry Zone ecoregion also serves as an important refuge for the critically endangered Burmese Starred tortoise, named for its distinctive yellow radiating star shaped patterns on its carapace (Wikramanayake et al. 2002:420). Today, the small Minzontaung Wildlife Sanctuary harbors a globally important population of this species.

The ecoregion of the Dry Zone overlaps with the Ayeyarwady Plains Endemic Bird Area, as sections of the Ayeyarwady are key biodiversity areas important for bird species (Tordoff et al. 2012; Wikramanayake et al. 2002). This area is so named as it is home to two species near-endemic to the Central Dry Zone, the Hooded treepie, and the White-throated babbler. Overall, there are over three hundred species of birds that frequent the Dry Zone, including two rare wetland birds, the Black stork, and Woolly-necked stork.

Domestic Animals of the Dry Zone

Domestic animals found in the Central Dry Zone are largely like those found throughout the rest of Southeast Asia. However, domesticates here also posses the hardiness capable of coping with this ecoregion's extremes (Lwin et al. 2018:57). Due to the relative lack of resources within the Dry zone, it is not uncommon for households to keep multiple livestock species with the necessary investments in feeding and sheltering

them spread across species (Zaw-Win et al. 2019:644). In addition, the purpose for rearing livestock may determine the number of animals per household, whether they be for commerce, consumption, or to support agricultural activities (Zaw-Win et al. 2019:644).

The Central Dry Zone is a major hub of livestock production within Myanmar, with almost half of the total number of animals reared in the country originating in the region (Zaw-Win et al. 2019:644). Animals in the Dry Zone, as with the rest of Myanmar, are mainly reared on backyard farms where they are fed using traditional methods such as grazing common fallow fields and eating crop residue and by-products, and small livestock like chickens also scavenge throughout the village environment (Henning et al. 2007; Zaw-Win et al. 2019:644).

Ultimately, little is known about the extent of livestock production in Myanmar as a whole, though estimates from the World Organization for Animal Health from 2009 suggested a population of approximately 13 million cattle, 3 million sheep and goats, and 135 million poultry (Zaw-Win et al. 2019:644). Cattle can be reared for very diverse purposes, including, draught power for carting and agricultural use, and as a source of manure for fertilizer (Zaw-Win et al. 2019:648). Rearing cattle specifically for sale is uncommon, though not rare. Sheep and goats are more commonly sold and reared for slaughter, though both cattle and goats are also raised for milk production (Zaw-Win et al. 2019:648). Fowl are the animal most widely bred for sale as live birds, for consumption, or even sport (Zaw-Win et al. 2019:648).

Historical Context

Protoclassic Period

The "Protoclassic period" conventionally refers to the time span running from 1 CE to 600 CE in Southeast Asian history (Miksic and Goh 2018:147). The term Protoclassic is used to describe the fragmentary nature of literary or archaeological sources available from this time. We begin our discussion of Southeast Asia's past here because despite these fragmentary sources, this is also the period in which we see early state development occurring throughout the region, both continental and insular. The end of the period corresponds to the appearance of the first written sources in Southeast Asia, around 600 CE (Miksic and Goh 2017:147). This period is marked by the appropriation of iconography imported from India and marks the time during which it becomes possible to understand something of the Southeast Asian perspectives on trade, urbanization, and politics. This, however, does not correlate to a cultural inferiority/superiority among indigenous Southeast Asian cultures in becoming "Indianized", rather the opposite (Mabbett 1977:2, 13). The import of cultural influence, including both literary and iconographic symbolic devices, from India during this time, though tied to the growth of many polities, merely enriched what were already complex cultural systems that borrowed from an external Indic idiom (O'Connor 1983:28). The effects of imported "Indianized" cultural elements on indigenous Southeast Asian cultures may have stemmed from these borrowings, playing a pivotal role by providing a structure that harnessed the internal dynamics of indigenous society (Mabbett 1977; O'Connor 1983:29).

The historical sources that shed light on Protoclassic Southeast Asia were all written outside of the region. According to Miksic and Goh (2017:148), among these sources is a work by Greek cosmographer Klaudios Ptolemaios, *Geographike Hyphegesis* (Geographical Guidance) from around 150 CE. The oldest known copies of the original, however, are about 700 years old, and it is more of a guide to map making. Besides this work, however, Southeast Asia is absent from European sources written in the ensuing centuries. By comparison, during this period the Chinese began acquiring their first bits of information on the region, with their records thought to represent the only reliable foreign descriptions of Classic Southeast Asia (Miksic and Goh 2017:149).

Archaeologically, this period signifies a transition from prehistoric village sites into cities. The Funan proto-state was established during the 1st century CE in the Mekong delta, eventually growing over five centuries to influence territory that today includes modern Myanmar, Thailand, Cambodia, and Vietnam, and founding cities linked by extensive canal networks between 100-500 CE (Higham 2014:279). The marshlands of the Mekong delta lacked many of the raw materials in demand locally for exchange. This area nevertheless had two strategic advantages that allowed it to act as a nodal point between east-west exchange and the transportation of goods between routes over the Malayo-Siamese isthmus and the coastal ports of Vietnam and Southern China. It was able to control the flow of available goods via the Mekong River valley and was itself situated in an agriculturally and comparatively resource rich location (Stark 2006:149). Funan's transition into statehood has been investigated and understood within the archaeological record through excavations at Oc Eo (Manguin and Vo Si Khai 2000) and Angkor Borei (Stark et al. 1999).

In Myanmar's Central Dry Zone at this time, walled circular and rectangular settlements first appeared, with the earliest spanning from the 2nd century BCE to the 9th century CE (Moore 2007:129; Moore et al. 2016:283). These are classified as "Pyu" settlements, with the best-known being Halin, Beikthano, Maingmaw, and Sri Ksetra (Aung-Thwin 1985:19; Liberman 2003:89; Moore 2007:145). The term "Pyu" is problematic when used to refer to the ethnic or cultural background of the people who lived in much of what is Myanmar today, prior to the migration of Burmans into the area in the 9th century (Aung-Thwin 1985:17, 19; Moore 2007:129; Stargardt 2016:341). The term possibly comes from the transliteration of the term *Piao* mentioned by Chinese sources as the group of people living in Myanmar at this time (Hudson 2004:36; Moore 2007:131). It is often using outside perspectives, Chinese accounts and/or Myanmar chronicles written after the fact, through which the Pyu are historically contextualized.

The Pyu have been considered a different ethnocultural group, and all together different people from the later Burmans (Liberman 2003:89-90), and are associated with several discrete artifact types, including coins, bricks with fingermarks or inscriptions, copper plate inscriptions, and mortuary pottery (Hudson 2004:153; Moore 2007, 2008:8-9; Stargardt 2016). The presence of these artifacts in settlements containing enclosed or semi-enclosed walls, temples, and water features like water tanks, reservoirs, dikes, and moats are considered criteria for classifying them as "Pyu" sites (Stargardt 1968, 2016). Decipherment of the Pyu language at the start of the 21st century has advanced our knowledge of this group. Nevertheless, the very nature of what, or who the Pyu were, is uncertain. It remains unclear whether they were truly a separate ethnolinguistic or cultural group from their neighbors, if their populations were merely replaced by incoming

Burmans, or, as suggested by O'Connor (1995:970), they may have been the result of an integration of previously distinct agro-cultural complexes. Most archaeological artifacts used as criteria for defining the Pyu closely resemble similar examples from across much of Southeast Asia, which complicates their identification (Moore 2008:5-6). The study of the Pyu continues to raise numerous questions, among them is whether such sites as those attributed to them can be truly defined as "cities" or "urban centers", especially when there is considerable debate as to the very definition of these terms, though certainly emerging from this debate is knowledge on the process of urbanization itself (Miksic and Goh 2017:206).

By the 7th century, societies in Southeast Asia began to incorporate the imported Indic literature, iconography, and architectural style with their own to express local ideas and identity, thereby retaining their coherence and becoming more clearly defined by Indian language and artistry (Miksic and Goh 2017:147).

Early Classic

The period referred to as the Early Classic spans 600-900 CE and corresponds to the period during which the local Southeast Asian sources, both historical and archaeological, become detailed and comprehensive enough to allow researchers to rely on them in the reconstruction of their societies (Miksic and Goh 2017:228). However, outside sources such as Tang Dynasty records, Arabo-Persian sources, and Indian inscriptions, continue to contain valuable information on Southeast Asia for this period (Miksic and Goh 2017:228).

During the Early Classic Period, a few major changes began shifting the cultural dynamic of the region. Cultural groups such as Funan disappear, while groups like the Khmer appear and expand (Stark 2006). This situation has led some scholars, such as George Coedès (1968), to refer to this period as a "troubled" time that boded well for some but not others. During the Early Classic Period, the Dvaravati cultural complex appears in Thailand (Higham 2014:311; Kealhofer and Graves 2008:206, 207; Wyatt 2003:6-8), while Srivijaya, on the island of Sumatra, appears and becomes a center of Buddhism and the main link between China, India, and the Persian Gulf (Chapman 2013:37).

During the Early Classic Period in Myanmar, the sites of Tagaung and Sri Ksetra gain importance as early examples of cities in the region (Stargardt 2016). The presence of artifacts like those of the Protoclassic suggests that many of these sites were occupied during the pervious period. The sites of Tagaung and Sri Ksetra mark the transition in Myanmar from the Early Classic to the established central polity of Bagan in the Middle Classic (Hudson 2004:138; 145). Though known for their archaeological excavation and texts, information on Tagaung and Sri Ksetra remains limited, with few radiocarbon dates in addition to limited sample sizes and adequate documentation (Hudson 2004:138).

According to Miksic and Goh (2017:277), the characterization of Tagaung and Sri Ksetra as Pyu sites seems to fuel the problematic nature of the term "Pyu" itself, especially as it relates to the question of ethnicity, not only in Early Classic Myanmar, but throughout Southeast Asia. Though the concept of ethnicity holds a degree of importance among early Southeast Asian societies, it is a concept that changes in accordance with time and context. It is important to perhaps view Tagaung and Sri Ksetra as local

sequences which may or may not be related, particularly when applied to the transition between the Early Classic and Middle Classic, during which we see the rise of Bagan.

Indeed, there is a problem in using ethnolinguistic categories when referring to peoples who inhabited sites between the 1st and 9th centuries as they probably came from varied and diverse ethnic, cultural, and linguistic backgrounds (Aung-Thwin 1990; Liberman 2003; O'Connor 1995). Questions should perhaps be asked regarding the transition between the Pyu and the Early Classic into the Middle Classic Period and Bagan. With this though must come a greater understanding of what makes Pyu sites and artifacts identifiably "Pyu".

Middle Classic

The Middle Classic encompasses the time from 900 CE to 1200 CE and is characterized by political changes observed among the societies of Southeast Asia (Miksic and Goh 2017:356). According to Miksic and Goh (2017:356), the decline of the Tang Dynasty in China at the start of the 9th century, and Mataram, a major Javanese kingdom, would seem to suggest that this would affect maritime trade in and out of Southeast Asia. Shipwrecks in the Java Sea, however, point to a thriving maritime trade network between the two, pointing to the idea that the fall of these kingdoms does not necessarily correlate to decreased interregional commerce. In fact, the new situation may have led to increased autonomy for merchants. The decline of these larger kingdoms seems to have allowed new societies to emerge.

Opposing settlement patterns arise in the Middle Classic with differing societal and socio-cultural goals and outlooks. Miksic (2017:547) terms them orthogenetic, and heterogenetic cities. Cities described as orthogenetic imply a generally conservative and highly religious social structure where social mobility is limited, and status is largely inherited. Featuring sprawling monumental complexes and a society focused on land and agriculture, such cities are exemplified by Angkor, Cambodia (Khmer), and Bagan, Myanmar (Burmese) (Fletcher 2012:288). Those cities described as heterogenetic tend towards a social structure characterized by upward mobility and wealth accumulation, often achieved through participation in trade, and highlighted by compact sites and dense artifact concentrations of pottery and industrial refuse in cities like Oc Eo, Vietnam (Funan), and Kota Cina, Sumatra. The Middle Classic was equally prosperous for the potentially more decentralized mercantile societies and the agrarian centralized polities of Southeast Asia, the latter exemplified by the Khmer capital of Angkor (Fletcher 2012:288). In the early parts of the 9th century, Angkor, with a primarily Hindu-based religion (Carter et al. 2019:2), developed into a centralized administrative power with a territorial identity, stable capital, militaristic society, and command economy. Soon after it expanded into the Chao Phraya river valley of what is today Thailand (Fletcher 2012:289; Miksic and Goh 2017:357).

Bagan also emerged during the Middle Classic. This state and its capital city in many ways mirrors the development of Angkor, but it also possessed unique qualities, as it was situated within a very different ecological environment and followed orthodox Buddhist religious doctrine. Bagan's regional power increased considerably in the 11th century, with the city becoming the center of an expansive polity (Aung-Thwin

1985:161). Conceivably, the ruling elite of Bagan were Burmese speakers who originated in the northeastern hills of what might have been Yunnan and settled in the plains of upper Myanmar and irrigated regions of Kyaukse following Nanzhao attacks from southern China in the 830's and 840's (Aung-Thwin 1985:161; Lieberman 2003:90). Another view posits that Burmese speakers were already living alongside the Pyu in Myanmar, suggesting that the Burmans might have resided in some of the nineteen founding villages which were the predecessors to Bagan (Hudson 2004:188, 190). Bagan itself might have been built over the site of a Pyu settlement and there are few differences between Early Burmans and the Pyu in terms of iconography, architecture, and even script, though there is little to no evidence of Pyu objects within the Bagan archaeological zone (Lieberman 2003:90; Miksic and Goh 2017:361).

According to retrospective historical chronicles and inscriptions (Pe Maung Tin and Luce 1923; Aung-Thwin 1985:161), as well as archaeological research (Iannone and Aung-Thwin 2021:187), Bagan potentially becomes a major center of power in Myanmar around the mid 10th century, though this is only partially supported by independent data, as few radiocarbon assays date from the second half of the 10th to 11th centuries (Grave and Barbetti 2002; Miksic and Goh 2017:362). In addition, few inscriptions can be assigned to dates before the 11th century, as it is often difficult to authenticate when exactly they were transcribed.

The Golden Age of Bagan (Kan Hla 1977:15; Iannone and Aung-Thwin 2021:187) coincides with the site becoming a central religious hub for Buddhist monks and pilgrims in the mid-11th century, under the reign of legendary king and proposed founder of Bagan, Anawrahta, though the extent and layout of the city has not been

widely discussed (Iannone et al. 2019a; Iannone et al. 2022: 1, 3; Kan Hla 1977). It is unclear whether Bagan fit within the orthogenetic or heterogenetic city paradigms outlined by Miksic (2017:547). Bagan itself seems to have been neither purely orthogenetic nor heterogenetic possessing aspects of both, though it probably leaned closer to the orthogenetic end of the spectrum given its strongly manifest orthodox religious characteristics and agrarian economy. This assertion remains unproven, however, though research continues to be carried out to identify settlement zones in Bagan and to ascertain their economic and political characteristics (Iannone et al. 2019a; Iannone et al. 2019b; Iannone et al. 2022; Tamura 2019; Talving-Loza 2019).

Harnessing perennial rivers, and centrally controlling intensely cultivated areas, Bagan supplied more than the necessary resources for the survival of a powerful state (Aung-Thwin 1985:97). Bagan also controlled most of the coastal settlements in southern Myanmar involved in trade with India, China, and Southeast Asia. The coastal settlements rarely challenged the more powerful inland agrarian states. The inland states like Bagan, more concerned with, and vulnerable to, domestic issues and problems, needed the luxury goods, ocean products, and the goings-on in the international world (Aung-Thwin 1985:97). Coastal, trade-oriented cities, depended on international trade, rather than "national" affairs, required the rice, and other inland products they did not produce (Aung-Thwin 1985:97). The accumulation of merit was integral in Bagan society, and was accomplished by performing good deeds for others, or donating to the *sangha* (akin to a Buddhist Church). Individuals could obtain the most merit by feeding monks and providing basic amenities, as well as building temples and monasteries for them. The quantity of merit received, however, was equivalent to gifts rendered, ensuring

that the rich would gain better merit than the poor. The relationship between social status and merit sharing was an important one, with social standing and spiritual status dependent on, not how much wealth one had, but how much one gave away (Aung-Thwin 1985:43). The king, possessing the most material wealth, accumulated the most merit through construction programs, which in turn gave him the most to share, providing merit for the whole kingdom (Aung-Thwin 1985:43). Inscriptions at Bagan point to a complex association of socioeconomic groups through lists of land, people, goods, and other objects donated to temples and monasteries (Aung-Thwin 1985; Iannone and Aung-Thwin 2021; Lieberman 2003:95). Included in these donations would be skilled artists and craftspeople, everyday items, and service workers (Aung-Thwin 1985:172). The varying degree of occupational specialization suggests that Bagan's society was both diverse and complex, with the city potentially exhibiting a form of low-density urbanism (Fletcher 2012:288; Iannone 2020:166). The same inscriptions that provide these insights also foster many questions, as most inscriptions at Bagan fail to give numerical information on the numbers of people involved with occupations related to monument construction and activities associated with the monastic Buddhist order, or the royal palace. This suggests an orthogenetic and redistributive economy where the elite controlled craft production. More archaeological investigations that focus on other aspects of Bagan besides its monumental architecture are necessary to refine the characterization of this ancient capital's economy (Miksic and Goh 2017:370).

It is proposed that Mongol invasions into Myanmar between 1277 and 1301 contributed to the decline of Bagan. However, it is debatable whether the Mongols even reached Bagan itself, though such an incursion might have acted as the catalyst for

institutional and structural failures, making the kingdom vulnerable to collapse (Iannone and Aung-Thwin 2021:194, 195). The interdependent relationship between the ruling authority and the Sangha (i.e., Buddhist "church"), was an Achilles' heel for Bagan, given the number and range of resources that were increasingly tied to non-productive religious consumption (e.g., physical temple and monastery construction, along with various institutional supports), although the Sangha did also play an important role in expansion and management of the agrarian economy (Aung-Thwin 1985:174; Iannone and Aung-Thwin 2021:193). A significant portion of the donations were made by societal elites, especially Bagan's kings, who hoped to foster their political legitimacy by demonstrating their close connections to both the Sangha and broader Buddhist religious system (Aung-Thwin 1984:174; Iannone and Aung-Thwin 2021:193). Such large-scale merit building activities not only had the unintended consequence of drawing vital resources away from the state itself, but it also enhanced the centrality of the Sangha as both a spiritual and economic institution (Aung-Thwing 1984:174; Iannone and Aung-Thwin 2021:193). The resulting internal fragmentation and instability coincided with an uptick in revolts in areas under Bagan's sphere of influence, invasion by Shan chiefs, the development of the independent Pegu kingdom in the south (Aung Thwin 2011), and climatic factors such as droughts and food shortages (Iannone and Aung-Thwin 2021:195; Lieberman and Buckley 2012).

Late Classic

The Late Classic in Southeast Asia spans from 1200 to 1400 CE (Miksic and Goh 2017:446) and coincides with the decline of Bagan and what would have been the last flourishing of Angkor following the reign of Jayavarman VII, who may have ruled until about 1219 (Carter et al. 2019:2). Though Bagan would ultimately physically sink into disarray in the early parts of the Late Classic, in spiritual terms, Buddhism remained strong and fundamental to Burmese identity and tradition (Iannone 2020:164, 175-176).

During this period, however, the decline of one kingdom led to the rise of another. Central Thailand became the central socio-political node of Southeast Asia realm with powerful and culturally influential kingdoms rising. These first emerge from the northern Chao Phraya valley, gradually increasing their authority down the valley to its delta, the two best known being Sukhothai and Ayutthaya (Baker 2003:41; Chitintaranond 1981:92; Evers 1987; Graves 1995:248; Tambiah 1977:74-79; Wyatt 2001). Central Thailand became the dominant power in what was formerly the Khmer sphere of influence, which had covered much of mainland Southeast Asia by the end of the period.

As discussed by Miksic and Goh (2017:446), as Classic Southeast Asian cultures like Angkor and Bagan declined, maritime trade grew, with Chinese investment via the Yuan dynasty in the late 13th to early 14th centuries. This did not last long though, as the Yuan were replaced by the Ming dynasty in 1368 CE (Laichen 2003:497). This dynasty almost immediately limited interaction with Southeast Asia, placing strict restrictions on commerce and contact with foreigners. However, this seems to have had little to no effect on the Southeast Asia economy, hence the perception that China was not the main engine of trade for the region. Commerce and trade networks within Southeast Asia, and throughout the Indian Ocean, was sufficient to maintain prosperous societies in the

region. The retreat of China from the region's economic sphere may have started a change in city types. Centers like Kota Cina in Northern Sumatra, and Tamasik (modern Singapore), moved away from a generalized, low-density urbanism to more high-density habitation. Though these may have been examples of foreign colonies, definitive proof remains unestablished.

Following the decline of Bagan, Myanmar went through a roughly 100-to-200-year period of fragmentation, during which it divided into multiple distinct geospatial regions or polities, which at times either competed against each other or allied together against others (Aung-Thwin 2011:1; Miksic and Goh 2017:459). This new political situation sets off the Myinsaing period which lasted from 1298-1312 CE. During this period, much of northern Myanmar was governed by three centers of power in Myinsaing, Sagaing, and Pinya who themselves controlled major centers of rice production including the Kyaukse and Mu valleys, though Bagan for some time retained control over the valuable Minbu valley (Miksic and Goh 2017:459, 461). The presence of such a period in Myanmar's history illustrates the patchy nature of knowledge available for this time, with records, inscriptions, and chronicles positing several competing and cooperating polities (Miksic and Goh 2017:460). Further definition of this period will likely come down to additional archaeological excavation and survey. Studies on settlement patterns will greatly assist in our interpretation as few such studies have been done so far on this period (Iannone et al. 2019a; Iannone et al. 2019b; Iannone et al. 2022; Tamura 2019; Talving-Loza 2019). Such studies will eventually help us to piece together what centers were important and how they were connected, along with their major functions and activities people may have been focused on.

Several new polities emerged during the period, including Inwa or Ava, and Bago or Pegu kingdoms (Aung-Thwin 2011; Iannone and Aung-Thwin 2021:196; Miksic and Goh 2017:462). By 1385 CE, Pegu controlled much of lower Myanmar while the three centers that had gained control of upper Myanmar were replaced in 1364 CE with the founding of the Ava dynasty (Aung-Thwin 2011; Iannone and Aung-Thwin 2021:196).

Exploring the Human-Animal Interactions in Ancient Southeast Asia

Archaeology as a discipline is important to the development of human-animal studies, adding unique perspectives and time depth to this type of research (Armstrong Oma and Birke 2013:113). It also helps give depth to cross cultural perspectives, ranging from hunter-prey relations to living with animals, both as a resource and companion (Brittain and Overton 2013). Archaeology also contributes to the cultural context of domestication, as understanding its processes can go beyond the simplistic taming, and ensuing genetic and morphological changes of animals, by addressing the changing political and social contexts within which the dynamic domestication process plays itself out (Argent 2013:178; Mlekuž 2013:151).

Zooarchaeological research provides a framework for understanding the nature of the human-animal interactions, primarily through the analysis of the physical remains of animals excavated at archaeological sites. Research into human-animal studies has, however, been focused on the human dominated aspect of interspecies relationships, which tends to result in a very physical “cost-benefit” type of analysis (Armstrong Oma

and Birke 2013:114; Higham and Kijngam 1982:21). The relationship between humans and animals in the past has primarily been interpreted through ecological and economic perspectives, which though enlightening, prohibits alternative insights (Brittain and Overton 2013:134). Zooarchaeological research, though, has begun to grapple with an understanding of animals beyond the idea that they are largely passive in the human world, and their importance is now understood to go beyond simply being available resources or as raw caloric yields (Brittain and Overton 2013:134). Achieving this level of understanding, though, may prove difficult in certain conditions.

The Southeast Asian environment is not conducive for the preservation of faunal remains. As outlined earlier, the humidity, precipitation, soil composition, and other biotic factors can leave few traces of humans on a landscape overtime, let alone their animals. Such environmental conditions make it so that clearly identifiable faunal remains are rare in the archaeological record of the region. Despite this, Southeast Asia is the source of significant data tracing human-animal interactions in the past. Interactions between humans and animals have occurred in the region since the prehistoric past, for subsistence and as cultural symbols (Conrad et al. 2015; Conrad 2016; Higham 2014:28-91; Higham and Kijngam 1982:17-24). There is also archaeological (Higham 2014:112, 120, 128) and genetic evidence (Larson et al. 2010; Wang et al. 2020; Zhang et al. 2020) linking the origin of multiple domestic animal species, or separate domestication events, to Southeast Asia. With this, the inclusion of ethnographic, and ethnoarchaeological methods into the study of human-animal interactions has brought new perspectives.

Ethnographic fieldwork and the subdiscipline of ethnoarchaeology bring nuanced perspectives to research into human/animal interactions, especially given their potential

for documenting more emic perspectives. More recent ethnographic work amongst people and cultures of the region is also noteworthy. For example, research conducted by Brian Hayden (2016) and Rowley-Conwy (2018) has looked at the animal component, primarily through the context of feasting. This has illuminated cultural facets that transcend the conventional view of the human/animal relationship within society, in addition to providing key methods for finding archaeological analogues. The nature of ethnographic research though, is reliant on data obtained through in person interaction, observation, participation and discussion, and it thus provides little information on the distant past. Ancient accounts from outside sources, such as those of Zhou Daguan on lifeways in late 13th to early 14th century Cambodia (Harris 2007), often only provide some limited observations concerning wild and domestic animal life and offer suggestions as to their importance as resources and commodities.

Bridging this temporal gap, the field of ethnoarchaeology generates analogies between past and present cultures, pairing data collected through ethnographic research and archeological material correlates, and pointing to similarly shared lifeways. This method, though, has primarily been applied to the application of what the data obtained can tell us about life in the prehistoric past (David and Kramer 2001), specifically in relation to hunter-gatherer-fisher lifeways. In Southeast Asian studies in particular, it has rarely been applied to the larger scale, more complex societies that leave behind a more significant and diverse historical record. In contrast, archaeological research on such complex societies has largely focused on the grandiose architecture, and historical information highlighting life of the ruling class.

The IRAW@Bagan project mitigates this bias by utilizing ethnoarchaeological research methods (Iannone et al. 2019; Iannone et al. 2022; Rivera-Borbolla 2019; Talving-Loza 2019) with the goal of elucidating the settlement patterns and living spaces of ancient Bagan's commoner population, especially those who resided in the city's suburban and peri-urban settlement zones. This research has also provided some general insight into the human-animal interactions of the Central Dry Zone, as we know that people and animals cohabitated during Bagan's florescence. Temple inscriptions also detail donations of animals to the Sangha as meritorious acts (Iannone and Aung-Thwin 2021:190). Many of the domestic animals which humans interacted with in the past are still present in the Dry Zone, utilized for similar roles and purposes, and they are observable through previous ethnoarchaeological studies in and around the traditional villages surrounding "Old Bagan" (Iannone et al. 2019; Rivera-Borbolla 2019; Talving-Loza 2019).

The ultimate aim of this thesis is to analyze the nature of human-animal interactions in the Central Dry Zone of Myanmar using an ethnographic and ethnoarchaeological framework. Humans share space, and lives, with animals. The very nature of rearing animals for any purpose must intrinsically mean that a certain aspect of life and lifeways is allocated to them within a society, and where we find evidence of domestic animals in particular, humans must be associated with them. Contributing to the larger IRAW@Bagan project in uncovering settlement patterns within ancient Bagan's suburban and peri-urban settlement zones, using past ethnographic and ethnoarchaeological research conducted throughout Southeast Asia, the goal of this thesis

is to provide insights into the material correlates of human-animal interactions, providing data that can inform past and future excavations and analysis at the site.

Conclusions

To conclude, this chapter has outlined the physical environments of Southeast Asia and the Central Dry Zone of Myanmar. The geographical nature of the region, paired with climate cycles governed by seasonal monsoons, creates a landscape of expansive rivers and river valleys dominated by tropical forests, which held sway over the floral and faunal life adapted to this environment. Within this broader environmental zone, Myanmar's Central Dry Zone appears as an ecological outlier, though not devoid of diverse examples of plant and animal life. Also discussed is how this environmental make-up is not conducive to the preservation of archaeological material which creates gaps in interpreting past animal use, and points to a need for more data to piece together more of Southeast Asia's distant past. Following this was an outline of Southeast Asia's historical context across several cultural time periods, with an emphasis on the economic and socio-political spheres that influenced settlement organization and patterning, religion, and ideology, while also emphasising the societies rising, thriving, and appearing to collapse within Myanmar across this chronological sequence. The chapter concludes by looking at how the human-animal relationship in ancient Southeast Asia has been explored, with particular emphasis on how the discipline of archaeology can contribute to this realm of research, and how looking at human settlements with animals in mind may help add context to our understanding of past lifeways.

The following chapter will highlight the methods and theories used in the research and analysis for this thesis, with emphasis on applying an ethnoarchaeological framework to observations of animal-human interactions. It will also outline the merits and drawbacks of applying ethnographic insights in our interpretations of the archaeological record, and examine the issues surrounding using contemporary analogies to formulate interpretations of life in the distant past.

Chapter 3: Theory and Method

This chapter will outline the theoretical approach for conducting ethnoarchaeological research. Included will be a discussion of the nature of ethnoarchaeology as a sub-discipline of archaeology. We will look at its origins and development into a research strategy, as well as its overall goals and contributions to interpretation of the archaeological record. This requires an overview of the use of analogy in archaeology, not only concerning how this can help one piece together interpretations and explanations of the actions and lifeways of past humans, but also how this may hinder such endeavors. The latter relates to the fact that ethnoarchaeology involves a kind of temporal blind spot, in the sense that even if something is similar or analogous to something that happened in the past, this does not mean that identical scenarios unquestionably exist between the source (present) and subject (past) contexts. Nevertheless, this chapter will also outline the goals and roles of ethnoarchaeology in relation to the larger archaeological discipline, underscoring that it is among the most useful tools researchers have when attempting to understand past human behaviour.

This chapter will also discuss the methodology behind this research project itself, as it will apply an ethnoarchaeological based approach to achieve its goals. It will also detail the original plan and intentioned goals to be accomplished by this research, while highlighting how extenuating global circumstances, and ones specific to Myanmar, have presented a series of obstacles inhibiting the conduct of said research as originally planned. Be that as it may, the larger IRAW@Bagan project, for which this research is

part, has already produced significant ethnoarchaeological data that have allowed this project to pivot and progress despite the various impediments faced by this researcher.

What is Ethnoarchaeology?

Coined by Jesse Fewkes (1900), the term, "ethno-archaeologist" describes an archaeologist who brings with them an in-depth knowledge of the present lives of the peoples whose prehistory is being investigated. Donald Thompson's (1939) paper *"The Seasonal Factor in Human Culture"* is what David and Kramer (2001:6) point to as the first example of ethnoarchaeology in its recognizable form, describing contrasting seasonal adaptations in material, settlement patterns, and other cultural characteristics among Wik Monkan Australian Aborigines. These differed so greatly that material remains would normally be interpreted by archaeologist as representing different cultures.

Ethnoarchaeology's emergence as an anthropological sub-discipline is often tied to Maxine Kleindienst and Patty Joe Watson's (1956:77) *Action Archaeology: The Archaeological Inventory of a Living Community*, which urged "archaeologists to take to the field of living communities with his own theoretical orientation and gather the necessary information" in an "attempt to define where and in what degree the total non-material culture of the community could be inferred from the information gathered." Richard Gould (1974:29) offered a similar line of thought by using the term "living archaeology," which referred to efforts made by the researcher, archaeologist or

ethnographer, to investigate living communities with a focus on references to archaeological residues of human behaviour.

David and Kramer (2001:9), following Raymond Thompson (1991:233), describe the relationship between ethnoarchaeology, archaeology, ethnography, linguistics, and ethnoscience in the following manner. Ethnoarchaeology can be seen as a combination of archaeological and ethnographic approaches, that may be conducted informally, involving a systematic and singular focus on the domain of material culture and site formation processes, or involve an in-depth study of significant parts of a living society and culture, or perhaps the culture in its entirety (see also Ascher 1961:324; Schiffer 1972).

It is perhaps better to borrow from the words of Michael Schiffer (1978:230) and William Longacre (1991:1), who provide widely accepted ideas concerning the roles and goals of ethnoarchaeology. For Schiffer (1978:230), ethnoarchaeology is "the study of material in systemic context for the purpose of acquiring information, both specific and general, that will be useful in archaeological excavation." Similarly, Longacre (1991:1) describes ethnoarchaeology as "the study by archaeologists of variability in material culture and its relation to human behaviours and organization among extant societies for use in archaeological interpretation." Finally, Carol Kramer (1996:396), expanding ethnoarchaeology's horizons beyond material culture, defines it as "ethnographic fieldwork carried out with the express purpose of enhancing archaeological research by documenting aspects of sociocultural behaviour likely to leave identifiable residues in the archaeological record."

The sub-discipline of ethnoarchaeology as outlined above arose out of a desire to understand cultures and societies we only know of from archaeological contexts by studying and analyzing the lifeways of contemporary ones, thereby using them as "surrogates" for past, unobservable events, processes, or things (Perrault 2019:15). Or, as aptly noted by Patty Jo Watson (1980:55), given the limitations of the archaeological record, we can never know the past as it was lived by those who lived it. It is only through observation of the present, and acceptance of a "uniformitarian assumption," that we can describe and explain the past, with ethnoarchaeology attaining knowledge through observation of present events or processes while systematically engaging with remains left as a result of the people, events, and processes of the past (Watson 1980:55). Ultimately, there is a perceived need for the incorporation of ethnographic material to make sense of the recognizable patterns in the archaeological record. In this sense, ethnoarchaeology is essentially the ethnographic study of living cultures, from an archaeological perspective (David and Kramer 2001:2).

As stated by Daniel Stiles (1977:88), ethnoarchaeology generally lacks an accepted definition, or body of theory and methodology. For many, ethnoarchaeology is neither a theory or method, but a research strategy (David and Kramer 2001:2; Lyons and David 2019:100). This strategy embodies a multitude of approaches to understanding relationships of material culture, settlement patterns, and site formation processes to a larger cultural narrative in the living context, and as it enters the archaeological record (Hodder 2012:62). Exploiting such understandings helps to inform archaeological conceptions, thereby improving interpretations (David and Kramer 2001:2). As illustrated by Daniel Stiles (1977:90), the general aim of ethnoarchaeology is to make use of

information gathered in the historical present, particularly that which holds relevance to interpreting and explaining the archaeological residues of past human behaviour. In this sense, ethnoarchaeology is about model formulation and/or analogical application, based on high quality data grounded in observations of living societies (Stiles 1977:90). Ethnoarchaeology may thus be seen as a form of anthropological inquiry with select focus on the material evidence of specific human behaviours (David and Kramer 2001:2). Lyons and Casey (2016:1-2) posit an even greater role of ethnoarchaeology. They acknowledge that although the research strategies employed fundamentally draw from ethnography and archaeology, it is only through long-term, historically situated, and ethically based research that the richness of ethnographic information concerning the variations and commonalities in the ways contemporary people engage with material, solve material problems through technology, and how they are affected by and interact with the materiality of other entities, can be underscored.

Analogies in Archaeology

Within the archaeological discipline, interpretation of material left behind by humans of the past depends on analogy of some sort. Described in its general sense as a form of inference, argument by analogy is based on the idea that if something is like something else in some regard, it is likely to be similar in other ways (Ascher 1961:317; David and Kramer 2001:1). Analogy is a widely used tool in archaeology that may be used to interpret artifacts in their singular form or look at them in a broader context

(Ascher 1961:317; David and Kramer 2001:1; Trigger 1993). In the case of ethnoarchaeology, the ethnographic analogy is of key importance, given that it involves specific sets of ethnographic data being compared to what is believed to be an analogous set of archaeological data (Stiles 1977:95). Though, as argued by Allison Wylie (1985:80), analogical inferences are by their nature "ampliative" in that they claim the existence of extensive similarities in their conclusions that may or may not have been fully established, meaning that they are always open to errors. This will be discussed further below.

The introduction of analogical reasoning into the archaeological discipline may be traced to an era of classical evolutionary thinking, where analogy was fundamental. If it were true that certain living peoples represented early phases of human history, then interpretation of the remains of those we only have archaeological evidence for could be referenced from their living counterparts (Ascher 1961:317). This idea led to what Ascher (1961:318), and later Stiles (1977:95), view as a distinction between two general types of ethnographic analogy.

The first general type of analogy is the basic "formal analogy," described by Hodder (2012:26) as one that suggests that if two objects or situations share some common properties, then they probably also have other similarities. Another type of formal analogy operates under conditions where two sets of data are broadly detached along the lines of time and space, where no connection is demonstrated between the culture producing the archaeological traces and the culture providing the ethnographic analogue. This type of analogy is also referred to by Ascher (1961:319) as a "new analogy", and it is used in restricted situations, where the factors of time, space, and form

create certain boundary conditions that are proportional to the probability of the analogy being valid, with the narrower the boundary, the greater the probability of a valid analogy (Stiles 1977:95).

A similar, but less restrictive form of this analogy is the cross-cultural approach, with a key difference being that the usual multiple comparative analogues can come from anywhere and be from any time (Gould and Watson 1982:357), although they are usually selected because they broadly share some combination of environmental, economic, settlement, or social characteristics with the subject. These general comparative approaches, which can at times be presented as cross-cultural laws, are utilized by Peterson (1971) and include Gould's (1974) "discontinuous model," and Yellen's (1974) "buckshot method," and it figures prominently in David and Kramer's (2001:43) outline of the logic and practice of analogy in ethnoarchaeology. One must be cautious though, as the connections between living cultures and those in the past remain purely formal, as there is no direct implied or historical relationship (Ascher 1961:320). Hodder (2012:16) suggests that before interpretations can be derived from these analogies, care must be taken to increase the number of analogical similarities.

The second general type of analogy occurs when time and/or space connections can be demonstrated between the archaeological and ethnographic cultures (Stiles 1977:95). This type is referred to as the "folk-culture" or "direct historical" approach by Ascher (1961) and Steward (1942:337), as the "continuous" model by Gould (1974), and as the "direct historical" analogy by Peterson (1971). Here, there is essentially some degree of historical continuity between the past and present that can be assumed. Or, as outlined by Julian Steward (1942:337), the direct-historical approach essentially works

from the known to unknown within a historically related sequence of cultures. This type of analogy is generally considered to provide the highest probability of being correct because the conditions of time, space, environment, and cultural affinity of the groups who produced the two sets of compared data are most analogous. That said, applying the direct-historical approach to analogical inference has its own significant issues. Specifically, the connections between the archaeological past and present societies observed may be severely altered, or even non-existent.

Given the different types of archaeological and ethnographic analogies and perspectives concerning their utility, a schism developed with respect to using analogical interpretations in explaining the archaeological past, where some saw it serving little use (Ascher 1961:321). Hawkes (1954) argues that applying analogy is, in certain areas, ineffectual. Specifically, he posits that interpretation cannot penetrate much beyond an understanding of basic subsistence and technology, with analogical interpretive tools being near powerless for grasping all the nuanced and complex structures of humanity (Hawkes 1954). Smith (1955) argues that ethnological based research has illustrated a wider range of human behaviour. Furthermore, utilizing living groups to interpret the archaeological past demands "logical alchemy," where interpretations by analogy are not arguments, but assertions. Taking a less drastic approach, Thompson (1956) argues that analogy has a role in interpretation, though evaluating any instance of its use can only be made by assessing the competence of the user, as the analogy itself may be valid, but the interpretations taken from the user in its application may not be.

Ascher (1961:322-324), acknowledging the negative discourse surrounding the theory and practice of analogical reasoning, makes some suggestions to place it on

"firmer ground." First, if there exists more than one analogy for a given archaeological situation, a systematic approach should be used to consider statements of results in terms of degrees of likelihood. The second suggestion points to the inadequacy of some ethnological literature for archaeological interpretation, mainly because it derives from idealized case studies with little to no detailed description of possible archaeological correlates, or detailed descriptions of these without considerations of the associated behavioural contexts. On this basis, Ascher, citing Kleindienst and Watson (1956), proposed that archaeologists themselves look to living communities, compiling their own ethnological inventories. Finally, Ascher states that the past and present may serve one another, that archaeology depends on ethnographic data for interpretation, and ethnography can benefit from the temporal depth of the archaeological record. He contends that there is no clear distinction between the ongoing and extinct regarding material culture evidence. Expanding on this, he underscores that "the observational fields of ethnology and archaeology overlaps on that proportion of a living community which is in the process of transformation," and that "it is the study of this very special corpus of data within the living community which holds the most fruitful promise for analogy in archaeological interpretation" (Ascher 1961:324).

Strengths and Weaknesses of Ethnoarchaeology

The Strengths of Ethnoarchaeology

The application of an ethnoarchaeological research strategy has many potential strengths, although there are also several weaknesses that undermine the veracity of interpretations made concerning the archaeological record. Both the strengths and weaknesses will now be discussed, with emphasis on the implications for this thesis. Before doing so, however, a general overview of how ethnoarchaeology has benefited the archaeological discipline is provided, followed by an assessment of where the approach has fallen short, thereby exposing certain pitfalls relating to its implementation.

As illustrated by Watson (1980:55), living in our present context, we will never be able to fully grasp the past in all its intricate entanglements, let alone understand it from the perspective of those who lived it. This, in and of itself, situates the sub-discipline of ethnoarchaeology in relation to perhaps its greatest strength. Through the application of ethnographic analogy, we can get a glimpse of the complex processes involved in living a life within certain socio-cultural, material, ecological, and environmental contexts. In other words, the ethnoarchaeological approach highlights the need to bridge the static archaeological record and the dynamics of the living systems that produced it (Binford 1981; Roux 2017:228). This requires shedding light on the various site formation processes associated with specific forms of human behaviour, with the goal of applying these regularities to archaeological data. While these are observations taken within the contemporary setting observed by the researcher, they inevitably provide insights into, and in certain respects physical representations of, what it meant to live long ago.

Conducting archaeological excavation is among the most difficult of academic pursuits. In many respects, ethnographic research is equally challenging. During excavations archaeological assemblages emerge piecemeal, bit by bit, often in

fragmentary and incomplete form. The incorporation of an ethnoarchaeological research strategy in essence provides a living human reference for archaeological materials. As discussed by Gould (1989:4), the researcher is required to have a general knowledge of their chosen research area, among these, the historical and archaeological past, and perhaps past and present socio-political situations. The researcher also brings with them their own ingrained perceptions of a society's relation to its material culture. Engaging with living cultures also means engaging with their material culture. One can observe the intricate entanglements between material objects, social action, and the people or persons involved in their uses (Hodder 2012:207). The key idea being that data acquired from ethnoarchaeological research can provide correlates and insights useful for interpreting not only the archaeological record, but the historical, epigraphic, and iconographic material of the past as well.

When applying an ethnoarchaeological research strategy, among its strengths can be time spent in the field. Just as we cannot see for certain how an artifact is used when viewing the archaeological record, we cannot gauge how views or uses may have changed and/or adapted over time during short ethnoarchaeological studies. As pointed out by David and Kramer (2001:64), ethnoarchaeology is traditionally done through in-depth field work in a single community with observations that are rich in detail on various levels of the society, from the person to the larger social group.

Another inherent strength also seemingly stems from the very nature of conducting ethnoarchaeological research. What immediately comes to mind when thinking of conducting any form of academic research is the notion of strict scientific rigor. To conduct an ethnoarchaeological study there must be a level of formality as to

how the research is being conducted. One cannot simply take in every and all aspects of a living society, especially when trying to piece together particular sets of data that not only contribute to answering research questions, but which also add insight to archaeological analogs, without having an organized plan. The intrinsic factor of conducting ethnoarchaeological research is the ethnographic aspect. The "what" that is being observed is attached inevitably to the "who." Connected to the formality of ethnoarchaeological research strategies is the inherent informality stemming from the ethnographic aspects of working within a living community. When conducting their studies researchers can also obtain knowledge concerning a culture's behavior, in terms of its material residues, that may not have been acquired through the sole application of a formal research strategy or the excavation of archaeological sites. This adds further insights into the larger cultural milieu.

Ethnoarchaeology also allows the researcher to prescribe a level of direct focus through applying certain concepts and testing different theories. At the same time, ethnoarchaeology can be malleable, as previously discussed concerning Ascher's (1961) "new analogy", or Yellen's (1974) "buckshot method." This adds strength to the archaeological subdiscipline, providing the ability to be both be specific and general, for it allows the researcher to ask focused questions, not only of people living in the society, but in some ways of the material culture itself. As discussed by Lyons and David (2019:102), ethnoarchaeology, especially within the last two decades, has seemingly evolved beyond its role of simply providing material correlates and analogues between past and present societies and cultures. It has, as Lyons and David (2019:102) put it, been "for some time…more than the handmaiden of archaeology."

Ethnoarchaeology has made multiple contributions to material culture studies, with its research being applied to a host of contemporary and ancient societies, thus furthering the general anthropological aim of understanding human variability in the past and present (Lyons and David 2019:102 citing Politis 2016). Lyons and David (2019:102) list additional "salient contemporary issues" that ethnoarchaeology has been, and is capable of, addressing, such as climate change, illegal immigration, inequality and marginalization, and identity politics. This is a research strategy that can also team up with other disciplines, and it thus becomes capable of being a useful contributor to areas of study such as experimental archaeology and archaeometry, in this way furthering insights or achieving new ones, and it may also contribute to the study of groups through a cultural historical context (David and Lyons 2019:102).

The Weaknesses of Ethnoarchaeology

Although applying an ethnoarchaeological research strategy and conducting such work in the field holds many strengths, especially given its ability to produce analogies in the present that may be analogues for understanding past societies, there are several potential weaknesses inherent in this approach. Many of these stems from ethnoarchaeology's strengths, with issues surrounding time and the application of ethnographic analogy being among them (Gosselain 2016:217). We live in the time and place that we are brought up in. Our upbringing shapes our perceptions of the world, our society, our culture, and to some extent the role of the individual within these nested

contexts. We cannot simply perceive the lives lived in the past from the archaeological material alone, and even though the application of an ethnoarchaeological research method in the present may provide analogues for the past, that may be all they are (Gosselain 2016:217). Their interpretation can neither be a true nor false statement, and occasionally they provide nothing definitive at all. Paired with this is the inherent issue of using contemporary societies as references for the archaeological past. People within societies change, and the temporal dynamics of culture is such that it is in varying degrees of flux at any point in time. The socio-cultural use and value of an object, action, or site may change as time progresses, thereby altering the contexts they are viewed in the present by the ethnoarchaeologist (Cunningham 2018:4).

Some scholars have had rather extreme points of view concerning the weaknesses of ethnoarchaeology, with some even questioning the very validity of ethnoarchaeology as a proper archaeological sub-discipline (Gosselain 2016). Among the most recent works that hit hard at the practices involved in ethnoarchaeological based research is the 2016 article by Olivier Gosselain entitled: "To Hell with Ethnoarchaeology." In it, Gosselain (2016:216) points out the flaws within the application of the research strategy that have been mentioned before, arguing that ethnographic analogies may not give the whole picture associated with a particular behavioral context, and they provide neither reasonable representation nor interpretations of the archaeological record. He also points out that in the past five decades of practicing and publishing ethnoarchaeological research, its practitioners are "clueless" as to their specific research methods and endeavors (Gosselain 2016:217).

Gosselain (2016:218) goes on to discuss the problems inherent in engaging with contemporary societies with the sole purpose of applying observations of their lifeways to those of the past. Among them, he cites William Longacre (1991:5), and the issue associated with formulating an ethnoarchaeological study, specifically in terms of selecting a society to study, which is usually guided by the nature of the research question the researcher intends to investigate. The question is, how is the most appropriate society to study determined? Gosselain (2016:218) argues that the most appropriate society to the researcher is often the one whose activities and material culture can most easily be applied to the archaeological record. However, this brings into question the varying motivations of the researcher in selecting whom they choose to focus their research on, given that what is sought out are those societies that fit the "image" commonly associated with the representations and perceptions of the past societies under investigation.

Gosselain (2016:219) argues that another thing that fundamentally undermines ethnoarchaeological research is the underlying ideology of the evolutionist paradigm of the archaeological discipline's early years, which continues to persist within Western thought, and which "constitutes one of the founding elements of our relationship with the rest of the world." Thus, when the first ethnoarchaeologists sought appropriate contexts for testing hypothesis about pre- and proto-historical behaviour, they logically fixed their choice on areas where one still found supposedly "premodern" peoples.

Nevertheless, Gosselain (2016:225) concludes that we should not seek the total banishment of ethnoarchaeological based research, as that would be far too extreme. Recent literature not only on ethnoarchaeology's past, but focusing on current contributions to the larger archaeological discipline (Lyons and Casey 2016), as well as a

direct response to Gosselain (2016) by Lyons and David (2019), point to the fact that many more researchers from different areas of study are conducting ethnoarchaeological research today, and that what researchers in the field do is engage with living societies in a contemporary world with the belief that analogues useful for understanding the archaeological past may be discerned, but in doing so they do not view these societies themselves as archaeological remnants. Be that as it may, what such critical arguments within and about the sub-discipline do highlight is that within ethnoarchaeological research strategies there are often inherent ethical issues that the researcher must consider before going into the field (David and Kramer 2001:63-90).

Ethnoarchaeology and the Current Thesis

This thesis is focused on the interaction between humans and animals. Though archaeologists may find the physical remains of animals during excavations, what can be said about the human-animal relationships based on these finds alone is largely limited to aspects of food acquisition, processing, and consumption (Conrad 2015; Higham and Kijngam 1982:21). These topics have normally been studied using zooarchaeological research methods developed to understand the subsistence patterns of prehistoric peoples, often hunter-gatherer-fisher societies, including those who once lived in Southeast Asia (Conrad 2015; Higham and Kijngam 1982:21). However, other aspects of the human-animal relationship remain difficult to discern from faunal remains alone – especially when it comes to the more complex, "historical" societies of Southeast Asia – such as

where animals were kept, how and where they were fed and watered, what their shelters looked like, and where these were situated in relation to other habitation structures. Other topics center on the socio-cultural or spiritual nature of the human-animal relationship, or their role as secondary actors in occasions that have been formative to the human story (Saha 2015, 2021). Rarely, if at all, are human-animal relationships considered with the intent of gaining insights into the complex economic, social, political, and religious aspects of societies classified as early states, or how this may inform us as to the layout and daily activities associated with large, urban settlements.

This problem is central to this research project, which seeks to provide insights into the settlement pattern for the 80 km^2 suburban/peri-urban settlement zone that surrounds Bagan's walled and moated "royal city." Specifically, using what can be observed and interpreted by considering the interactions between humans and their animals in the contemporary context, I aim to enhance our understanding of the potential animal related activities that may have occurred across the dispersed urban center of Bagan during its florescence, from the 11^{th} to 14^{th} centuries CE (Iannone et al. 2019). The villages selected for ethnoarchaeological based research by the IRAW@Bagan project were done so based on a set of parameters including limited urban buildup in the area, and an adherence, largely, to a small-holder agrarian economy. Crucially, for the purpose of this thesis, animals had been observed by IRAW@Bagan researchers working with humans and participating in traditional agricultural practices in a manner like those seen in artistic and literary representations of farming during the Bagan Period. The methods used to accomplish this will be discussed below, along with some of the key issues that influenced the approach that had to be taken in this thesis research.

Methods

At the onset of this research project, the original intention was to conduct a true ethnoarchaeological based study within ten traditional village sites situated in and around the remains of the walled and moated royal epicenter of ancient Bagan, including a number that are situated within what we believe to have once been the city's suburban and peri-urban (e.g., mixed urban-rural) settlement zones. The approach was meant to involve asking questions about and observing the interactions between humans and animals in these contemporary villages, followed by the application of the direct-historical approach of analogical interpretation to the ancient Bagan excavation contexts. More specifically, the goal of this thesis research was to advance the aims of the IRAW@Bagan research project, which is focused on "generating an integrated socio-ecological history for residential patterning, agricultural practices, and water management at Bagan," across a range of significant ecological, climatic, economic, socio-political, and religious changes (Iannone et al. 2019:5). This sub-project would have been added to other similar studies already conducted by IRAW@Bagan that incorporated ethnoarchaeological based research strategies and data within the examination of agricultural practices (Macrae 2019), the organization and composition of traditional house compounds (Talving-Loza 2019), and the use of water rituals and water symbolism (Rivera-Borbolla 2019). While focusing on aspects of the human-animal relationship within the traditional village context, the current sub-project was devised to contribute to the IRAW@Bagan project by continuing to advance our understanding of the material correlates of domestic lifeways specific to the central dry zone of Myanmar, and by

extension continuing to enhance our ability to recognize and interpret the archaeological residues of Bagan's ancient citizens (Iannone et al. 2022).

The working hypothesis that inspired this research was that the contemporary house lots in the vicinity of Bagan maintain many of the traditional practices surrounding human-animal relationships that characterized the classical (11^{th}-14^{th} centuries CE) community, such as transportation, agricultural work, and food. Thus, an ethnoarchaeological study would provide useful insights for settlement archaeology, thereby forwarding the goals of the IRAW@Bagan project. The overarching research questions guiding this sub-project, and from which it would build from, are as follows: 1) What are the material correlates of human-animal relationships in traditional house compounds around Old Bagan? 2) What are the material correlates of human-animal relationships in the traditional villages around Old Bagan? 3) What might these look like many years from now? (i.e., following many decades and centuries of decay and abandonments). 4) How can these be used to inform settlement archaeology in the area encompassing the ancient capital city? Paired with these would be a series of subsidiary questions focused on certain aspects of the human-animal relationship, such as: 1) How are animals procured? 2) Who owns them? 3)Who is involved in their care? 4) What is involved in their care? 5) How, and for what purposes, are animals used? 6) How, and where, is animal refuse deposited?

With these questions framing the sub-project and thesis, the intent was to then implement an ethnoarchaeological research strategy that had both formal and informal components. Formal aspects of the research would be centered around village visitations and semi-structured interviews with residents of house compounds and other villagers.

These would be paired with detailed notes and photographic record taking of associated tools and constructions associated with animals within house compounds and the village, along with their measurements. The goal of the formal research would be to assess how, where, and why animals are kept in the traditional village contexts around Old Bagan, with emphasis on the materials involved. The informal aspects of the research would be centered around participation in village events and ceremonies, if invited, as well as simple meals and informal conversations with local landowners and other villagers. Complementing the primary data gathered by the ethnoarchaeological study would be the ancillary data on the human-animal relationship in classical Bagan provided by translations of temple inscriptions (Duroiselle 1919-1936) – especially those relating to donations of animals to monasteries and temples – retrospective chronicles such as *The Glass Palace Chronicles of the Kings of Burma* (Pe Maung Tin and Luce 1923), and archaeological assemblages collected from excavations conducted by the IRAW@Bagan at the ancient residential sites of Shwe Creek and Otein Taung (Tamura and Cheong 2019; Rivera and Cheong 2019).

This thesis plan had to be modified, however, because of global events faced by all the world over, and by specific events that have transpired within the research country of Myanmar. In 2020, the COVID-19 virus swept across the world causing its virtual shut down. With this came lockdowns and travel advisories aimed at halting the diseases' spread. Faced with this situation, there remained a degree of hope that the IRAW@Bagan project members would still be able to make it to Myanmar at some point to conduct their research. Alternatively, it was believed that, with the rise and advancement of video conferencing technology, the thesis sub-project could at least be carried out in direct

partnership with IRAW@Bagan team members from Myanmar carrying out the ethnoarchaeological fieldwork, and subsequently relaying the data to Canada for collation and analysis. Unfortunately, an even greater challenge was to emerge on February 1st, 2021, when Myanmar's military junta, the Tatmadaw, deposed the democratically elected government and seized control of the country, leading to a near total shutdown of international travel into and out of the country, and the initiation of large-scale civil disobedience movement that effectively closed all post-secondary schools, collectively bringing research to an abrupt halt. With this, it became something of an impossible task to conduct ethnoarchaeological based research in Myanmar, hence the overall trajectory of this research project had to pivot to a considerable degree.

To forward this research project and allow for a thesis to be written, albeit without the ability to engage with any human participants, the methods for collecting data has essentially shifted from something done in the field, to an approach that is possible to be carried out on the campus of Trent university. That said, the essential nature of the project has remained. Specifically, instead of asking questions of participants, the same overarching and subsidiary questions will be asked, but the "answers" will be provided through careful analysis of data already collected over the past several years of field work undertaken by the IRAW@Bagan project. The primary data will thus consist of information about human-animal relationships presented in field reports and theses based on past ethnoarchaeological research projects conducted by IRAW@Bagan team members (Macrae 2019; Rivera-Borbolla 2019; Talving-Loza 2019), along with their extensive field notes, maps, and the corpus of photographs of Bagan and the traditional villages of interest taken by the various IRAW@Bagan researchers. Secondary data will

be derived from translations of inscriptions (Duroiselle 1919-1936), and the retrospective chronicles (Pe Maung Tin and Luce 1923), all of which are available for consultation via publications or internet sources. Tertiary information will consist of published ethnographies on the traditional societies of Myanmar, as well as relevant ethnographic studies from elsewhere in Southeast Asia and neighboring India.

The objective will be to provide possible answers to the overarching research questions for the thesis by carefully studying and analyzing these various data sets. It is understood, however, that much of this data – especially the ethnoarchaeological materials – were not originally collected with the intentions of this thesis and its research questions in mind. Nevertheless, preliminary reviews of these data revealed that they contained significant information concerning the usage of animals, which indicated that they could be a fruitful source of primary data for the thesis.

Conclusions

This chapter has discussed the theory and methods of the ethnoarchaeological sub-discipline and outlined how observations of living cultures may inform the interpretation of the archaeological record. This chapter has also discussed the inherent strengths and weaknesses of analogy-based reasoning in interpretations of archaeological material, as well as the pros and cons of ethnoarchaeology itself. The specific fieldwork approach that was initially intended for this research was discussed in detail, as were the extenuating circumstances that required modification to the data collection strategy.

Finally, the specific methods and data sets to be employed in this research were outlined. The following chapter will present these different data sets in considerable detail.

Chapter 4: Data

Due to the previously mentioned circumstances of the 2021 military coup in Myanmar, and the Covid-19 pandemic, the ethnographic component of this ethnoarchaeological project required revision. Thus, this chapter will not be an exploration of data collected through fieldwork. Instead, it will be a presentation of relevant data collected from previous research and field surveys initially conducted by the IRAW@Bagan team during the 2017 and 2019 field seasons. Particularly, Talis Talving-Loza's (2019) thesis on traditional villages and house compounds, and Scott Macrae's (2017) research exploring Bagan's peri-urban agricultural strategies. Primary data for this thesis takes the form of photos and field notes, which, though not focused specifically on animals, highlight aspects of the human-animal relationship in the traditional context, and are presented in the same case study format as Talving-Loza's (2019:70) thesis, focusing on ten traditional villages, chosen due to their adherence to small-holder agrarian economy, limited urban build-up, and traditional construction methods, as well as presumed to have been situated in the suburban and peri-urban (mixed urban-rural) zone of Old Bagan. These villages being: Thae Pyin Taw; Shwe Halaing; Zee Oo; Kon Sin Kyi; Kon Tan Gyi; Minnanthu; Hpauk Sein Pin; Thuhtaykan; East Pwa Saw; West Pwa Saw (Figure 4.0). This will be followed by relevant data (e.g., photos) pertinent to, and/or featuring humans and animals, taken at other sites and villages by the IRAW@Bagan team not included in those listed, which will add further insight into the types of animals present, where they are kept, and how they are used.

Secondary data will comprise information gathered from retrospective historical chronicles, such as *The Glass Palace Chronicles of the Kings of Burma* (Pe Maung Tin and Luce 1923), that highlight animal use, along with other descriptions of the human-animal relationships during the classical period of 11th-14th century Bagan. Paired with this will be information collected from translated temple inscriptions, including those documented in Charles Duroiselle's *Epigraphia Birmanica* (1919-1934) and Tilman Frasch's (2014) *Bagan Epigraphic Database*, many of which focus on donations to Bagan's temples and religious institutions, and which include descriptions of animals of different species being donated for various purposes.

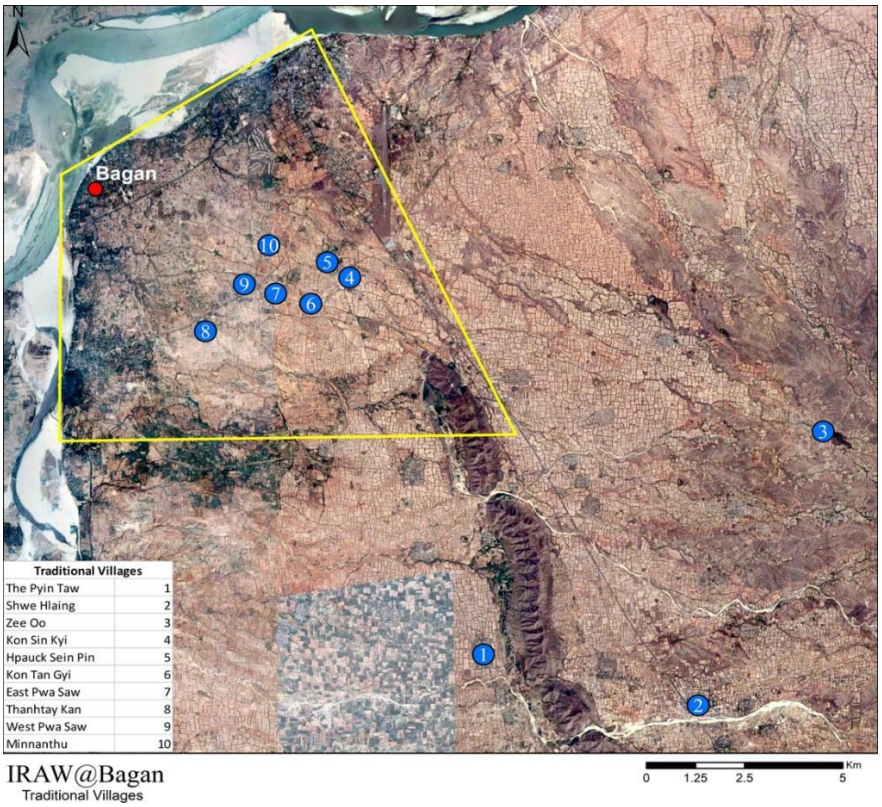

Figure 4.0. Map of ten traditional villages that witnessed ethnoarchaeological study by IRAW@Bagan (Map courtesy of Scott Macrae and the IRAW@Bagan Project).

Thae Pyin Taw

The first village surveyed by the IRAW@Bagan team was Thae Pyin Taw. Visited on December 10th, 2017, this village is located 16.2 km south-east of "Old Bagan's" walled and moated *shwe myo taw*, or "royal golden city" (Talving-Loza 2019:70). The house compound visited was in the shape of a rough triangle and bordered by woven bamboo and palm reed fences. The house was in the southern section of the compound with a cumulative measurement of 9.1 m wide along its frontal façade, and 12.8 m along its sides. Immediately north of the house was an open veranda which was 6.4 m of the total length of the enclosed house space (Talving-Loza 2019:72).

A section on the front of the western side of the veranda contained a small 2.3 m x 3.7 m kitchen area. The cooking surface of the kitchen area was created using several upturned toddy pots over a fire, while the bamboo wall closest to the fire was covered by brick lining (Figure 4.2). Also, observable in Figure 4.2 are various styles of cooking pots, both metal and ceramic, as well as several woks hanging along the kitchen wall and what appeared to be a large wooden table with a woven basket covering on top. On the floor of the kitchen were what looked to be above ground cookers made from ceramic or brick like material, circular in shape with a square opening. The exact purpose of these are unknown to this researcher, however, one appeared to be holding up a large metal pot when the kitchen was observed. Bricks also appeared to line the kitchen's perimeter, filling gaps between the floor surface and the bamboo panel walls, while the floor surface appeared rather smooth. One corner of the kitchen also appeared to house several large ceramic pots in a section where the floor looked slightly raised.

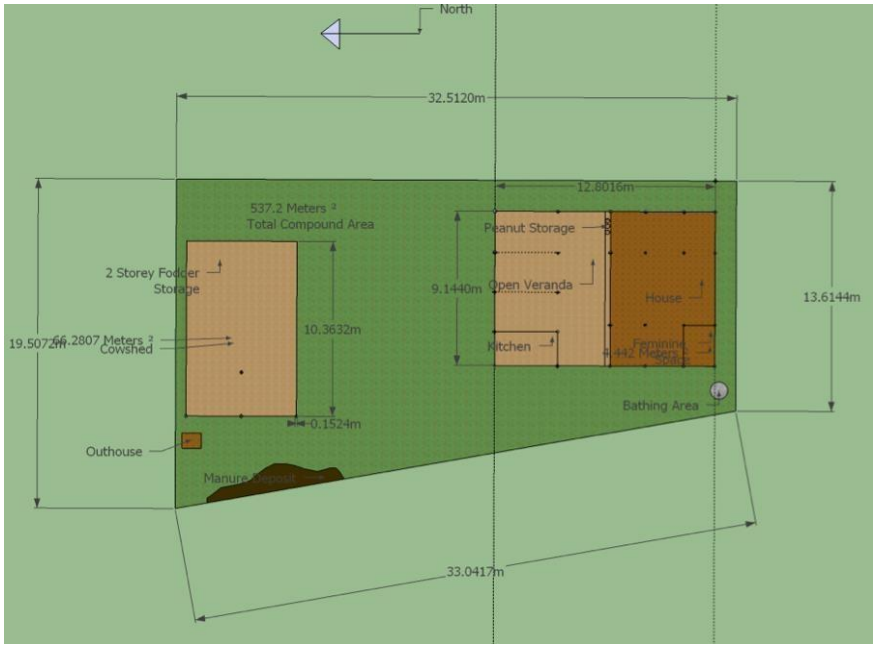

Figure 4.1. Plan view of Thae Pyin Taw house compound (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.2. Kitchen at Thae Pyin Taw house compound. (Photo courtesy of Gyles Iannone and the IRAW@Bagan Project).

Located in the northern part of the compound, along the northern wall was the cow shed (Figure 4.1). Roughly rectangular, the cow shed measured 10.36 m on its

northern and southern sides, and 6.4 m on its eastern and western sides. The sides of the cow shed were open except for an area that was partially enclosed dividing a cow area from a cart storage (Figure 4.4). The acacia posts supporting the cow shed were regularly spaced, with three along its side and five along its length with slight variation in diameter (Table 4.0), while the roof was constructed with toddy palm leaves.

ID	Village	Associated Building	Feature	Measurement	Material
CS7	Thae Pyin Taw	Cow Shed	Post	19.0 cm	Acacia
CS8	Thae Pyin Taw	Cow Shed	Post	19.0 cm	Acacia
CS9	Thae Pyin Taw	Cow Shed	Post	16.5 cm	Acacia
CS10	Thae Pyin Taw	Cow Shed	Post	15.2 cm	Acacia

Table 4.0. Thae Pyin Taw cow shed post diameters (Courtesy of Talis Talving-Loza and IRAW@Bagan Project).

Sheltered under the cow shed, on its eastern side, was a large trough made from a hollowed-out tree trunk and raised off the ground by posts (Figure 4.6). The floor surface around the area appeared to be covered in manure and fodder. There was also a large stone within the floor surface (Figure 4.6), though its purpose was not documented. Also, observable in Figure 4.6 was a crudely made fence, constructed by stringing thin branches/stalks to the main support posts of the cow shed, along with a pair of woven baskets within the cow shed. The floor surface on the eastern side of the cow shed looks smooth, appearing to be a plastered or tamped surface (Figure 4.3). A small line of stones can also be observed along the eastern edge of the floor surface, and the upper floor of the cow shed was utilized as storage space for animal feed (Figure 4.3). The floor surface on the western side of the cowshed, where the animals are kept, appears disturbed, particularly the area directly underneath the roof of the cow shed (Figure 4.4). Observable in Figure 4.4 is a line of lighter dirt on the surface between the ground directly beneath

the cow shed, and that just outside. Whether it is a part of the same plastered or tamped floor observed on the eastern side of the cow shed is unclear. Adjacent to the western side of the cow shed was a pile of manure, cribbed by the fence line and a small retaining wall constructed from stones and logs (Figure 4.7), along with a stored pile of dry branches.

Figure 4.3. Southern side of cow shed (Courtesy of Talis Talving-Loza and IRAW@Bagan Project).

Figure 4.4. Eastern side of cow shed (Courtesy of Talis Talving-Loza and IRAW@Bagan Project).

Figure 4.5. Western side of cow shed (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.6. Close-up of feeding trough (Courtesy of Talis Talving-Loza and IRAW@Bagan Project).

Figure 4.7. Collected animal dung pile (Courtesy of Talis Talving-Loza and IRAW@Bagan Project).

Animals that were present and documented in Thae Pyin Taw at the time the IRAW@Bagan team conducted their surveys included: oxen and cows; pigs; chickens; goat; dog; and cat (Macrae 2017:109). However, only the oxen/cow were pictured here, with no photographs of the pigs, chickens, goat, dog, or cat taken. Also present, and used in conjunction with animals, were two oxcarts and a plow. Oxen and cattle were used for labour, while the goat, pigs, and chickens were mostly for the occupant's personal consumption.

Shwe Hlaing

Visited on December 11th of 2017, Shwe Hlaing was the next village surveyed by the IRAW@Bagan team. This village was the furthest from Bagan, at 20.7 km to the southeast of the walled and moated epicenter. The house compound visited was organized into a rectangular shape with the north to south running fencing measuring 25.9 m, and east to west fencing extending 27.3 m. The fencing was constructed of thin wooden sticks woven between a frame of larger sticks (Talving-Loza 2019:78). The enclosed main house was built in the centermost northern section of the compound and faced south, toward an open veranda. The main house measured 3.96 m wide by 7.3 m long, with the veranda measuring 3.96 m by 6.4 m (Figure 4.8).

A small, separate construction 1.8 m southwest of the main house was the kitchen. The enclosed structure was 2.7 m x 3.5 m, constructed with nine evenly spaced posts, bamboo panel walls, and a dried toddy palm roof. The kitchen also had its own veranda measuring 2.2 m x 7.4 m. Everything within the kitchen had been removed due to an

impending move by the compound's occupants, though, scorch marks were observed on the floor surface close to the northwestern wall where a cooking fire had been previously.

Located towards the northeast corner of the compound was a large cow shed running 7.62 m north to south, and 4.72 m east to west (Figure 4.9). The frame of the cow shed consisted of posts in a configuration of four posts running down the length, and three posts across the width. Each of the posts was made of acacia wood (Figure 4.11), though their diameters range from 15.24 to 21.59 cm (Table 4.1), supporting a roof constructed of dried toddy palm. In the southwestern corner of the compound stood a feeding trough made from a hollowed-out tree trunk and held up by posts, and what looks like stacked pieces of wood (Figure 4.12). Along the southern fence line, behind the feeding trough, was an area used to store manure, and what look like other refuse items (branches, palm leaves, pieces of fencing) (Figure 4.12).

Surrounding the floor of the cow shed appears to be a small trench/berm, or the floor of the cow shed could be raised slightly above the rest of the surrounding floor surface (Figure 4.11). From Figure 4.11, it is difficult to discern the texture of the cow shed floor surface, though from the photograph, it appears rough. The rafters of the cow shed were also utilized as a storage space. A pile of beans is also observable to the south of the cowshed and covered by a layer of toddy palm (Figure 4.11), though it is unsure whether it was to be used as animal feed.

Figure 4.8. Plan view of Shwe Hlaing House Compound (map courtesy of Talis Talving-Loza and IRAW@Bagan Project).

The animals observed at Shwe Hlaing while the house compound was surveyed include the following: cows; chickens; pigs; goats; dogs; and cats (Macrae 2019:109). However, there were no clear photographs taken of the animals themselves, save for some cows in the background, though its unclear if this was the same house compound, or a neighboring house compound. Also noted was the occupants use of cow dung as fertilizer, preferring it to modern fertilizers, which they only used when traditional fertilizer runs out. Also documented was the variety of animal pests faced by the occupant, specifically rats, and flocks of pigeons, which were not recorded in either of the other villages.

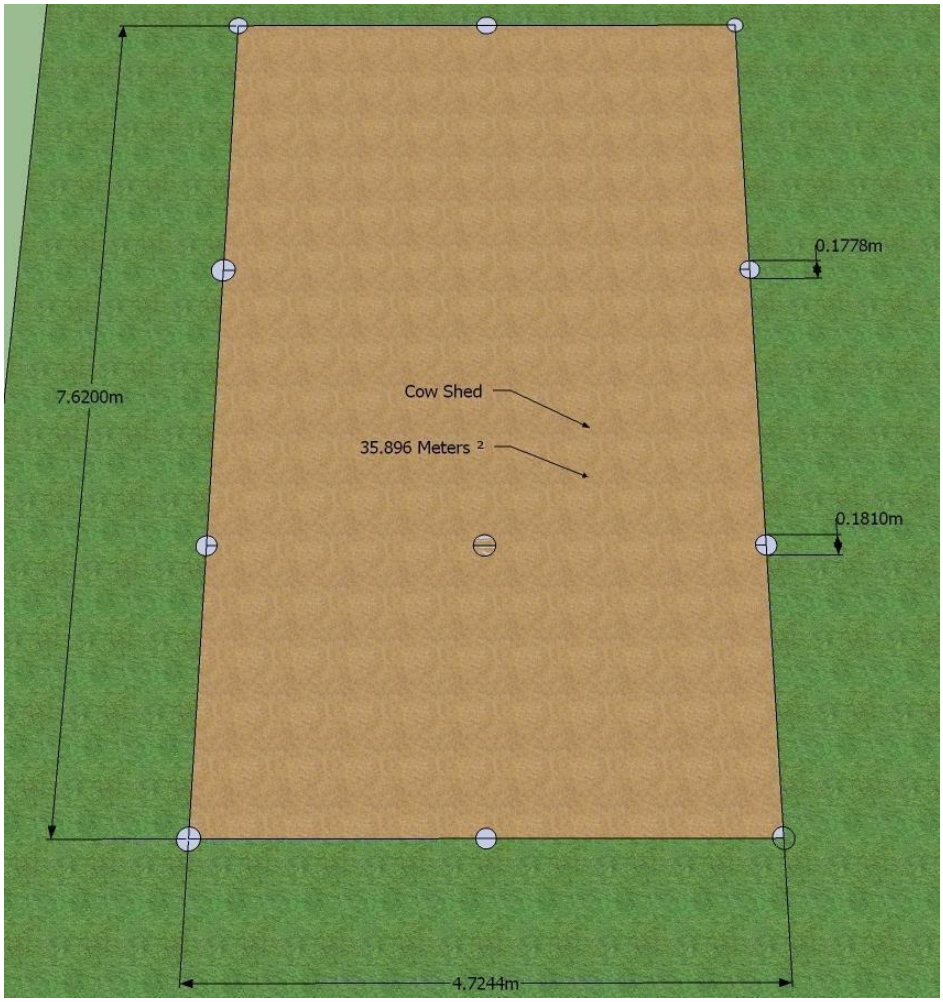

Figure 4.9. Shwe Hlaing Cow Shed (Map courtesy of Talis Talving-Loza and IRAW@Bagan Project).

ID	Village	Associated Building	Feature	Measurement	Material
CS55	Shwe Hlaing	Cow Shed	Post	19.05 cm	Acacia
CS56	Shwe Hlaing	Cow Shed	Post	17.78 cm	Acacia
CS57	Shwe Hlaing	Cow Shed	Post	16.51 cm	Acacia
CS58	Shwe Hlaing	Cow Shed	Post	19.05 cm	Acacia
CS59	Shwe Hlaing	Cow Shed	Post	19.05 cm	Acacia
CS60	Shwe Hlaing	Cow Shed	Post	17.78 cm	Acacia
CS61	Shwe Hlaing	Cow Shed	Post	17.78 cm	Acacia
CS62	Shwe Hlaing	Cow Shed	Post	21.59 cm	Acacia
CS63	Shwe Hlaing	Cow Shed	Post	15.24 cm	Acacia
CS64	Shwe Hlaing	Cow Shed	Post	19.05 cm	Acacia
CS65	Shwe Hlaing	Cow Shed	Post	17.78 cm	Acacia
CS66	Shwe Hlaing	Cow Shed	Post	19.05 cm	Acacia

Table 4.1. Shwe Hlaing Cow Shed Post Diameters (Table courtesy of Talis Talving-Loza and IRAW@Bagan Project).

Figure 4.10. Shwe Hlaing House Compound (Photo courtesy of Talis Talving-Loza and IRAW@Bagan).

Figure 4.11. Shwe Hlaing Cow Shed (Photo courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.12. Feed Trough and Manure Pile at Shwe Hlaing House Compound (Photo courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.13. Mural at Shwe Hlaing Temple featuring cows plowing a field (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Zee Oo

The next village surveyed by the IRAW@Bagan researchers was Zee Oo, visited on December 12th, 2017 (Talving-Loza 2019:86). Located 19.6 km southeast of Old Bagan, the village of Zee Oo was characterized by a small, wooded area directly east of the village, which served as the venerated home of a water spirit. These woods also served as a source for fuel and construction material, as well as being the location of the village water tank (Talving-Loza 2019:86). The house compound surveyed by IRAW@Bagan researchers was in a rectangular shape, narrowing towards the north of the compound (Figure 4.14). The fences bordering the compound were primarily constructed of individual posts, and a mixture of woven bamboo and dried toddy palm. The eastern fence line ran a length of 31.7 m, while the western fence extended 30.8 m. The northern fence line marked the shortest side at 17.7 meters, and the southern fence measured 24.99 m.

The kitchen was attached to the main house's veranda on its western side, consisting of three posts running 3.9 m north to south in two rows, with the kitchens bamboo panel walls running a length of 2.6 m east to west (Talving-Loza 2019:93). Along the northwestern edge, inside the kitchen, was a small cooking area dug into the ground and covered by a concrete, clay, or plaster construction with an embedded toddy pot at one end serving as a smokestack. Small ceramic pots, along with medium and large metal cooking pots were also nearby the cooking area. Metal trays and bowls were placed on top of some of the metal cooking pots. The floor surface of the kitchen appeared smooth, with a woven bamboo mat on top in front of the cooking area. Bricks lined the edge of the kitchens floor surface filling the gap between the wall panels and floor. One

of the metal cooking pots also appeared to be sitting on top of some sort of base, as if it had been raised from the floor surface itself, though this is unclear (Talving-Loza 2019:93). A small shop at the northeastern end of the compound also contained a cast-iron cooking surface along its southwest edge, placed over a fire pit dug into the floor surface with an upright toddy pot chimney (Talving-Loza 2019:95).

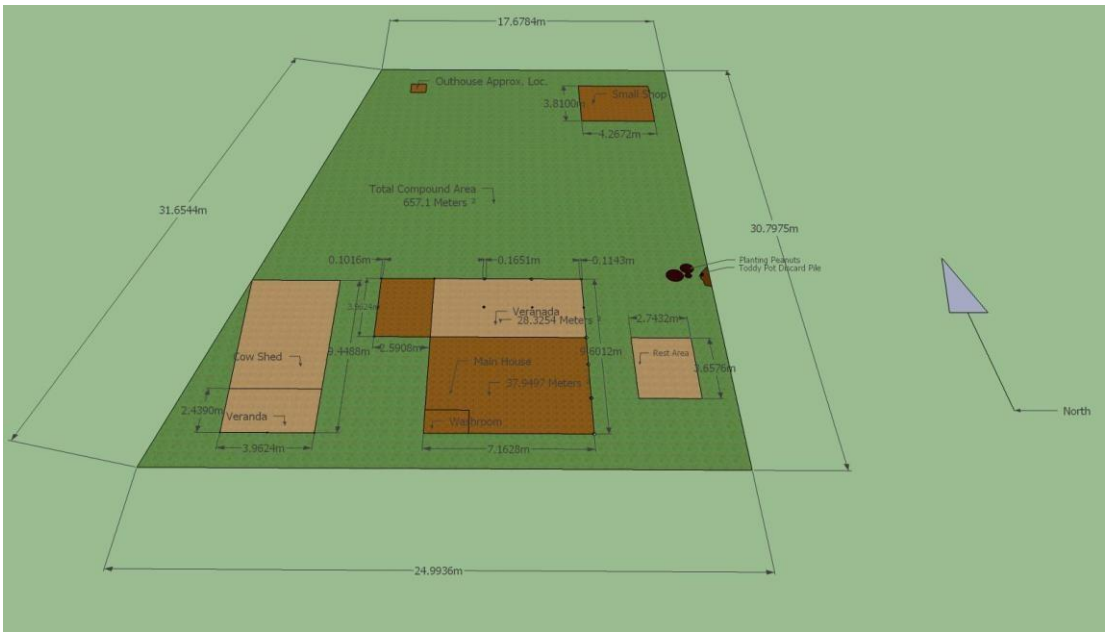

Figure 4.14. Plan view of Zee Oo house compound (Map courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

ID	Village	Associated Building	Feature	Measurement	Material	Notes
CS122	Zee Oo	Cow Shed	Post	6.4 cm	Acacia	Overhang Post
CS123	Zee Oo	Cow Shed	Post	6.4 cm	Acacia	Overhang Post
CS124	Zee Oo	Cow Shed	Post	6.4 cm	Acacia	Overhang Post

Table 4.2. Cow shed post measurements at Zee Oo (Table courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

The cow shed at Zee Oo was a large structure directly east of the compounds main house. Rectangular, the eastern and western sides of the cow shed measured 9.4 m, while the northern and southern sides measured 3.9 m. This included a small 2.4 m overhang

extending over the southern side of the cow shed (Figure 4.15). Five posts made of acacia wood spanned the length of the cow shed along the eastern and western sides, while three posts spanned the width on the north and south sides, supporting a steel roof. The rafters of the cow shed were used to store items such as bamboo poles and baskets. Also, observable in Figure 4.15, is a long, red, rectangular object, seemingly supported by a large, wheel-like object. Whether this is a feeding trough, or something else is unclear.

At the front of the cow shed was a pile of logs, which also appear to be stored along the western fence line of the house compound (Figure 4.16). Observable in the foreground of Figure 4.16 are ceramic vessels of various sizes, and an oxcart with a barrel and chocks beneath the wheels. Also, in the background of Figure 4.16, a feeding trough supported by posts can be observed. The feeding trough also appears to be sitting on some sort of platform (Figure 4.16). The texture of the house compounds floor surface varies throughout, though appears considerably rougher in areas where it appears there are also cattle. There are also other items related to animals viewed within the house compound, including what looks like a basket to house chickens (Figure 4.17), and extra posts to tie up the many cattle observed in the compound.

Figure 4.15. Zee Oo cow shed (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.16. Inside Zee Oo cow shed looking north (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.17. Zee Oo house compound courtyard (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.18. Small shop at Zee Oo house compound (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.19. Ox cart moving through Zee Oo (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Animals documented and noted at the Zee Oo house compound include numerous cattle, goat, pig, and chicken. Only the cattle were present in many of the photographs taken, with no pictures taken of the other animals noted by the IRAW@Bagan team. Other animals photographed but not noted include dogs and cats present around the house compound. There was also no clear note or image for the location of the feed trough, nor where animal waste was stored, though the floor surface beneath the animals was covered in manure and urine (Figure 4.16). It was noted that cow and goat dung were the preferred fertilizer used on the occupants' fields. Also documented was a small shop in the northeast part of the house compound (Figure 4.18). This structure measured 4.2 m by 3.8 m, with four acacia posts running along the eastern and western sides, and three posts

along the northern and southern sides. The shop was used by the occupants as a place to sell some of their stock (Talving-Loza 2019:94).

Kon Sin Kyi

Kon Sin Kyi, located 6.8 km from Old Bagan, was the next village surveyed by the IRAW@Bagan team on December 13th, 2017 (Talving-Loza 2019:97). The house compound visited was surrounded by a perimeter fence that extended 15.24 m north to south, and 29.7 m running east to west and constructed of woven dried toddy palm. It was noted that this compound offered for survey was missing most of its components, having been removed and re-arranged to supply space for several more cows and a larger cow shed (Talving-Loza 2019:99). The cow shed that was in the compound (whether it was new or already present was not specified), was located on the southeast side of the compound, and was constructed of a dried toddy palm roof held up by six acacia wood posts. The floor surface of the compound appears rough, and observable in Figure 4.19 are extra items such as animal dung, a pile of dried brush, a tree stump, and some stones, along with posts in the ground to tie animals.

Figure 4.20. Cows at Kon Sin Kyi house compound with cow shed behind (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.21. Cow at feeding trough in Kon Sin Kyi compound (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.22. Animal feed storage in Kon Sin Kyi compound (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.23. Plow with plowshares at Kon Sin Kyi compound (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.24. One of several oxcarts at Kon Sin Kyi compound (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.25. Collected manure at Kon Sin Kyi compound (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Animals that were documented and photographed at the Kon Sin Kyi primarily consisted of cattle (Figure 4.20). Apart from the animals themselves, the IRAW@Bagan researchers were able to document and photograph things either related to animals or animal use. Within the compound was a large animal feed trough made from a hollowed - out tree (Figure 4.21). The feed trough sat on two stumps and was framed by posts, while also sitting on a sort of plaster, concrete, or stone base. It was also covered, with the feed trough, and animals feeding at it, being sheltered by an overhang. Within this structure appeared to be a storage space for animal feed as well, framed by large posts and enclosed with woven bamboo (Figure 4.22). Though its base could not be seen, there also appear to be some stacked bricks along part of the base of its walls. Observable in Figure 4.25 is a large, collected manure pile, cradled by a small fence constructed from individual posts of various sizes. Also, observable are two large logs, seemingly shoring up the front of the manure pile.

Also documented at the Kon Sin Kyi compound were several oxcarts, with two appearing more utilitarian, as the one pictured above (Figure 4.24), while another appeared more ornate. Another animal related tool pictured and noted by the IRAW@Bagan researchers was an ox-drawn plow with accompanying plowshares (Figure 4.23). In a corner of the compound was pile of animal manure, collected to be used as fertilizer in the fields. Animals noted as being present within the village, but not the house compound, and not photographed, include pigs and goats. Chickens had been the livestock animal noticeably absent from either village or house compound.

Kon Tan Gyi

Kon Tan Gyi, located 6.3 km from Old Bagan, was the next village surveyed by the IRAW@Bagan team, with the researchers visiting on December 13th, 2017, and located 6.3 km from Old Bagan (Talving-Loza 2019:103). The house compound visited was irregularly shaped (Figure 4.26), bordered by palm reed fencing. The compound contained many structures including two houses, a cow shed, and a cart shed. The larger main house, constructed of modern materials, was roughly 9.2 m by 11.9 m, save a 2.6 m by 2.8 m notch in the northeast corner, and a smaller, older, 7.3 m by 6 m house was also situated to the east of the main house (Talving-Loza 2019:104). Attached to the eastern side of the main house was a large rest area help up by three rows of four posts, utilized for oxcart, and other storage. A small 3.9 m by 2.7 m cart shed was in the northeast corner of the compound, housing another oxcart, and supported by nine evenly spaced posts, roofed by toddy palm (Figure 4.28: B). Observed within the cart shed, in Figure 4.28: B, was not only the oxcart, but also a large woven basket used for storage, and ceramic vessels.

The kitchen of the house compound was in a small off section of the western part of the secondary house's veranda, with a cooking surface made of brick, to contain the fire located in the northern section of the kitchen. Observable in the kitchen was a large metal wok with a covering and a metal tea kettle sitting atop a contraption holding the kettle above the cooking surface (Talving-Loza 2019:105). In the southern part of the kitchen was a stack of wood for the cooking fire, and a basket with what appeared to be some kind of plant material inside of it, with what looked like a cooking wok cover covering the basket. The floor surface and lower base of the kitchen was made from brick (Talving-Loza 2019:105).

The cow shed was located at the far northern end of the compound, 14.8 m away from the main house (Figure 4.27). This structure measured 3.7 m by 4.4 m and was around 16.1 m². It was constructed of myaw and acacia wood posts, supporting a toddy palm roof, spanning three rows of four posts in a north-south direction (Table 4.4). A feeding trough was housed on the southern side of the cow shed, made from a hollowed-out tree trunk, and supported by a Y-post on one side, and what look like stacked tree stumps, or stones, on the other. The floor surface of the cow shed appeared rough, with spots of manure and urine.

East of the cow shed was a manure pile, which was noted to be kept for later use (Figure 4.28: A). As observed in Figure 4.28: A, the manure pile was bordered by laid down logs and pieces of fencing.

Figure 4.26. Plan view of Kon Tan Gyi house compound (Map courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.27. Kon Tan Gyi cow shed (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

ID	Village	Associated Building	Feature	Measurement	Material
CS197	Kon Tan Gyi	Cow Shed	Post	15.2 cm	Acacia/Myaw
CS198	Kon Tan Gyi	Cow Shed	Post	15.2 cm	Acacia/Myaw
CS199	Kon Tan Gyi	Cow Shed	Post	10.2 cm	Acacia/Myaw
CS200	Kon Tan Gyi	Cow Shed	Post	16.3 cm	Acacia/Myaw
CS201	Kon Tan Gyi	Cow Shed	Post	12.7 cm	Acacia/Myaw
CS202	Kon Tan Gyi	Cow Shed	Post	16.5 cm	Acacia/Myaw
CS203	Kon Tan Gyi	Cow Shed	Post	12.7 cm	Acacia/Myaw
CS204	Kon Tan Gyi	Cow Shed	Post	12.7 cm	Acacia/Myaw

Table 4.3. Kon Tan Gyi cow shed post diameters (Table courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.28. A) Kon Tan Gyi collected manure pile; B) Kon Tan Gyi cart shed (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

No animals were purposefully documented, noted, or photographed by the IRAW@Bagan team, save for a cow in the background of the manure pile photograph (Figure 4.28: A). What was noted was the use of cow and goat dung as natural fertilizer in the occupants' fields. The occupants had also noted the danger posed by venomous snakes, particularly vipers and cobras, something not noted in the other villages surveyed.

Minnanthu

Located 4.7 km southeast of Old Bagan, and the sixth village surveyed by the IRAW@Bagan team, was the village of Minnanthu, the survey for which was conducted on December 14th, 2017. Something that distinguished Minnanthu was the presence of an ancient reservoir dating to the time of Bagan's florescence that measured 65 m by 65 m, located north of the village (Talving-Loza 2019:111).

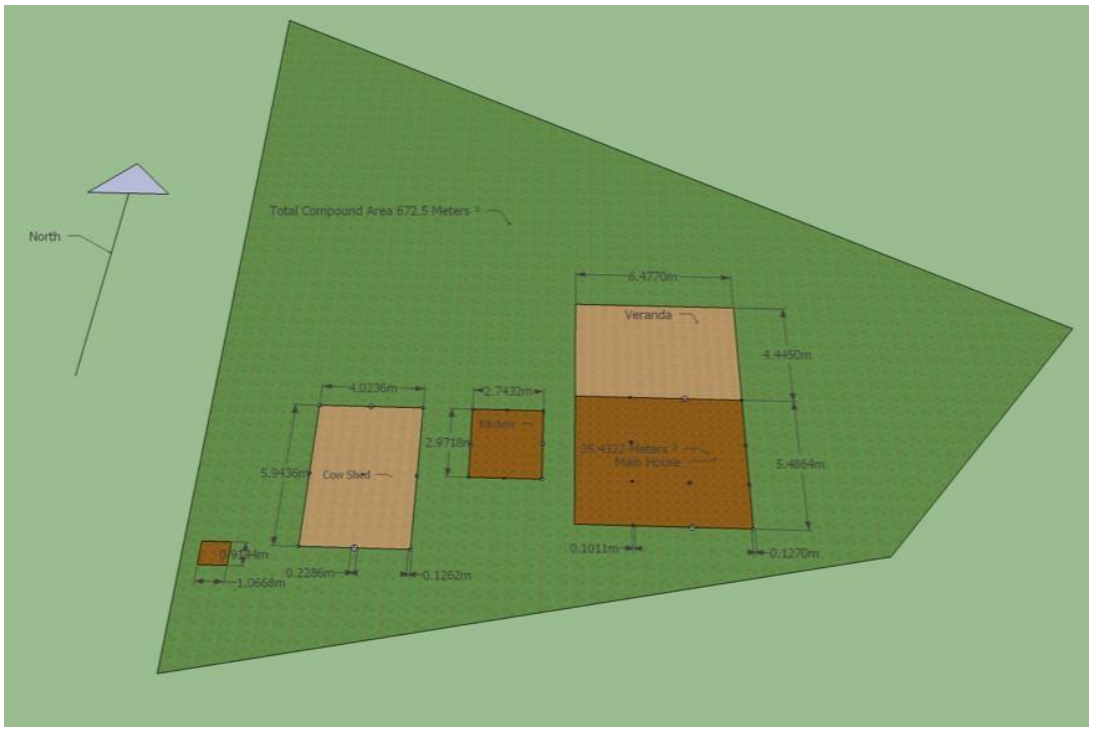

Figure 4.29. Plan view of Minnanthu house compound (Map courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

The house compound visited was irregular in shape, though surrounded by a perimeter fence on four sides (Figure 4.29). The two longest sides of the compound were the northern fence, extending 38.6 m, and the western fence, spanning 32.9 m. The Southern fence line measured 25.8 m, and the eastern fence was the shortest at 13.5 m. Within the house compound, the main structures were more in the southern section of the space. The main house was north facing with an enclosed space and veranda. The

enclosed space measured 6.5 m, running east-west with four evenly spaced posts, and 5.4 m, with four posts running north-south. Floor levels of the house were elevated on the posts in the main structure, with the space underneath used for storage and pest prevention (Figures 4.30 and 4.31). Stones had also intended to be placed along the drip line of the roof to prevent soil erosion. The veranda nearly doubled the size of the main house, constructed of four posts extending 4.4 m north-south, and another four posts running 6.4 m east-west, all made form acacia wood (Talving-Loza 2019:116-117). The structures surveyed contained few items due to a renovation in progress on the house compound at the time if the IRAW@Bagan researchers visit.

A self-contained kitchen, measuring 2.7 m x 2.9 m, was located directly west of the main house (Figure 4.30). The kitchen was made from eight acacia posts, ranging from 7.6 cm to 13.97 cm, enclosed with woven bamboo panels and roofed with dried toddy palm. The interior was void of items in preparation for a renovation, though a small brick-lined fireplace was located along the kitchens western wall (Talving-Loza 2019:117).

Figure 4.30. Minnanthu house (right) and kitchen (left) structures (Photo Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.31. Minnanthu House close-up (Photo Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.32. Minnanthu Cow Shed (background) (Photo Courtesy of Gyles Iannone and the IRAW@Bagan Project).

West of the main house was a large rectangular cow shed (Figure 4.32). The cow shed measured 5.9 m long by 4 m wide, and its toddy palm roof was supported by rows of three acacia posts on each side, though the post diameters varied greatly (Table 4.5). As with the other structures within the house compound, the cow shed was mostly empty, save for serving as a storage space for some construction material, and as a temporary kitchen area (Figure 4.32). Though the cow shed itself was mostly empty, the space around it was observed to contain some materials, such as, a pile of bamboo poles along the southern fence line, baskets, and what looked like some sort of pot, or tray, propped up on a stone base, with another stone beside it. There also appeared to be a single post dug into the floor surface off the southeast corner of the cow shed (Figure 3.32). This was like the one observed with cattle tied to it elsewhere in the compound (Figure 3.33). The floor surface surrounding the post looked considerably more rough, possibly due to being pock marked with hoof prints, while there also appeared to some traces of feces and/or urine.

ID	Village	Associated Building	Feature	Measurement	Material
CS284	Minnanthu	Cow Shed	Post	22.9 cm	Acacia
CS285	Minnanthu	Cow Shed	Post	12.7 cm	Acacia
CS286	Minnanthu	Cow Shed	Post	10.2 cm	Acacia
CS287	Minnanthu	Cow Shed	Post	13.97 cm	Acacia
CS288	Minnanthu	Cow Shed	Post	7.6 cm	Acacia
CS289	Minnanthu	Cow Shed	Post	12.7 cm	Acacia
CS290	Minnanthu	Cow Shed	Post	12.7 cm	Acacia
CS291	Minnanthu	Cow Shed	Post	19.05 cm	Acacia
CS292	Minnanthu	Cow Shed	Post	15.2 cm	Acacia

Table 4.4. Minnanthu cow shed post diameters (Table courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.33. Cows in Minnanthu house compound (Courtesy of Scott Macrae and the IRAW@Bagan Project).

The only kind of animal documented and photographed by the IRAW@Bagan were cows (Figure 4.33), with the house compound itself having two cows. The occupant of the house compound mentioned how younger villagers keep extra cows to sell, and that when they were younger, they once raised pigs. This was no longer practiced at Minnanthu due to Buddhist teaching that raising pigs was de-meritorious. Cow dung was also used as a favored form of traditional fertilizer, and dung was observed on top of the floor surface in parts of the compound (Figure 4.33). Also observed in Figure 4.33 surrounding the cows, were spots of ash on the floor surface, one of which still had a fire burning. The purpose for the ash, or for the burning, is unclear, though it appeared to be some kind of refuse.

Hpauk Sein Pin

The next village surveyed by the IRAW@Bagan team was the village of Hpauck Sein Pin, located 6.2 km southeast of Old Bagan, which was visited on December 15th, 2017. The house compound was bordered by a woven bamboo fence, with the compound taking an irregular, four-sided shape (Figure 4.34). Measuring 33.5 m, the eastern fence was the longest, followed by the northern fence at 32.5 m, the western fence at 22.6 m, and the south fence being the shortest at 13.7 m.

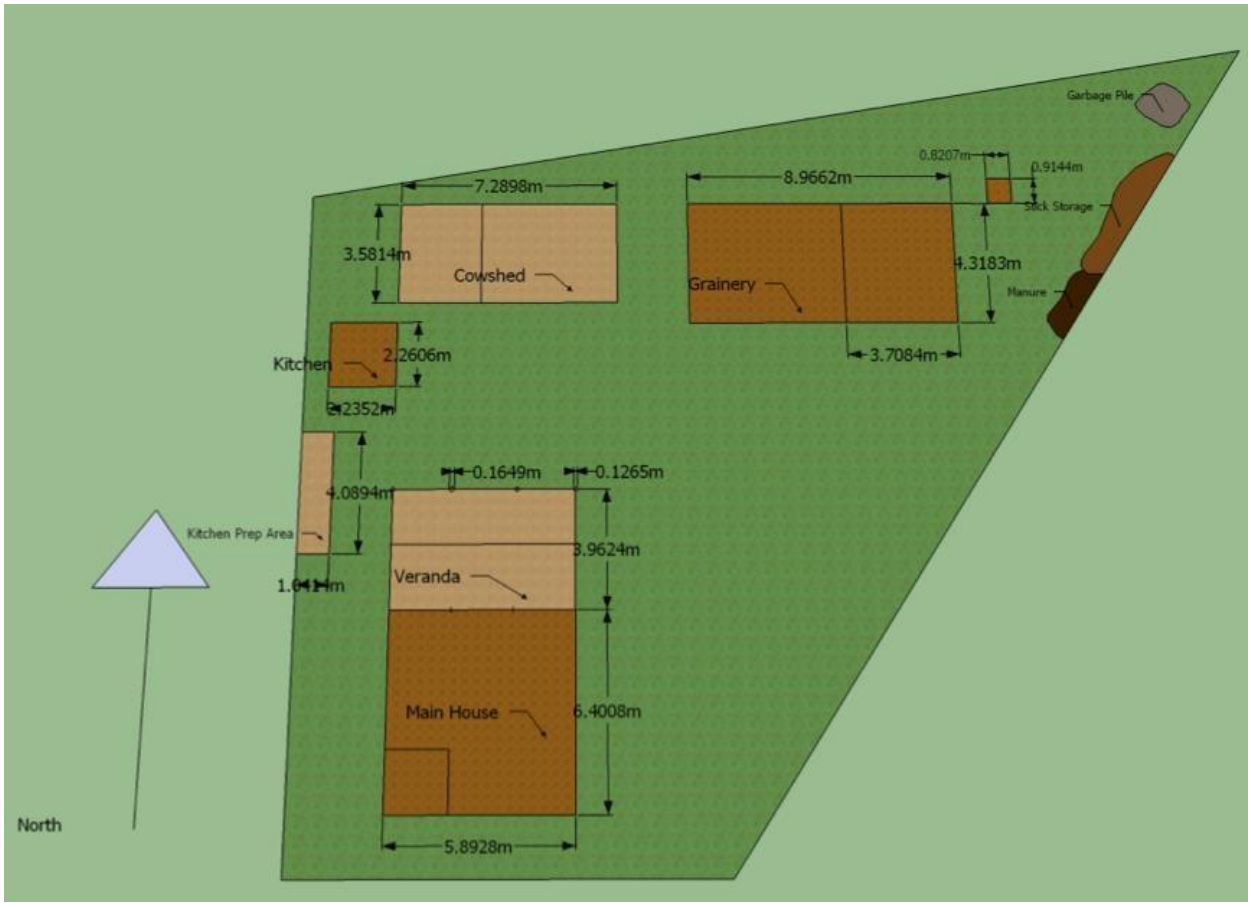

Figure 4.34. Hpauk Sein Pin house compound layout (Map courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

A total of six constructions were housed in the Hpauk Sein Pin house compound including a main house, and two cow sheds. The main house was divided into two sections with an enclosed space measuring 6.4 m in length by 5.89 m in width, and a veranda directly north with open walls measuring 3.96 m by 5.89 m. The main house was raised, stilted on sixteen posts, evenly spaced in a four-by-four configuration, while the veranda spanned four posts along its long axis, and three posts along its short axis. Along the western fence line was a large 1.04 m x 4.1 m kitchen preparation area housing a bench, a table, and washing stations, while a number of pieces of pottery were kept underneath the table, and several large ceramic jugs filled with water bordered the structure. The kitchen preparation area was constructed of six posts holding up a dried toddy palm roof. A separate enclosed kitchen was located directly north of the kitchen preparation area, made from eight posts propping up a roof of shredded bamboo thatch and walls of bamboo panelling running 2.3 m north to south, and 2.2 m east to west. Stones and bricks were placed where the panels met the swept earth floor surface for pest control. The cooking area was located in the southwest corner of the kitchen, with a large fireplace bordered by sheet metal to protect the bamboo walls from burning (Figure 4.35). Various large steel pots and ceramic pottery were set out on a brick surface directly adjacent to the fireplace, while wood intended as fuel for the fire was stored in the northern half of the structure (Figure 4.35).

Figure 4.35. Hpauck Sein Pin Kitchen (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

North of the main house was a large cow shed that consisted of two distinct buildings with separate roofs constructed of toddy palm. The western cow shed measured 7.8 m by 3.5 m and was constructed with nine posts. This side of the cow shed had an upper level constructed from bamboo poles (Figure 4.38). The eastern cow shed (labeled granary in Figure 4.34), measured 8.9 m by 3.7 m, and was held up by nine posts with a 3.7 m overhang on its east side. It was primarily used to provide shade for the occupant's cows. The eastern part of the cow shed also consisted of a slightly raised granary, walled by woven bamboo panels and with a brick foundation on top of the floor surface. It was used for storage of cow fodder (Figure 4.39). This was also where a feeding trough made from a hollowed-out tree trunk was housed, supported by wooden posts and a tree stump. Acacia wood was again the primary material used for post construction, with their diameter varying considerably (Table 4.6). The floor surfaces of both cow sheds were

rough due to animal activity, with both also appearing to have manure and/or urine on the surface (Figure 3.38 and Figure 3.40).

ID	Village	Associated Building	Feature	Measurement	Material	Notes
CS352	Hpauck Sein Pin	Cow Shed	Post	7.6 cm	Acacia	Cow Shed
CS353	Hpauck Sein Pin	Cow Shed	Post	8.9 cm	Acacia	Cow Shed
CS354	Hpauck Sein Pin	Cow Shed	Post	8.9 cm	Acacia	Cow Shed
CS355	Hpauck Sein Pin	Cow Shed	Post	10.2 cm	Acacia	Cow Shed
CS356	Hpauck Sein Pin	Cow Shed	Post	15.2 cm	Acacia	Cow Shed
CS357	Hpauck Sein Pin	Cow Shed	Post	15.2 cm	Acacia	Cow Shed
CS358	Hpauck Sein Pin	Cow Shed	Post	13.97 cm	Acacia	Cow Shed
CS359	Hpauck Sein Pin	Cow Shed	Post	19.1 cm	Acacia	Cow Shed
CS360	Hpauck Sein Pin	Cow Shed	Post	19.1 cm	Acacia	Cow Shed
CS370	Hpauck Sein Pin	Cow Shed	Post	12.7 cm	Acacia	Overhang for Trough
CS371	Hpauck Sein Pin	Cow Shed	Post	12.7 cm	Acacia	Overhang for Trough
CS372	Hpauck Sein Pin	Cow Shed	Post	7.6 cm	Acacia	Overhang for Trough
CS373	Hpauck Sein Pin	Cow Shed	Post	10.2 cm	Acacia	Overhang for Trough

Table 4.5. Hpauk Sein Pin cow shed post diameters (Table courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.36. Hpauk Sein Pin house compound (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.37. Hpauk Sein Pin cow sheds (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.38. Interior of Hpauk Sein Pin western cow shed (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.39. Hpauk Sein Pin eastern cow shed fodder storage (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.40. Hpauk Sein Pin eastern cow shed overhang and feeding trough (collected manure pile also pictured) (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Save for a dog captured in the foreground of a photograph (Figure 4.36), no images of animals were directly taken by the IRAW@Bagan team within the house compound or village, nor were animals such goats, pigs, or chickens noted. There were several photos taken featuring items related to animal use, and the presence of animals noted by IRAW@Bagan researchers while conducting their survey (Macrae 2019:109), including two cows, a dog, and three cats. Among the items housed in the western cow shed were an oxcart, along with what appeared to be a plow and accompanying plowshares (Figure 4.38). Also noted, towards the eastern side of the house compound and adjacent the eastern cow sheds overhang, was a collected pile of manure to be used as fertilizer by the occupant (Figure 4.40). Observable in Figure 4.40 is a long piece of wood, though it is unclear if this marks some sort of boundary for the manure pile, or if it is part of storage pile situated directly behind the manure pile (Figure 4.34).

Also, observed by the IRAW@Bagan team while surveying Hpauk Sein Pin was the use of an earth oven (Figure 4.41). The oven consisted of a pit, dug an undetermined depth into the ground, with a width just wide enough to hold a large metal wok at the sides of its base above the cooking fire. The oven was roughly rectangular in shape, though it flares out slightly towards the front, with the front edge slanting towards the fire, perhaps to act as a chimney, or allow for safe and easy placement of wood on the fire. It was noted by the IRAW@Bagan team that pork was being prepared in this instance.

Figure 4.41. Earth oven being used to cook pork at Hpauk Sein Pin (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Thuhtaykan

Surveyed by the IRAW@Bagan team on December 16th, 2017, Thuhtaykan was the next village visited, located 4.98 km southeast of Old Bagan. The house compound surveyed, did not have a cow shed, however, as the occupant was involved in lacquer ware production for commercial sale (Talving-Loza 2019:140). Therefore, the cow shed surveyed was that of the adjacent house compound (Figure 4.40).

Figure 4.42. Thuhtaykan cow shed (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

The cow shed was made for three rows of four posts, taken from acacia, holding up a large fodder storage area, and granary, and covered with steel roofing. The entirety of the structure measured 6.3 m by 4.1 m, with the storage area/granary elevated 1.7 m above the ground surface. The space directly beneath the granary also appears to be used as storage for wooden material, and one can make out what looks to be a stone block base (Figure 4.42).

ID	Village	Associated Building	Feature	Measurement	Material	Notes
CS505	Thuhtaykan	Cow Shed	Post	16.5 cm	Acacia	On adjacent lot and raised grain area
CS506	Thuhtaykan	Cow Shed	Post	19.1 cm	Acacia	On adjacent lot and raised grain area
CS507	Thuhtaykan	Cow Shed	Post	27.9 cm	Acacia	On adjacent lot and raised grain area
CS508	Thuhtaykan	Cow Shed	Post	27.9 cm	Acacia	On adjacent lot and raised grain area
CS509	Thuhtaykan	Cow Shed	Post	20.3 cm	Acacia	On adjacent lot and raised grain area
CS510	Thuhtaykan	Cow Shed	Post	25.4 cm	Acacia	On adjacent lot and raised grain area
CS511	Thuhtaykan	Cow Shed	Post	30.5 cm	Acacia	On adjacent lot and raised grain area
CS512	Thuhtaykan	Cow Shed	Post	15.2 cm	Acacia	On adjacent lot and raised grain area
CS513	Thuhtaykan	Cow Shed	Post	22.9 cm	Acacia	On adjacent lot and raised grain area
CS514	Thuhtaykan	Cow Shed	Post	19.1 cm	Acacia	On adjacent lot and raised grain area
CS515	Thuhtaykan	Cow Shed	Post	11.4 cm	Acacia	On adjacent lot and raised grain area
CS516	Thuhtaykan	Cow Shed	Post	20.3 cm	Acacia	On adjacent lot and raised grain area

Table 4.6. Thuhtaykan cow shed post diameters (Table courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.43. Thuhtaykan cow shed close-up (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

A 2.7 m x 3.1 m structure housed the compound's kitchen 1.3 m west of the house's veranda, made from thirteen posts supporting bamboo panel walls, while bricks were placed at the base of the walls as a rainwater deterrent. Modern cooking appliances located in the kitchen were powered by a small generator. A storage unit for house wares was located in the southeast corner of the kitchen while the western half consisted of a

large, bamboo covered platform, and a table used for holding other appliances and food related paraphernalia (Talving-Loza 2019:136-137).

The only animal noted and photographed at Thuhtyakan was an ox (Figures 4.42 and 4.43). Visible in the photos taken of the cow shed, and noticeable around it, are some items with association to animals. These include two feeding troughs made from hollowed out tree trunks that, although they were supported by posts, also appear to be sitting very close to the ground. There is also what appears to be another small shelter held up by acacia posts with a toddy palm roof (Figure 4.43), and a plow (Figure 4.42). The floor surface in the area beneath, and around, the granary/cow shed appears rough, with dung also present on the ground. Noted as well was the presence of a village pig pen, though no other information about it was provided. Also noted was the use of cow and goat dung by the occupant as a natural fertilizer, though it was not documented if there was a manure pile present on the house compound surveyed.

East Pwa Saw

East Pwa Saw was the ninth village surveyed by the IRAW@Bagan team. It was located 5.4 km southeast of Old Bagan and visited on December 17th, 2017. The house compound visited was an irregular four-sided shape which was not bordered by fences due to what was noted as good relationships with neighbors (Talving-Loza 2019:142). The north side of the compound measured 16.5 m, the east side 66.1 m, the south side spanned 41.5 m, and the west side of the compound 62.8 m (Figure 4.44).

This house compound featured many structures, including three separate houses. The largest house was the southern most house with an open north facing veranda, with the interior space measuring 4.64 m by 5.8 m, the living floor raised 91.6 cm above the ground, and the veranda measuring 6.95 m by 5.8 m. The layout of house posts in the first large house consisted of five rows of four evenly spaced posts. The second house measured 6.9 m by 10.26 m, with an enclosed space again supported by five rows of four posts and had two levels. This created a 114.3 cm high open area under the house, along the eastern side of which was a small bamboo enclosure housing chicken (Figure 4.48). The third house was smaller, southward facing structure that measured 4.26 m by 5.6 m, with a veranda which was 5.6 m by 2.7 m.

The kitchen was a separate 2.2 m x 3.3 m in the central area of the compound west of the main houses framed by two rows of three, square milled posts, and a floor at ground level with a surface that was swept clean and appeared to be a concrete slab (Talving-Loza 2019:149-150). The foundation was created with cement blocks along the posts, and brick that reached a third of the height of the kitchen's walls. The kitchen's interior contained several small tables holding appliances and wares, as well as large ceramic pots. The kitchen did not have a hearth, instead several modern cooking appliances were present, including hot plates and rice cookers. Extra bamboo strips were used to cover gaps where the kitchen's wall panels did not entirely meet the floor to deter animals, particularly chickens and snakes. The wall panels of the kitchen were made from woven bamboo panels and roofed with corrugated steel (Talving-Loza 2019:149-150). A small kitchen was also located in the southern-most half of the small northern house's

veranda, containing a brick-lined hearth and two other surfaces holding ceramic vessels and cookware (Talving-Loza 2019:149).

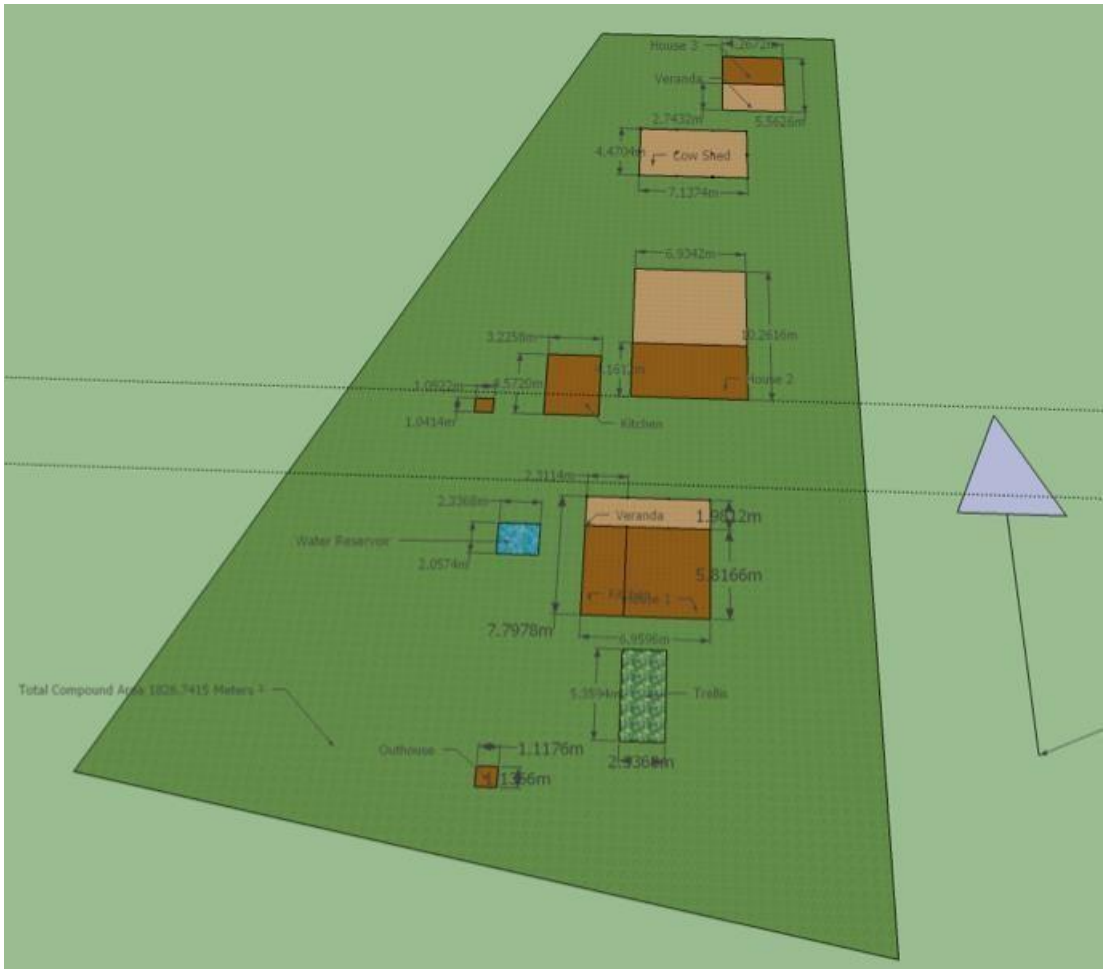

Figure 4.44. East Pwa Saw house compound layout (Map courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Between the central and northern most house was a large cow shed, measuring 7.1 m by 4.4 m. Spanning its length and supporting it were three rows of four posts constructed of sandal and inn wood (Table 4.8), that held up a toddy palm roof. The cow shed was subdivided into areas dedicated to storage, shelter for cows, and a granary/fodder storage area. The occupant's cart was housed in the eastern section of the cow shed, which also contained a raised platform, while the northeast corner had been

dedicated to a raised, walled-off area where fodder was stored. Some posts also appear to have flat stones surrounding their base to form solid footings (Figure 4.46).

ID	Village	Associated Building	Feature	Measurement	Material
CS525	East Pwa Saw	Cow Shed	Post	12.7 cm	Sandal/
CS526	East Pwa Saw	Cow Shed	Post	17.8 cm	
CS527	East Pwa Saw	Cow Shed	Post	10.2 cm	
CS528	East Pwa Saw	Cow Shed	Post	1	
CS529	East Pwa Saw	Cow Shed	Post		
CS530	East Pwa Saw	Cow Shed			
CS531	East Pwa Saw	Cow Shed			
CS532	East Pwa Saw	Cow			
CS533	East Pwa Saw				
CS534	East Pw				
CS535					
CS5					

Table 4.7. East Pwa Saw cow shed post diameters (Map courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.45. East Pwa Saw cow shed (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.46. Close-up of East Pwa Saw cow shed with sheltered oxcart (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.47. Cows in East Pwa Saw compound (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.48. Chicken coup beneath house in East Pwa Saw house compound (Courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.49. East Pwa Saw feeding trough (Courtesy of Talis Talving-Loza and the IRAW@Bagan Porject).

The only animals photographed at the East Pwa Saw house compound surveyed were two cows. However, as noted above, there were chickens kept in the compound, although the only related feature photographed was the chicken coupe beneath the main house (Figure 4.48). Animal related items present within the house compound included the oxcart sheltered within the cow shed (Figure 4.46), and another oxcart with parts kept along the western edge of the compound. Also along the western edge of the compound was a shaded area where the cows were primarily tied up, within which was a feeding trough made from a hollowed-out tree trunk and supported by posts on one side, and what look like stacked stones on the other (Figure 4.49). There was also a large manure pile along the eastern side of the compound, this material destined to be used as fertilizer. It is also noted that the occupant mixes goat dung for natural fertilizer and purchases it from herders if necessary. The floor surface of the house compound was generally smooth, save for the areas where animals would be. However, noticeable on the surface of the compound were a few bricks (Figure 4.47), and ceramic vessels of various sizes (Figure 4.49)

West Pwa Saw

The last village surveyed by the IRAW@Bagan team during the 2017 field season was West Pwa Saw, located roughly 4.53 km southeast of Old Bagan, and adjacent to East Pwa Saw, with each separated by a major road. The house compound visited was organized in a rough L-shape, with its borders surrounded by a large woven bamboo fence (Figure 4.51).

Within the compound were five main structures including two houses, a cow shed, a kitchen, and a storehouse. The first and larger house was in south-central section of the compound, with a north facing sitting area and enclosed space measuring 5.5 m by 11.2 m, with a small 1.9 m by 2.6 m kitchen in the northwest corner. A large hearth backed onto the western wall of the kitchen and was marked by a thick layer of ash, several stones, and a cast iron cooking surface. The bamboo panel walls of the kitchen closest to the cooking surface were covered with different pieces of sheet metal for fire protection. Fuel for fires was stacked beneath the southern wall while stones and sticks were places along the kitchen's exterior, filling the gaps between the wall panels and floor surface prohibiting pests from entering (Talving-Loza 2019:160).

A smaller, north facing, second house sat directly east of the first house. It measured 4.6 m by 7.04 m. The compound also contained a 2.5 m x 2.3 m second kitchen 3.5 m north of the second house in a separate structure, supported by eight posts, walled by bamboo panels, and a thatched bamboo roof. The floor of the kitchen was directly on the surface, with many sticks located at the base of the north-facing walls used as fuel for cooking fires. The cooking surface was made from bricks on either side supporting some metal implements, allowing pots to be placed on top of the fire. The wall panels were covered by a large piece of sheet metal for fire protection, while bricks were placed onto the floor adjacent the cooking fire to serve as a surface for pots and pans when they were not on the fire. Various metal and ceramic cooking vessels were located throughout the kitchen space, while what appeared to be some ingredients and other ceramic vessels sat on or bellow a shelving unit along the eastern wall (Figure 4.50).

Figure 4.50. Secondary kitchen at West Pwa Saw house compound (Courtesy of Talis Talving-Loza and the IRAW@Bagan project).

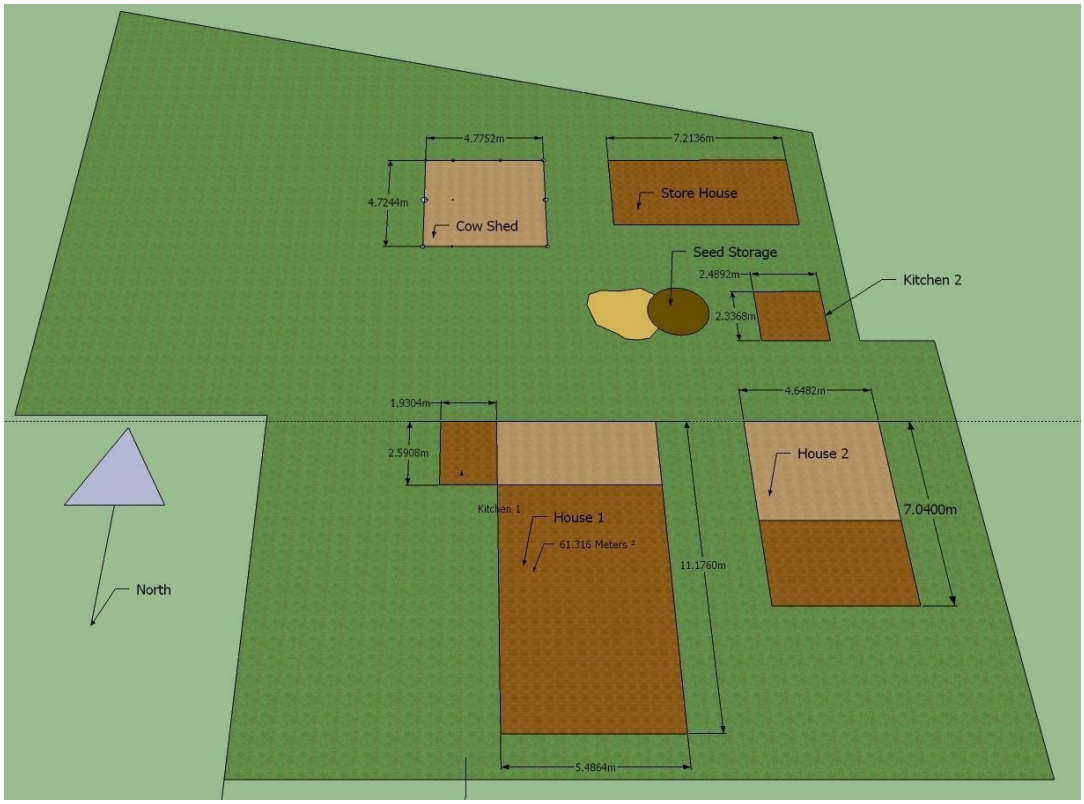

Figure 4.51. West Pwa Saw house compound layout (Map courtesy of Talving-Loza and the IRAW@Bagan Project).

The cow shed was situated in the north-central section of the compound, square in shape and measuring 4.7 m by 4.7 m and held up by sal wood posts (Table 4.8). The southern section of the cow shed housed stored lumber, while a large feed storage area was in the northern section. Located 2.6 m east of the cow shed was what is described as a large storehouse measuring 7.3 m by 3.5 m with three rows of four posts supporting it spanning its length. This structure consisted of two levels with the upper level serving as grain storage, while the lower level acted as general storage, as well as housing the family oxcart (Figure 4.52).

ID	Village	Associated Building	Feature	Measurement	Material
CS614	West Pwa Saw	Cow Shed	Post	16.5 cm	Sal w
CS615	West Pwa Saw	Cow Shed	Post	19.1 cm	
CS616	West Pwa Saw	Cow Shed	Post	15.2	
CS617	West Pwa Saw	Cow Shed	Post		
CS618	West Pwa Saw	Cow Shed			
CS619	West Pwa Saw	Cow Shed			
CS620	West Pwa Saw	C			
CS621	West Pwa				
CS622	W				
CS6					

Table 4.8. West Pwa Saw cow shed post diameters (Table courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

Figure 4.52. South side of West Pwa Saw cow shed (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.53. West side of West Pwa Saw cow shed (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.54. Interior of West Pwa Saw cow shed (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.55. West Pwa Saw compound storehouse (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.56. Cows and manure pile in West Pwa Saw compound (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.57. Goats in enclosure at West Pwa Saw compound (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

The house compound surveyed by the IRAW@Bagan team had several animals which were documented and photographed. It was also noted that the occupants work in rearing livestock, which is also observable from the multiple posted structures. The animals present included three cows, spread throughout the compound, and a few of what appeared to be young goats in a sheltered enclosure in the northwestern section of the compound, roughly adjacent to the cow shed (Figure 4.57). A fence enclosed the space beneath the structure, constructed from poles tied to posts. There was also a small space in the roof of the goat pen constructed from bamboo that appears to be used for storage. The floor of the goat pen also appears to rise gradually towards the center of the pen and is covered in dung and urine. Other things in the compound with connection to animals included two oxcarts, one of which was described as the family cart, and another carrying a barrel (Figures 4.53, 4.55, and 4.56). Also present was a feeding trough made from a hollowed-out tree trunk and supported by posts and stumps, with what also looks like a stone base directly beneath it (Figure 4.53). Also observed was a large pile of cow manure bordered by fencing and shored by logs at the front. This material was meant to be mixed with goat dung to be used as a natural fertilizer. The floor surface in areas associated with animals was rough, and often covered in manure and urine. Also, observed throughout the house compound were large woven baskets, and large ceramic vessels. There are also many piles of wood of various sizes throughout the compound.

Other Relevant Photo Data

Aside from the villages visited by the IRAW@Bagan team for the specific purpose of ethnoarchaeological based surveying, questioning, and observation, the

researchers also visited several communities in the area, either for research purposes, or to view and observe a village event. While doing so, the IRAW@Bagan team photographed a few instances in which the human/animal relationship is contextualized, not only within the house compound, but at times on the scale of the entire village or town. These villages include East Ywa Naung; Let We; Myinkaba; and Nyaung U. The village of Taung Shae was also visited, though the IRAW@Bagan team did not photograph any animals here.

Paired with these images, photographs had also been taken by the IRAW@Bagan researchers while traveling to the villages to be surveyed or stopping at a toddy shop along the way. These photos highlight agricultural practices involving animal use and animal husbandry in herds of livestock moving around Bagan's countryside.

Figure 4.58. Cow shed, cows, feeding trough, manure pile in East Ywa Naung (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Observable in Figure 4.58. in a cowshed photographed by IRAW@Bagan researchers in a house compound surveyed in East Ywa Naung, are material components associated with animals. The cowshed itself appears to have a 3 x 2 post configuration, though the directionality, and distance from other structures in the house compound are unknown. The roof consisted of sparsely thatched toddy palm, with a couple of woven baskets and a small ceramic pot sitting on the floor surface. Also, within the space of the cow shed was a basket like chicken enclosure, housing a chicken, weighed down by a stone sitting on top. Next to the cow shed, along the fence line, was a large manure pile, cribbed by bamboo poles with two large wooden front posts, while the far side appears braced by large stones. Also observable in Figure 4.58 are two cows at a feeding trough constructed from a hollowed-out tree trunk, supported by wooden posts, with what appear to be stones along the bottom. The floor surface appears rough, and as previously mentioned, strewn with much material.

Figure 4.59. Cows at feeding trough in Let We (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.60. Procession of children on decorated horses through Let We (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.61. Earth oven observed in Let We (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Animal related features observed in the photo from the house compound surveyed in Let We is a tall standing cow shed, roofed by what appears to be thatched palm, though the post configuration is unknown (Figure 4.59). Also observable in Figure 4.59 is a feeding trough made from a hollowed-out tree trunk, supported by two posts. In the foreground of Figure 4.59 can be observed what looks like a pile of stones on the right, and a circle of stacked bricks to the left, though the purpose for either of these is unknown. While Figure 4.60 does show horses being ridden in a ceremonial context, it does not point toward other material correlates, such as where and how they are housed and fed, and whatever other components may be involved in this.

Also, observed in Let We by the IRAW@Bagan team, was an earth oven being prepared for cooking fish and vegetables (Figure 4.61). The oven was made from a pit dug an indeterminant depth into the ground, with the width of the opening being just wide enough to set a large metal wok above the cooking fire. A separate opening appeared to have been dug to the side at a slanted angle, connecting to the bottom of the main pit, serving as a vent and for adding more wood to the cooking fire. Several, large, metal woks surrounded the earth oven while another sat atop the oven in use. Another smaller metal cooking vessel also sat just to the side of the oven, containing what looked like meat to be cooked. Several baskets were also observed in the area around the earth oven, with one, holding the cuts of fish, being held up by a metal three-legged stand. Also, observable in the background of Figure 4.61, was a brick lined cooking area, containing a small fire.

Figure 4.62. Cow, shelter, trough, and manure pile in Myinkaba (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.63. Dried fish at market in Myinkaba (Courtesy of Gyles Iannone and the IRAW@Bagan Project).

Figure 4.64. Cuts of meat at Myinkaba market (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.65. Chicken at Myinkaba market (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.66. Fish at Myinkaba market (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.67. Whole chicken at Myinkaba market (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.68. More Fish at Myinkaba market (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.69. Cuts of fish at Myinkaba market (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.70. Other fish at Myinkaba market (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.62 features cows sheltered under a stilted structure in a house compound while visiting the village of Myinkaba. This structure serves to store feed for the cow. It is observable that the structure appears to have a 3 x 3 post configuration is walled with woven bamboo panels, and roofed by thatched toddy palm, though its height above the floor surface is unclear. Housed under the cow shed was a feeding trough made from a hollowed-out tree trunk supported by wooden posts, with what also look like a few stones at its base. The floor surface appears rough directly beneath and around the structure, with a considerable amount of manure and urine on top. Also, observable in Figure 4.62, on the floor surface of the house compound on the right side, is a pile of stones, though their purpose is unknown, and a large ceramic vessel that also seems to be sitting on top of a pile of stones.

Also photographed by IRAW@Bagan researchers in Myinkaba was a market which featured animal products. Many of the animal products sold in this market are fish (Figure 4.62; Figure 4.66; Figure 4.68; Figure 4.69; Figure 4.70). The fish sold consisted of different species, with different sizes of fish, and they are prepared in a variety of ways. Most common were medium to small fish sold whole on large round platters (Figure 4.66; Figure 4.68; Figure 4.70). Observed in Figure 4.70, however, is a person processing a fish, though it is undetermined if each stall selling fish did this. Some stalls appeared to sell dried fish (Figure 4.63), and others cuts of larger fish (Figure 4.69). Chicken, both in cuts (Figure 4.65), and whole (Figure 4.67), were observed for sale, and on stall had a variety of cuts from an unknown animal (Figure 4.64). Apart from the fish and meats observed, one can also see some objects associated with their processing. These materials include cutting instruments, such as cleavers and knives, large, wooded butcher blocks made from tree stumps or cuts of tree trunks, as well as the large, usually metal, but also woven baskets, and plastic trays used to present the goods.

Figure 4.71. One of several elephants in a procession through Nyaung U (Courtesy of Gyles Iannone and the IRAW@Bagan).

While visiting the village of Nyaung U, the IRAW@Bagan researchers observed a ceremonial procession that featured several elephants (Figure 4.71). However, much like the horses at Let We, the photograph of the elephants does not immediately point to observable material correlates. Unlike the horses though, the size and behaviour of an Asian elephant might require specific needs, the main one being a space large enough to shelter them, along with the food and water resources required to maintain them. Large animals also produce large amounts of manure and urine. Despite their size, however, the large, round, flat feet of an elephant may leave the ground smooth and highly compacted, as opposed to the rough floor surfaces created by cow hooves.

Figure 4.72. Cow powered peanut grinder at a toddy stop (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 4.73. Cattle pulling plow (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Pictured in Figure 4.72 is a peanut grinder. The grinding is cattle powered, with an oxen harnessed to a large, seemingly teak wood, pestle. The oxen was then walked in a circle, grinding the peanuts in what appears to be a teak wood mortar. This action leaves a large, observable, circular impression on the surface. Also observed by the IRAW@Bagan researchers was a farmer plowing his field, utilizing cattle as the draft animals, in a scene that is reminiscent of the image from the mural at Shwe Hlaing Temple (Figure 4.73).

Ancillary Data from Inscriptions and Retrospective Chronicles

Inscriptions

Throughout the four volumes that comprise Charles Duroiselle's *Epigraphia Birmanica* (1919-1934), most of the inscriptions that detail animal use in some aspect center around the ruling class of Classical Bagan. In Volume 1: Part 2, on side C of The Great Inscription of the Shwezigon Pagoda, lines 24 to 29 indicates that King Sri Tribhuwanadityadhammaraja "…shall ride upon noble steeds…" in times of war, and wear ear ornament in the shape of elephants and lions (Duroiselle 1920:119). And on side D, between lines 6 to 10, it describes "…King Sri Tribhawanadityadhammarajarajadhirajaparamiswarabalacakkrawar, the exalted, who rides upon a male white elephant…" (Duroiselle 1929:142). A similar inscription in the Phayre Museum, Yangon – once part of The Great Inscription of the Shwezigon Pagoda – mentions in line 43 discusses "King Sri Tribhuwanadityadhammaragaradhirajaparamiswar, the exalted mighty universal monarch, who rides upon a white elephant…" (Duroiselle 1920:146). Another inscription, on the Talaing Plaques on the Ananda Temple, also highlights the importance of animals to places in the Vessantara Jataka. Specifically, in Volume 2: Part 1of Duroiselle's Epigraphica. Inscription 279 indicates that the citizens of a place called Jetattara show distain at Vessantara for giving away a white elephant to foreign brahmins (Duroiselle 1921:106-107). The following inscription, 280, details Vessantara's response, in which he gives a "…Great Offering, which consisted in giving away seven hundred each of everything, elephants, horses, chariots, virgins, slaves, etc." (Duroiselle 1921:107). Something similar appears in inscription 139, labeled "Mahosadha decides the case of the bull," in which a royal bull is said to be cared for by a village (Duroiselle 1921:46). In the Mon Inscriptions, comprising Volume 3: Part 1, on side J of the

inscription, lines 14-15 detail a message sent by the king to monks throughout the "Mon country" to give up their possessions, specifically including cattle or buffalo (Duroiselle 1928:259).

Some inscriptions point to the importance of treating animals well, as is documented on the third Inscription found at Shwezandaw Pagoda, Prome. As detailed in Volume 1: Part 2, on side B in lines 2-5 a passage illustrates a Buddhist doctrine of "kindness to animals" (Duroiselle 1920:155). While the following lines 8 and 9 infer animals in general were "secured generous treatment and some provision of food" (Duroiselle 1920:167). Another inscription from the Great Inscription of the Shwezigon Pagoda, Bagan, alludes to what animals may have been popular, and symbols of prosperity. On side E line 2, the inscription states "…in the realm of King Sri Tribhuw-anadityadhammaraja, O King of deva, there shall be plenty of elephants, horses, buffaloes, cattle, pigs, goats, (and) fowl…" (Duroiselle 1920:123). Line 23 of the same inscription also mention "Those who lack cattle shall have plenty of cattle…" (Duroiselle 1920:123). One inscription even alludes to the legal ownership of an animal. The Talaing Plaques on the Ananda Temple detailed in Volume 2: Part 1, inscription is 128 labeled "The case of cattle", referring a matter of possible cattle theft that is decided based on the rightful owner knowing what they fed the cow (Duroiselle 1921:42). Another inscription points to animals used for semi-martial purposes in the Mon Inscriptions, on side G, where line 28 mentions "…men mounted on elephants, and men mounted on horses…" guarding a temple.

Figure 4.74. Examples of animals on the Talaing plaques on the Ananda Temple: A) The case of the cattle; B) Mahosadha decides the case of the bull; C) The king goes out to his pleasuance; D) Vessantara gives the horses in alms (Modified from Duroiselle 1921, Vol. 3: Part 2).

Within Tillman Frasch's (2014) *Bagan Epigraphic Database*, consisting of 808 known inscriptions from the Bagan period, animals are mentioned 48 times as donations to temples. These animals primarily consist of "cattle", "cows", and "oxen", each appearing differentiated, along with elephants and horses. The "cattle", "cows", and "oxen" are by far the most mentioned throughout the inscriptions, being listed as offerings for donation in 45 of the 48 inscriptions mentioning animals. The number of animals donated ranges from a single animal, to as many as 500 bullocks donated for the

construction and maintenance of the Dhammayazika stupa by King Narapatisithu in CE 1196-1198, which is discussed in inscription B 560-1 (Frasch 2014:51-52).

Elephants appear as donations on four occassions, though in considerably fewer numbers than cattle, with a total of seven animals mentioned throughout, and predominantly by Bagan's ruling class. Inscription B 615-5 details several elephants donated to the Jeyyaswat Temple in CE 1243, the most donated at one time (Frasch 2014:111). Horses appear in three donations, though in greater numbers than elephants, but not nearly as many cattle, with a total of 26, with 15 horses being the most donated at one time to the Mahabodhi Temple in CE 1208, as outlined in inscription B 570-1 (Frasch 2014:59).

Chronicles

Within Pe Maung Tin and Gordon Luce's translation of the *Glass Palace Chronicle of the Kings of Burma* (1923), there are many areas which allude to important relationships between humans and animals. Though taken as the literal history of Burma's past by many Myanma people today, much of the *Glass Palace Chronicle* is laden with metaphor and allegory. The instances in which animals are mentioned often reflect such fantastical themes, making their true nature difficult to grasp. Nevertheless, animals appear to play an important role in the actions of humans, in some cases acting as the focul point of important events, as in selecting the location to construct the Shwezigon Pagoda, where King Anawrahta commanded a holy Buddist relic be placed on

a white elephant, and wherever the elphant knelt, that would be the spot to build the auspicious construction (Maung Tin and Luce 1923:87).

Much like the incriptions discussed above, however, many of the instances in which the human-animal relationship is featured are primarily focused around the lives of Bagan's ruling class. However, unlike the inscriptions, the chronicles also describe the practical and/or pragmatic uses and importance of animals. Throughout the text there are numurous descriptions of animals used by kings and their militaries, primarily elephants and horses. One example is a description of King Anawrahta's mission to Thaton, where "His land force, it is said, contained eight hundred thousand elephants, eight million horses, and eighteen million fighting men." (Maung Tin and Luce 1923:77). Another example describes the armies of King Alaungsithu, where it was said to contain "…threescore thousand captains, thirty-two white elephants, eight hundred thousand black elephants, eight million horses, eight million boats, one hundred and sixty million soldiers…" (Maung Tin and Luce 1923:113). With these animals used in military campaigns, there is also mention within the chronicles of those responsible for them, as alluded to when King Anawrahta successfully captures Thaton. Upon his victory he sends to Bagan "…trainers of elephants and horses…" (Maung Tin and Luce 1923:78). Eleswhere, Kings such as Dhajaraja of Tagaung give title-warrants "…to ministers and high officials, to his minions, masters of elephants, and horses, foot-soldiers, wealthy men, brahmins, astrologers, doctors of medicine, and aritsans." (Maung Tin and Luce 1923:4).

There are also descriptions of how human-animal relationships within the martial context that are symbolic of rank, as illustrated by the passage detailing the final days of

King Narapatisithu, where he states “Again, men who go forth to fight should be raised to the cavalry only when they have won ten infantry battles, to the elephantry only when they have won ten cavalry battles, to the fleet only when they have won ten elephantry battles” (Maung Tin and Luce 1923:151). Paired with these descriptions of animals used in a martial context is a passage mentioning what happens with them when not used for such purposes, where amongst King Alaungsithu’s public works “Wherever food availed he settled his soldiers and the host of elephants and horses” (Maung Tin and Luce 1923:113).

Though many of the animals appear as rather ambiguous and anonamous actors in human events and chronicles, some are given greater prominence because of the specific people they are associated with. One example is King Anawrahta’s elephant, Thanmyinzwa, which he rides on many occasions, for transportation, in battle, and for enjoyment. Other examples include the five “demon horses of imeasurable wealth” that were captured by King Kyansittha (Anawrahta’s successors) and his paladins. The name’s of Kyansittha’s horse was“Hnalonhkungaung”, and the one belonging to Anawrahta was called “Kandikalek-hla” (Maung Tin and Luce 1923:69-70).

Some passaages within the Glass Palace Chronicles also detail what animals may have been present in Bagan, in the context of being around people. One example is in the passage *Of Nyaung-u Sawrahan, the Farmer King 931-964 A.D.,* where it indicates that “To be king is exceedingly glorious. Verily he hath good clothes, good victuals in abundance, gold, silver, elephants and horses, buffaloes, oxen, goats, pigs, paddy and rice” (Maung Tin and Luce 1923:58). Another passage, *Of King Kyazwa fl. 1284-1250*, states that the King “Damned water falling from the foot of Mt. Tuywin, and filled it with

five kinds of lotus and caused all manner of birds, duck, shelrake, crane, waterfowl, and ruddy goose to take their joy and pastime therein." (Maung Tin and Luce 1923:156).

There are instances within the chronicles that also point to animals being used for food and for work. One passage stresses that "Pigs forelegs and hindlegs he would have as meat for his curries…" (Maung Tin and Luce 1923:170). However, an unfortunate event documented in the chronicles is the demise of King Hluntai, who the chronicles mention "flourished" from 569-582 AD. "After the custom of kings he went forth with, golden buffaloes, golden oxen, and golden plaugh, to observe the solemn ceremony of ploughing. And as he plowed the oxen took affright at the cotton sleeve of the kings golden cloak being blown to and fro by the wind, and they bolted, and the king fell within the arc of the ploughshare and he died" (Maung Tin and Luce 1923:51).

Animal Bones from IRAW@Bagan Excavations

During the 2019 field season, the IRAW@Bagan project researchers conducted excavations at the sites of Shwe Creek and Otien Taung, both located in what was once likely to have been Bagan's suburban zone. At Shwe Creek, Unit 315a-1, animal bones were found throughout the excavation levels. The only contexts that did not produce animal bones were Features 315a-F/1 and 315a-F/2 (both post fill contexts), as well as Level 1 and 2 (surface and plow zone, respectively), likely a result of soil disturbance caused by agricultural activity.

Radiocarbon dates were determined by analyzing charcoal samples collected from the adjacent Unit 315a-2, discussed further below. This was then stratigraphically cross-referenced to Unit 315a-1, providing relative dates indicating the site was likely occupied from the 11th – 13th century CE (Iannone et al. 2019: Table 3.3). The animal bone uncovered in Levels 4b and 5b were radiocarbon dated to the Late Bagan Period (1174 – 1300 C.E.), while those in Level 6b had been dated to the Early Bagan Period (1044 – 1113 C.E.) (Tamura and Cheong 2019a: Table 8.1). The context of Levels 4b, 5b, and 6b were noted as Floor Surface. The matrix of Levels 4b and 5b was listed as Tamped Earth, while the matrix for Level 6b was Plaster. The majority of the animal bones recovered were highly fragmented, though a partial mandible belonging to a small to medium sized herbivore, possibly a goat, was found in Level 4b (Figure 4.76) (Tamura and Cheong 2019a:125). Some of the animal bone excavated from Shwe Creek Unit 315a-1 was associated with Feature 315a-F/8, dated to the Late Bagan Period (1174 – 1300 C.E.). This feature was interpreted by the IRAW@Bagan researchers as associated with pit fill.

Excavations conducted in Shwe Creek, Unit 315a-2 by the IRAW@Bagan team recovered highly fragmented animal bones in Levels 5b, 4b (both living floors), and 3 (sub-plow zone), though they were absent in Levels 6b (living floors), and Levels 1 and 2 (surface and plow zone, respectively). Radiocarbon dates were determined by the IRAW@Bagan team (Iannone et al. 2019: Table 3.3) through analyzing two charcoal samples recovered from Levels 5b and 6b of Unit 315a-2. The sample recovered from Level 6b provided a date of 1045-1216 calAD, which is associated with the Early (1044 – 1113 CE), Middle (1113 – 1174 CE), and beginning of the Late Bagan Period (1174-1300 CE), indicating that the site was likely occupied during the 11th to 13th century.

Due to the small size and fragility of the animal bones uncovered in Unit 315a-2, the species are yet to be identified (Rivera and Cheong 2019a:163). It was noted that some of these bones appeared burnt. The animal bone recovered from Levels 5b and 4b were both dated to the Late Bagan Period (1174 – 1300 CE), with a Tamped Earth matrix (Rivera and Cheong 2019a: Table 10.1).

Figure 4.75. Small to medium sized herbivore mandible found at Shwe Creek, Unit 315a-1, in Level 4b (Courtesy of Scott Macrae and the IRAW@Bagan Project).

Animal bones were commonly found in the layers of Otien Taung, Unit 748a-1, with the only levels not producing animal bones including Levels 1, 13, and 14 (Tamura and Cheong 2019b:233). Animal activity removing bones from the surface of the site was described as the likely reason no bones were recovered from Level 1. It was also noted that since Levels 13 and 14 did not also contain evidence of being a living surface, it is

suggested that the presence of animal bones may represent the presence of human activity (Tamura and Cheong 2019b:233). Radiocarbon dates were interpreted from charcoal samples recovered during excavations of Unit 748a-2, to be discussed in more detail later, since no samples were collected from Unit 748a-1 (Tamura and Cheong 2019b:226). Stratigraphic cross-referencing between Unit 748a-1 and 748a-2 provided relative dates. Based on the earliest date 891 – 993 calAD (Feature 748a-F/18 from level 7b of Unit 748a-2), and the latest date 1046 – 1249 calAD (Level 4b of Unit 748a-2), Otien Taung was occupied, possibly functioning as a ceramic production site, from the 9th – 13th centuries CE (Iannone et al 2019: Table 3.3).

Some features, identified by IRAW@Bagan researchers as post-holes, encountered in Unit 748a-1, contained animal bones (748a-F/1, 748a-F/10. 748a-F/12. 748a-F/15, 748a-F/16, and 748a-F/19) (Tamura and Cheong 2019b:233). The animal bones excavated from these features were dated to the Pre-Bagan Period (600 – 1044 CE). Animal bone encountered in Levels 4b and 4a dated to Early (1044 – 1113 CE) and Middle Bagan (1113 – 1174 CE), and Level 3b which dated to the Late Bagan Period (1174 – 1300 CE) (Tamura and Cheong 2019b: Table 12.2). The context of Levels 4b and 3b was Floor Surface, and the matrix Tamped Earth. While the context of Level 4a was On Floor, and the matrix Habitation Debris. The animal bones encountered in Unit 748a-1 were ultimately highly fragmented, however, with no distinct features to allow for quick identification of which species they belonged too.

Animal bones were also a prominent find encountered throughout Unit 748a-2 (Rivera and Cheong 2019b:283). Radiocarbon dating was determined using charcoal samples recovered from Levels 4b and 6b. Samples were also recovered from Features

748a-F/18, a pit fill, and 748a-F/20, a hearth from an earth oven feature (Iannone et al. 2019: Table 3.3). The sample from Feature 748a-F/18, associated with Level 7b, provided a date of 891-993 calAD, while the sample from Level 6b provided a date of 980-1031 calAD, placing them in the Pre-Bagan Period (600-1044 CE) (Rivera and Cheong 2019b:278). The radiocarbon sample from Level 4b provided a date of 1046-1249 calAD, placing it in a time spanning the Early (1044-1113 CE), Middle (1113-1174 CE), and Late Bagan Periods (1174-1300 CE). Based on the earliest date of 891-993 calAD, and the latest date of 1046-1249 calAD, Otein Taung was likely occupied and possibly functioned as a ceramic production site from the 9th – 13th centuries CE (Iannone et al. 2019: Table 3.3).

Animal bones encountered in Levels 9b and 9a appeared burnt, while other fragments were uncovered from Level 8b and Feature 748a-F/20, the hearth deposit associated with this level (Rivera and Cheong 2019b:283). It was possible to identify the animal bones associated with the hearth feature as fish, chicken, and rats. Fragment of different sized animal bones were encountered in Levels 7b and 7a, as well as 6b and 6a. The fragments recovered from Levels 6b and 6a were significantly larger and better preserved (Rivera and Cheong 2019b:283). These included pigs teeth, and a partial mandible of a goat or cow (Figure Figure 4.72). Fragments of animal bone were also uncovered in Levels 5b and 5a, as well as Levels 4b, 3b, and 2. Most of the animal remains uncovered date to the levels associated with the Pre-Bagan Period (600-1044 CE) (Rivera and Cheong 2019b: Table 13.1). Those recovered from Levels 4b date Early (1044-1113 CE) to Middle Bagan Period (1113-1174 CE), while those from Level 3b date to the Late Bagan Period (1174-1300 CE). The context for both of was listed as

Floor Surface, and the matrix Tamped Earth (Rivera and Cheong 2019b: Table 13.1). The animal bone encountered in these levels have yet to be identified.

Figure 4.76. Partial mandible encountered at Otien Taung, Unit 748a-2, in Level 6a (Photo courtesy of the IRAW@Bagan Project).

Conclusion

This chapter has presented data which highlights the material correlates associated with animals, and animal use with house compounds surveyed by IRAW@Bagan researchers at the ten traditional villages surrounding the ancient ritual epicenter of Old Bagan. Specifically, material associated with cow shed structures, and other animal related material housed, within the boundaries of the house compounds. Photo data courtesy of the IRAW@Bagan project taken by researchers in villages other then the ten surveyed, and while travelling through the countryside, detail other instances of animal use. This chapter also presented data gathered from retrospective historic chronicles, and

translations of temple inscriptions, detailing how animals were utilized during the Classical Bagan Period, albeit primarily by the ruling class of Bagan society. These also detail how animals were signs and signifiers of status, donated by wealthy benefactors to the Buddhist *sangha* for the accumulation of merit.

Though this data had originally been collected by the IRAW@Bagan project for purposes other than that of those intended for this thesis, this data does provide much to be analyzed, pointing to what might be observable for archaeologists undertaking future settlement archaeology-based research at Old Bagan. This will be highlighted in the following Analysis chapter.

Chapter 5: Analysis

To begin this analysis chapter, one must first reiterate that the data being analyzed was not ones own. The data was obtained by IRAW@Bagan researchers in past field seasons, and thus not collected with this researcher's research questions in mind. Nor were the original researchers focused on the same subject matter. What this chapter is then, is a re-analysis of the data collected by the IRAW@Bagan researchers, applying a direct-historical approach with a focus on research questions pertaining to the human-animal relationships at ancient Bagan, with a specific emphasis on aspects of the archaeological record that may be amenable to the examination of such relationships as part of the IRAW@Bagan settlement study. The general research questions this thesis hopes to answer by querying the data include: 1) What are the material correlates of human-animal relationships in traditional house compounds in the area of Old Bagan? 2) What are the material correlates of human-animal relationships in traditional villages in the area of Old Bagan? 3)What might these look like many years from now? 4) How can these be used to inform settlement archaeology in the area encompassing the ancient capital city?

With the subject of the human-animal relationship in particular, analysis of data collected personally would itself be difficult, let alone attempting to do it through the research carried out by someone else. It is one that is by nature personal, in which the questions asked requires data collection, analysis, and answers with some specificity. Re-analyzing past ethnoarchaeological research and using it to attempt to answer one's own questions is like being a third-party interpreter. None the less, though not directly related

to, or focused on the human-animal relationship, the past ethnoarchaeological research conducted by the IRAW@Bagan team has provided one with data to be analyzed and directed towards answering the research questions posed by this thesis. Ethnoarchaeological research strategies implemented in traditional house compounds (Talving-Loza 2019), use of water ritual and symbolism (Rivera-Borbolla 2019), and agricultural practices (Macrae 2017), broadly highlight aspects of the human-animal relationship useful for understanding what the material correlates of this relationship are, and how it can inform future settlement archaeology at Bagan.

Analysis of Data from Ethnoarchaeological Surveys

Animals Present in Villages Surveyed

The primary data for this thesis came mostly from information gathered through conducting ethnoarchaeological surveys of house compounds by IRAW@Bagan researcher Talis Talving-Loza (2019), in the ten traditional villages of: Thae Pyin Taw; Shwe Hlaing; Zee Oo; Kon Sin Kyi; Kon Tan Gyi; Minnanthu; Hpauk Sein Pin; Thah Tay Kan; East Pwa Saw; and West Pwa Saw. Animals were present at each of the ten villages surveyed, though the species varied by village (Table 5.0).

Animals	Thae Pyin Taw	Shwe Hlaing	Zee Oo	Kon Sin Kyi	Kon Tan Gyi
Cow	Yes	Yes	Yes	Yes	Yes
Goat	Yes	Yes	Yes	Yes	N/A
Pig	Yes	Yes	Yes	Yes	N/A
Chicken	Yes	Yes	Yes	No	N/A
	Minnanthu	**Hpauk Sein Pin**	**Thuhtaykan**	**East Pwa Saw**	**West Pwa Saw**
Cow	Yes	Yes	Yes	Yes	Yes
Goat	No	No	No	No	Yes
Pig	No Longer	No	Yes	No	No
Chicken	Yes	No	No	Yes	No

Table 5.0. List of animals kept at village compounds (Data courtesy of Scott Macrae and the IRAW@Bagan Project).

The animal most commonly present at each of the villages surveyed were cattle, with at least one cow/ox being present at each of the house compounds surveyed (Macrae 2017:109). Though based on viewing the photographic data and reading ethnographic notes it appears multiple cows/oxen per house compound are preferred. That said, while interviewing the occupant of the house compound at Zee Oo, it was mentioned that every household was meant to keep two cows/oxen on their property (Talving-Loza 2019:109). Within his analysis of data collected from ethnoarchaeological surveys conducted on traditional house compounds, Talis Talving-Loza (2019:171) produced an average size of a traditional village, approximately 114,886.2 m^2, thereby producing an average of 102 house compounds per village. This number may also be useful for approximating the number of cattle present in traditional villages.

With two cows/oxen per house compound, and 102 compounds within the average village size, one can estimate that there may be as many as 204 cattle are present in each traditional village. However, viewing primarily photographic data, and

ethnographic surveys not centered on animals, one cannot be certain that every household did generally have two cows/oxen. This also may not include animals of those that produce livestock, or those among herds moving and grazing out in the fields. As outlined in Table 5.0 though, cattle were the only animals consistently present at each of the traditional villages and house compounds surveyed.

With cattle present in each village and house compound, one might be able to hypothesize that cattle would be commonly present within the faunal record in and around the area of Old Bagan. However, neither Talving-Loza's (2019) surveys of traditional house compounds, nor Scott Macrae's (2017) study of agricultural practices directly point to the location faunal remains were deposited when an animal died naturally. Indeed, they did not provide any information concerning how an animal was treated after death, and what became of its remains. With Buddhism being the major religion in Myanmar, one wonders if the philosophy of *ahimsa*, a general philosophy of kindness to living things (Lodrick 2005:69-70), is and was practiced, particularly towards cattle. Cattle are often favoured more for their resource value beyond food, though they are still utilized for meat protein (Zaw Win et al. 2019:644).

Also not specified was what became of faunal remains of animals butchered and processed for food, much like the animal-based foods exemplified in pictures by IRAW@Bagan researchers while visiting the market at the village of Myinkaba. It was noted that the boundary of the village, and areas along the fence line within the house compounds, were used to deposit refuse (Talving-Loza 2019:172, 182), though it is unclear if faunal remains were also deposited in these areas, or if they would be scavenged by animals. Subsidiary questions that might have been asked, if this researcher

was part of the original study, would have concentrated on faunal remains pre-deposition and deposition into the archaeological record, as well as possible insights into the processes effecting the context of the remains post-deposition.

Other livestock present and noted by researchers while conducting ethnographic surveys included goats, pigs, and chickens (Table 5.0). Goats and pigs were present and noted at the villages of Thae Pyin Taw, Shwe Halaing, and Zee Oo, while chickens had been noted at these three villages and East Pwa Saw. Goats were only photographed at the house compound surveyed in West Pwa Saw (Figure 4.54), and the presence of a village pig pen was noted at Thuhtaykan, though little additional information was provided. It was also noted that the occupants of the house compounds surveyed at Zee Oo and West Pwa Saw engaged in rearing livestock to be sold later, but in other village compounds those interviewed indicated that such animals were mostly reared for personal consumption. When it comes to pigs, the villages where they were present are those that are furthest from the ritual epicenter of Old Bagan, save for Thuhtaykan. Although they had once been raised in Minnanthu, those interviewed during ethnographic surveys mentioned that they no longer raise pigs there as it is considered a demeritorious act. This is curious, as there does not seem to be anything within the retrospective chronicles and temple inscriptions that point to this aversion. Nor are faunal remains belonging to pigs likely to be completely absent among those uncovered at the Shwe Creek and Otein Taung site excavations by the IRAW@Bagan team, as will be discussed later in this chapter. As was true for cattle, the IRAW@Bagan researchers did not engage with their informants to determine what became of these other animals remains after their death,

therefore making it difficult to build some processual models concerning their deposition and entry into the archaeological record.

Oxcarts

It is from the material correlates and structures associated with animals and animal use present within the house compounds surveyed that the ethnographic data collected is the most useful in trying to determine archaeological analogues. This is most evident with items related to cows/oxen. Oxcarts were present at eight of the ten house compounds surveyed, and based on the photographic data taken by the IRAW@Bagan researchers, these farming implements were widely used by the people living on the Bagan plain. Oxcarts are utilized for a variety of purposes, including moving barrels of water, carrying harvested crops, or transporting other materials and people. The basic construction of the oxcarts appears consistent, with the key features being a platform sitting on a single axle with two large wheels on either side. A long beam extends out from the cart to a yoke, allowing the oxcart to be driven by two animals. The cart platform itself appears to be able to be retrofitted to suit specific purposes, with some seemingly constructed to move barrels, and others, with a sort of "fencing" along their sides, utilized for most other purposes (Figures 4.18 and 4.29).

The examples of oxcarts seen moving around the Bagan plain today are similar in design and overall appearance to depictions and reconstructions of those used in Old Bagan at its height, from the 9th – 14th centuries C.E.. One example is a model of an ancient oxcart pictured during a museum visit, along with corresponding artistic representation (Figure 5.1). Also pictured was a small figurine depicting an oxcart being

driven by two oxen along with a variety of other animal representations, though contextual information is absent (Figure 5.2). While similar in appearance, there are some notable differences in the artistic depictions of oxcarts to those pictured by IRAW@Bagan researchers, one being the more ornate design of the model as well as the figurine. There is also some slight differences in the design of the wheels, with the model featuring a solid wheel, reminiscent of scenes carved in temples like those on the Talaing plaques on the Ananda Temple (Figure 5.0), while the wheels on the oxcart figurine and those seen and pictured throughout contemporary Bagan are spoked. Due to the ornate design of the model oxcart, it is difficult to discern whether it is a genuine depiction of a utilitarian oxcart used in 9th – 14th century C.E. Bagan, or an idealized representation. The overall similarity though between past and present oxcarts is noticeable, however, with each sharing the same essential components, with the ability to be utilised for multiple purposes.

Figure 5.0. Vessantara gives horses in alms (modified from Duroiselle 1921, Vol. 3: Part 2).

Figure 5.1. Model of Old Bagan oxcart (Photo courtesy of Scott Macrae and the IRAW@Bagan Project).

Figure 5.2. Assorted animal figurines (Photo courtesy of Scott Macrae and the IRAW@Bagan Project).

Oxcarts may also leave archaeologically relevant material. Though one does not know the precise method of construction, nor the actual materials used in the past, photographs taken by the IRAW@Bagan research team do point to some useful elements for settlement archaeologists. Only some components of the oxcart, as opposed to the entire oxcart, are likely to be uncovered. Some of the common components of the cart do contain metal elements, such as the hub of the wheel, metal rivets, and the thin metal rim surrounding the wooden wheel. Wheel hubs, like those seen on oxcarts in Bagan, are often constructed from harder wood materials capable of withstanding the load weight and pressure generated by the rotation of the cartwheels. So too is the axle of the oxcart made of wood, though it was not specified how this was made nor did the team take an adequate picture of this feature. The whole oxcart, if stored in the cow shed and then abandoned, may leave an embedded impression given its size and shape, and it may even be more recognizable if left with its components, such as the wheel, wheel hubs, and axle. However, with most of the oxcart being constructed of wood, much of it may decompose overtime. The harder wood components, such as the wheel hubs, may preserve, but only under the right conditions. The wheel itself, given its size and construction, particularly the solid wheel shown on the model of a Bagan Period oxcart (Figure 5.3), may be archaeologically relevant, depending on the preservability of the material used to make it. Metal components, if involved in making Bagan Period oxcarts, may also be incorporated into the archaeological record after decomposition of the perishable remains. It must be said, however, that in the case of oxcarts, it was not always clear if they were stored in and around the cow shed, or elsewhere. Only the house compound surveyed at Kon Tan Kyi had a designated cart shed.

Plows and Plowshares

Apart from oxcarts, the next most prevalent item associated with cows/oxen observed in the ethnographic surveys were plows and their associated plowshares. Plows and plowshares had been noted and pictured at four of the ten house compounds surveyed, and they were also pictured used in numerous agricultural fields. The plows consisted of a simple triangular design with two smaller "yoke" beams extending out from a thicker, perpendicular wooden "attachment" beam with a number of sockets carved into it. The smaller beams would then be attached at the centre of a yoke used to harness two driving animals. Stemming from the thicker slotted, "attachment" beam was a simple crossbar where the operator could hang on and guide the plow while being driven. Numerous square sockets are usually carved out of the large attachment beam, which acted to receive the ends of various plow components, including the yoke beams, handle, and plowshares. The plowshares appear to be over 30 cm in length, are spayed shaped, and made of wood of an unspecified variety. The exact dimensions of the plowshares are also hard to determine through the photographs.

Based on the photographs and notes taken by the IRAW@Bagan, the plows and plowshares used in and around the area of Old Bagan today are identical to representations of plows seen in temple murals. A good example of this is the one found in a mural with the temple in Shwe Hlaing (Figure 4.12), as well as artistic interpretations of agricultural practices undertaken in 9^{th} – 14^{th} century Bagan showcasing their use found in the Bagan Museum (Figure 5.3). A noticeable difference between past and present plows are the materials in which some of the components are made from. Pictured in the foreground of Figure 5.3 are what appear to be components associated with a plow,

such as brackets or pieces for yoke harnessing made from metal, though this is not certain as the only recognizable pieces are the plowshares, and little context has been provided on the pieces. Nevertheless, the design, function, and mode of attachment to the plow appear identical.

Figure 5.3. Background: Artistic representation of plowing in Old Bagan; Foreground: Tools and components possibly associated with plow (Photo courtesy of Scott Macrae and the IRAW@Bagan Project).

Though the contemporary examples photographed tend to be made of wood, the archaeological plowshares and some of the other components photographed during the museum visit by the IRAW@Bagan researchers (Figure 5.3) are made of metal. The context of these artifacts was, however, not given. This makes it difficult to say whether

these are definitively plowshares, where they were uncovered, or if they are from the Bagan Period (9th – 14th centuries C.E.). In addition, one cannot tell if they are utilitarian or ceremonial plowshares. Metallurgy was practiced in Myanmar (Hudson 2006) and used to craft agricultural tools. In addition, metal artifacts have been recovered by IRAW@Bagan researchers during their excavations at Shwe Creek (Tamura and Cheong 2019a:108) and Otein Taung (Rivera and Cheong 2019a:163). It may be possible to uncover some examples of metal plowshares. Given that they are made from wood, it is unlikely that many components of the plow would preserve. That said, the museum displays suggest that some of the plow components were made of more durable metal, such as yoke brackets to secure the driving animals, and other harnessing components. However, it should be noted that in the house compounds surveyed, waste materials were often left in low traffic areas along the boundary fence of the compound. It was not documented what the residents of the compound would do with broken, unfit, or unwanted plow components. Metal, being a valuable and reusable material, suggests that plow components from the Bagan Period may have been repurposed, meaning that they are less likely to be recovered in their original form, though this is not out of the realm of possibility.

Cow sheds

The most prominent feature associated with cows/oxen in the house compounds surveyed are the cow sheds. Apart from providing shelter for animals from inclement weather, these structures also provide shade from the sun, and in many cases also housed many of the other items associated with animals and animal use, including oxcarts, plows

and their components, and in some cases the feeding trough. While conducting ethnographic surveys on housing compounds, Talving-Loza (2019) documented most of the key characteristics of the cow sheds (Table 5.1).

The average distance from the cow shed to the main house of the compound was 17.4 m, with a standard deviation (from here on referred to as SD) of 6.04 m, and a coefficient of variation (from here on referred to as CV) of 0.35 when measured from the southeast corner of each structure (Talving-Loza 2017:180; Iannone et al. 2022:10). Four of the eight cow sheds surveyed for their spatial relationships with the rest of the buildings were situated in the northern end of the house compound.

The average area of the house compound occupied by the cow shed was 31.89 m², with a SD of 13.85 m² and a CV of 0.41. The north-south running walls of the cow sheds had an average of 5.56 m, with a SD of 2.26 m and a CV of 0.41, while the walls running east-west of were on average 5.8 m long, with a SD of 1.84 m and a CV of 0.32.

Feature	Average	Standard Deviation	Coefficient of Va
D. between house and cow shed	17.4 m	6.04 m	
Area of Cow Shed	31.89 m²	13.85	
Length of cow shed N/S walls	5.56 m		
Lenth of cow shed E/W			
Cow Sh			

Table 5.1. Cow shed standard deviations and coefficients of variation (Data courtesy of Talis Talving-Loza and the IRAW@Bagan Project).

According to data collected by Talving-Loza (2019:180), most of the cow shed surveyed by IRAW@Bagan researchers were supported by posts, set in a 3x4 configuration, with ten posts in total supporting the structure. The interior posts within

the cow sheds had been removed at some house compounds visited to create unobstructed space within. Each of the cow sheds surveyed was organized in a roughly rectangular shape, with posts spread out even distances apart, though it appears that the overall size of the cow shed varied.

Acacia wood was the most common material used for post construction, utilized at five of the nine surveyed house compounds according to data collected (Talving-Loza 2019:181). The average size of the posts used for a cow shed was 15.4 cm in diameter, with a SD of 5.25 cm, and CV of 0.34 (Table 5.1). As suggested by Talving-Loza (2019:181), with a coefficient of variation this low, it may be possible to suggest that most of the posts found in association with cow sheds will be roughly this diameter. Excavated post holes encountered by IRAW@Bagan researchers were observed to be dug an average of 12.4 cm into the ground, with considerable variation, though, most holes were less than 20 cm deep (Iannone et al. 2022:13). Data suggests that few of the post holes would have been wide enough to hold posts employed in the construction of cowsheds, kitchens, or houses observed in ethnoarchaeological case studies, which observed the average diameter of house posts to be 13.2 cm, and placed in post holed dug between 45.7, and 76.2 cm deep (Iannone et al. 2022:9). As such, these features seem to be related to less substantial constructions, however, the average depth of post holes for cow sheds was not documented.

Dried palm leaves were used at eight of the nine cow sheds surveyed as roofing material, with only one using a corrugated steel roof. A built-in area, most commonly in the roof of the cow sheds framing, though occasionally on one side of the cow shed, was meant for storing cow fodder, feed, or other materials. The walls were generally open,

requiring no form of bamboo, or other wall paneling. Manure was often stored along the outer fence line of the house compound.

Though cow sheds were surveyed at most of the house compounds and were present in every village visited by IRAW@Bagan researchers, according to analysis from Talving-Loza (2019:186), it may be difficult to deduce the function of these structures in the archaeological record. This researcher thinks differently. Even though this data was not collected overtly with the animals themselves, and other aspects associated with them, one can still see beneficial information that may provide further insights, aiding future settlement archaeology research by IRAW@Bagan.

The average post formation for the cow shed as discussed earlier is the 3x4 post configuration, which Talving-Loza (2019:186) points out is like the post formation of the main house of the compound. However, a house would look different from a cow shed in an archaeological context. As stated earlier, the average area of the cow shed was 31.89 m^2, with a SD of 13.85 m^2, and CV of 0.43. This is less than the average area of the compound occupied by the main house which had a total area of 58.06 m^2, with a SD of 27.3 m^2, and CV of 0.47. Also, the average cow shed post diameter was 15.4 cm, with a SD of 5.25 cm, and CV of 0.34. Which is slightly different from the average post diameter of the main house which was 13.19 cm, with a SD of 3.44 cm, and CV of 0.26 (Talving-Loza 2019:190). Though the average diameter of the house and cow shed posts varied minutely, with acacia often utilized in making both, the average house encompasses a larger area when including the veranda, essentially doubling the number of posts used by the main house in comparison to a cow shed. In addition, though the post configuration of 3x4 was used to frame both the main house and cow shed, the cow shed

is consistent in this characteristic, with the only variation being the possibility of fewer posts, since some could be removed to open the interior space. The post configuration of the houses varied, with some houses surveyed having a 4x4 configuration, and the smallest organized into 3x3, not including the veranda (Talving-Loza 2019:191).

Aside from post holes, the materials left behind would differ between the main house and the cow shed. The main house is, as its name suggests, the primary living space for residents of the house compound. One can see in photos taken by the IRAW@Bagan team that these spaces could contain much evidence of being lived in. Materials related to the cow shed were separated from material associated with other activity areas, or structures of the house compound (Talving-Loza 2019:186). This space was utilized as a shelter and feeding area for cows/oxen, and as a space necessary for the care of large animals.

Internally, cow sheds often had areas for fodder storage, though these would eventually collapse and release their content, leaving the content to decompose. The carved tree trunk trough used to feed animals may be present within the footprint of the cow shed, or near it, which would make it a good indicator of the structure. Though it was mentioned by Talving-Loza (2019:186) that this may be unlikely if the compound was abandoned, and in the process the feeding trough was taken away, or even decomposed over time. Dung was regularly removed from the floor of the cow shed, collected, and stored in one place within the compound for use elsewhere, usually as fertilizer in agricultural fields. Ultimately, it was suggested that a researcher would be unlikely to find other well-preserved materials within the footprint of the cow shed,

unlike the other large structures of the house compound, which will have some degree of predictable inorganic indicators (Talving-Loza 2019:187).

Photographs of cow sheds reveal that these spaces do in fact contain objects and ecofacts that could be discernable in the archaeological record. As observed by Talving-Loza (2019: 186), cow sheds typically have well-patted down floors, though they often also appear rough in photographs, marked with animal prints, which when combined with their typical 3x4 post configuration, could be highly indicative of such a space. Feeding troughs, though the troughs themselves might not preserve, may also indicate interior spaces within cow sheds. Based on the types of platforms observed in the photos, it is likely that, even if the trough itself is no longer present, an embedded impression may still be visible. These troughs are commonly propped up by perishable Y-posts, but also by other materials gathered from around the compound, including stacked logs, stones, tree stumps, and barrels. Another trough observed during the study appeared to have been constructed on a concrete or stone platform. Though it must be acknowledged that the average dimension of the animal feeding areas was not recorded, there are still features indicating the interior space of the cow shed.

Manure may be another indicator of a cow shed, or general animal presence in an area – such as an ancient house compound – and it should be detectable through certain types of soil composition and soil chemical analysis. Though manure may have been removed from the floor of a cow shed, it is difficult to remove every bit of dung. Unless, of course, the floor of the cow shed was also washed with water, which was not mentioned during the project's ethnoarchaeological study. As outlined by Hall and Kenward (1998:123), manure is the end product of long and involved processes reflecting

sources, materials, and activities. Insight on this is gained through testing for elevated soil phosphorus levels, or multi-element analysis (Nielsen and Kristiansen 2012).

Also notable is that fodder was often stored in or around the cow shed, often in a storage area with a wooden floor, in the roof of the cow shed. When the cow shed fell into disuse, and ultimately collapsed, the perishable floor itself might destabilize, its components and the remaining fodder falling to the cow shed floor below. Though it is acknowledged that this material would likely decompose, it may create a discernable difference in the soil composition, marking off the area of the cow shed from the rest of the house compound. This, paired with the manure, may make for a greater archaeologically relevant marker for the presence of animals in a house compound (Charles 1998:111). Animal dung removed from the cow shed, as previously mentioned, was taken to a designated manure collection area. This was so that the manure could be used as fertilizer later. These areas were often bordered by material such as fencing or stone (Figure 4.4). This manure dump is likely to leave an archaeologically discernible feature, as well as altered soil chemistry. Searching for indicators of animal manure in archaeological soil has provided further insight into past fertilization practices and land use (Nielsen and Kristiansen 2012), suggesting that there are broader implications for such evident.

During his ethnographic research on the Apa Tanis of the Apa Tani Valley, in the region of Assam, northeastern India, Furer-Haimendorf (1962:31) makes interesting observations that may relate to this idea. Whenever a house is rebuilt, the Apa Tanis collect the medley of kitchen refuse, ashes, animal and human excrement left underneath, which will then be worked into agricultural soil, which also left a layer of black soil.

Though not to this extent, a similar pattern may be viewable within house compounds at Bagan as raised houses were a common house type (Talving-Loza 2019:194; Tamura 2019:124), and it was documented that animals had been kept under structures.

Figure 5.4. A stilted home using the area below as an animal shelter, Pitakat Hpaya temple (Modified from photo courtesy of Ellie Tamura and the IRAW@Bagan Project).

Ultimately, contrary to the opinion of Talving-Loza (2019:186-187), this researcher thinks that the presence of a cow shed, or other material corresponding to animals or animal use, is not entirely absent from other house compound activities or structures. Rather, the activities themselves, and aspects of the whole house compound, often have an animal related component. So, despite the cow shed itself most likely not leaving an easily identifiable imprint, one is still likely to find evidence of animal use throughout the traditional house compound. An important aspect of this is uncovering faunal remains, to be discussed further below.

Kitchens and Earth Ovens

Six of the ten compounds surveyed by IRAW@Bagan researchers contained detached kitchens, with a total average of 8.83 m^2 of floor space, with an SD of 3.4 m^2 and a CV if 0.39. The north and south facing walls of the kitchens averaged 2.8 m long, while the east and west facing walls were an average of 3.21 m long. All detached kitchens surveyed were constructed with acacia wood posts, with a 3 x 3 post configuration, with no central post, totalling eight posts in all. The average diameter of the posts used for the kitchens was 9.76 cm, with an SD of 1.84 cm and a CV of 0.19. The walls of the kitchens were made from woven bamboo panels on a bamboo stalk frame. The roofs were equally likely to be constructed from dried palm leaves, bamboo thatch, or corrugated steel sheets.

The kitchens southeast corners were located an average of 11.13 m from the southeast corners of the enclosed spaces of the houses. Four of the detached kitchens were located to the north of the main house. This figure has an SD of 3.5 m and a CV of 0.31, suggesting minimal variation to this distance, likely aiding in risk reduction to the house considering that kitchen hearths sometimes caught fire, though not all kitchens had hearths. However, the hearths that were observed had all been placed directly on the floor of the kitchen with a metal or brick guard behind the hearth to protect the walls from exposure to flames. The ash created by fires was frequently used as fertilizer if the house compounds occupants were involved in farming. Half of the unattached kitchens appeared to line the foundations of the structures with bricks and large stones, while the area where bamboo panels met the ground were lined with different kinds of material as

deterrent and protection from rainwater and pests from entering the interior. However, this was just as likely to appear as it was not.

Kitchens find relevance to the human-animal relationship through the context of food. While conducting their surveys, IRAW@Bagan researchers observed numerous instances of animals, either being prepared for, or incorporated in some dishes. The presence of a kitchen, though it may not directly point to the human-animal relationship in the working sense, could simply point to the presence of animals which humans are utilizing within the house compound, as food remains an important context in which we can view the human-animal relationship. The large ceramic and metal cooking vessels observed within the kitchens surveyed by the IRAW@Bagan team may also point to archaeologically relevant material and behavioural residues centered around the human-animal relationship, and with their continued use, may leave behind physical residues of previous meals cooked within them, and if they may have involved animal protein. Remains of the cooking surfaces, mainly the bricks used to create slightly raised cooking areas, along with the ash and scorched floor surface, may also provide evidence of kitchens in future excavations. Also, the use of brick, stone, wood, or other hard materials to line the edges of the kitchen may leave behind and archaeology relevant footprint in the floor surface and mark the boundaries of a kitchen structure. The presence of such a feature within the IRAW@Bagan house compound observations was, as noted, used to keep pests from entering the kitchen space, thereby pointing not only the presence of animals, albeit pests, but a way in which humans work, and try to mitigate their presence.

Also, observed by IRAW@Bagan researchers, were earth ovens in use cooking large quantities of food in Hpauck Sein Pin and Let We (Figures 4.41 and 4.61

respectively). The earth ovens observed by the IRAW@Bagan team are similar to the one uncovered in their excavation at Otien Taung Unit 748a-2, a concave feature which enclosed an ash-rich matrix interspersed with the small bones of fish, birds, and rodents (Iannone et al. 2022:13). The earth oven, or *myae out meepho*, was formed from the combination of an air duct connected to a vertical vent, such as those observed in use at Hpauck Sein Pin and Let We. Such ovens were noted by IRAW@Bagan researchers as often being found in the "back yards" of house compounds, in open spaces conducive to the preparations of substantial amounts of food (Iannone et al. 2022:13).

Analysis of Inscriptions and Retrospective Chronicles

The data collected from translated inscriptions by Duroiselle (1919-1934) and Frasch (2014), along with the retrospective chronicles (Maung Tin and Luce 1923), may point to material correlates related to human/animal interactions and add insight concerning what to look for. The inscriptions and chronicles may also provide insight into how animals were viewed socio-culturally and valued in classical Bagan. What is made clear from the inscriptions and chronicles is that animals were present and utilized in Bagan, with diverse species including elephants, horses, multiple kinds of cattle, pigs, goats, and fowl (Duroiselle 1920:123). What is not clear, however, is where and how these animals are kept, or what would become of them when they died.

Though the inscriptions and chronicles detail humans and animals working in tandem, with many references to horses and elephants, in particular as mounts, there is no

information on precisely where such animals were sheltered or how they were cared for. While touring villages around Bagan, the IRAW@Bagan team photographed elephants and horses moving through a ceremonial procession in the village of Nyaung-U. An ethnoarchaeological based research strategy with questions directed towards human/animal interactions and use could be used to provide insight on such characteristics.

Elephants are large animals, thus requiring a great amount of food and water resources, up to 150 kg of food per day. They also require a large enough space to comfortably shelter an animal that reaches 2.75 m tall at the shoulder, 5.5 to 6.5 m in length from trunk to tail, weigh over 3,600 kg, and live between 60 and 80 years. Posts for such a structure must be both tall, and strong enough, not just to bear the weight of a roof, but the animals rubbing up against them. Also, unlike the rough floor surface observed in ethnoarchaeological surveys of cow sheds, pocked with hoof imprints, the wide, flat, padded feet of an elephant may leave a smooth, highly compacted surface. It may also be that fodder storage, and manure collection areas associated with elephants might leave larger surface impressions. Manure and urine may also alter the soil chemistry, perhaps differentiating the space from other animals, and animal related structures. It should be noted, however, that information directly pertaining to elephants was unavailable to the IRAW@Bagan research team in the instances where elephants had been observed, for which questions could have been asked, and information attained regarding contemporary elephant care, their uses, and what happens to their remains after death.

Despite the many mentions of elephants in inscriptions and retrospective chronicles, there is little information regarding their general care in Classical Bagan, though numbers of elephants presented range from the hundreds, thousands, and even tens and hundreds of thousands as mentioned in the *Glass Palace Chronicles*. Whether these numbers are entirely accurate, any large number of elephants would certainly consume an incredible amount of food and water resources. Also, not clearly discussed, or represented, is where and how elephants were housed in Classical Bagan. Whether it was in a similar fashion to cow sheds observed in ethnoarchaeological surveys by IRAW@Bagan researchers, or individual stables, like the elephant stable which can be seen at the ancient central Indian site of Hampi, or both. Though detailed in a photograph taken by IRAW@Bagan researchers at the village temple in Shwe Hlaing are what appeared to be two adult elephants and a calf. It is undetermined, however, if they are enclosed or otherwise, though it appears they are near some sort of wall and water feature.

Figure 5.5. Elephants Featured in Shwe Hlaing Temple Mural (Photo courtesy of Scott Macrae and the IRAW@Bagan Project).

Horses, though not as large as elephants, are animals that still require a significant level of maintenance to keep healthy. As in the case of elephants, however, the inscriptions and retrospective chronicles point to little direct information regarding where and how horses were housed and cared for. Also, it is unclear if there were different horses for different purposes, though, the inscriptions and retrospective chronicles point to what may be different kinds of horses, such as those of King Anawrahta's paladins mentioned in the *Glass Palace Chronicles,* and the mention of a donation of special horses from India to a temple construction, by a wealthy donor. Though, again, like descriptions of the elephants, the number of horses described in some cases are likely to be inflated, they would none the less require a substantial amount of food and water resources. The style of structure associated with horses may depend on how the animals are used, though they generally require ample pasture space, and shelter in the form of a stable. Being herd animals, horses, like elephants often fair better when others of their species are around. Horses also require consistent access to food and water, but are fed periodically, as opposed to having a large amount of food available to them at one time. Horse hooves themselves are an important care matter, as an unmaintained hoof can be extremely detrimental to the animals' health. Also, being wandering animals by nature, horses require a fenced, or otherwise corralled space when set out to pasture, or when not otherwise secured by other means. For a horse that is mostly stabled, constant exercise would be a necessity.

Understanding what elephant and/or horse shelters look like in the contemporary context may provide observable correlates for what might have comprised all aspects of these structures in the past, much like the cow sheds of the traditional house compound.

This may then inform future archaeological excavation conducted as part of the larger IRAW@Bagan project.

Something that does seem to provide great insight into how animals may have been valued in Bagan can be seen in the descriptions of donations to the temples. As outlined by Frasch (2014), of the 808 inscriptions from the Bagan period that he presents, 48 mention animals as temple donations. These included cattle, elephants, and horses. Given that animals were donated mainly by the ruling class of Bagan, it may be that the kind and number of animals donated to the temple also says something about the status of those giving the donation. Similar themes are evident in ethnographic research conducted by Hayden (2016:45, 60-61, 68, 119-122, 248) and Furer-Haimendorf (1962:37-42) among various ethnic tribal groups in Southeast Asia, as well as among Bofi and Aka forest foragers in Central Africa (Lupo and Schmitt 2005:350). Both researchers point to animals as very physical and cultural signifiers of wealth and status. Animals are also used to mitigate social actions and relationships amongst individuals or groups. Further research on animals, utilizing an ethnoarchaeological research strategy, would be necessary to provide further insights into how animals may also provide signifiers for social standing and resource distribution.

One thing that must be noted within the Great inscriptions of the Shwezigon Pagoda, as well as in the *Glass Palace Chronicles*, is the mentioning of "buffaloes" (Duroiselle 1920:123). Though water buffalo, *Bubalus bubalis*, are a common domestic animal in Southeast Asia today, they are more often associated with wetter, hot and humid environments, and they are utilized for rice padi cultivation while also feeding a lot on aquatic plants (Higham and Kijngam 1982:22). Water is important for these

animals as it also helps them regulate their body temperature in the high heat conditions. Buffalo were not documented by the IRAW@Bagan team in their ethnoarchaeological surveys of traditional villages, nor were they listed as livestock reared by farmers in livestock studies conducted specifically within the Central Dry Zone (Zaw Win et al. 2019). Seeing as most of the animal bone encountered by IRAW@Bagan researchers in their excavations at Shwe Creek and Otein Taung, to be discussed below, have yet to be identified, there may be a possibility of identifying buffalo remains. Doing so may not only point to changes in the types of animals present between past and present Bagan, but perhaps provide insights into climatological changes in the region of the Dry Zone. The IRAW@Bagan team has suspected that climate during Bagan's florescence was wetter, (e.g., Lieberman 2011; Lieberman and Buckley 2012), which would have all kinds of implications for the economy, including the types of animals utilized.

Analysis of Faunal Remains Recovered by IRAW@Bagan at Shwe Creek and Otein Taung Excavations

Ultimately, the IRAW@Bagan researchers encountered many animal bones in Shwe Creek Units 315a-1 and 315a-2, and Otein Taung Units 748a-1 and 748a-2. However, many of them were highly fragmented, making quick identification difficult, with further examination necessary before detailed discussion of implications can ensue. Though, as mentioned, a partial mandible belonging to a small ruminant in Level 4b of Shwe Creek Unit 315a-1 dated to the Late Bagan Period (1174 – 1300 CE). Animal bone excavated from Level 5b of Shwe Creek Unit 315a-1 was associated with Feature 315a-F/8, dated to the Late Bagan Period (1174 – 1300 C.E.). This feature was interpreted by

the IRAW@Bagan researchers as being associated with pit fill. Pit fills, can be indicators of many processes, such as hearths like those observed in ethnoarchaeological surveys, either directly on the ground or in small pits (Talving-Loza 2019:185), or those of the *myae out meepho*, or "underground earth oven" (Iannone et al. 2022:13). Pit fills may also be related to waste management, though as observed by Talving-Loza (2019:130; 172) in traditional house compounds surveyed, trash was concentrated above ground on the edges of the compound, while village waste was deposited at designated sites outside the village. This village waste also did not include ceramics, which had been uncovered in Feature 315a-F/8. This layer was sealed beneath the overlying floor surface, and would not have been exposed, which negates its function as a hearth (Tamura and Cheong 2019a:124).

The dark, ash-like soil within Feature 315a-F/8 supports the idea that burning took place in conjuction with the deposited materials. Many broken ceramics were also found mixed within the ashy soil, along with animal bones, seeds, and wood. It has been suggested by IRAW@Bagan researchers that this material is waste removed from a fire hearth and deposited into the pit fill with other organic waste, and the inclusions of large ceramic sherds, many with fresh/clean breaks, supports the ideas of this being a ritual deposit of items related to a ceremonial feast or meal (Tamura and Cheong 2019a:124; Iannone et al. 2022:15). However, a widespread, though not universally practiced aspect of Southeast Asian feasts, is giving choice portions of the sacrificed animals to honoured guests to take away and eat or share at their own home, and/or with closesly related households, which could considerabley blur feasting patterns at the household level and locus of deposition (Hayden 2016:61). Aspects of this feature are reminicent of

descriptions of the beneath house refuse collected by the Apa Tanis of northeastern India during the construction of a new house (Furer-Heimandorf 1962:31). Other identifiable remains were recovered from Otein Taung Unit 748a-1, including fish, chicken, and rats from the hearth feature 748a-F/10, along with pigs' teeth, and part of the mandible of a goat or cow in Levels 6b and 6a. Burnt animal remains associated with Feature 748a-F/10 were also uncovered form Levels 9b and 9a. Burnt animal bone was also encountered in Shwe Creek Units 315a-2.

Numerous animal bone was also encountered in the post features associated with Otien Taung Unit 748a-1. It must be noted, however, that many of the animal bone encountered in Otein Taung Unit 748a-1 dated to the Pre-Bagan Period (600 – 1044 CE). Though most of the levels where the IRAW@Bagan team encountered animal bones dated to the Bagan Period (1044 – 1300 CE). Even those animal remains recovered dated to Pre-Bagan, the context was documented as Floor Surface, and the matrix Tamped Earth. Though the matrix of Shwe Creek Unit 351a-1, Level 6b was documented as Plaster, and Level 4a of Otien Taung Unit 748a-1 was documented as Habitation Debris.

Though highly fragmentary and fragile, the quantity and consistency of animal bones encountered by the IRAW@Bagan team can do much to inform future settlement archaeology-based projects at Bagan. As noted by Tamura and Cheong (2019a:233), the presence of animal bones may correlate to the presence of human activity. That said, due to the fragmentary nature of the animal bone, more analysis on the remains themselves needs to be conducted to gain greater insight into what species are represented, whether these animals were indeed domesticates, and what human activities they reflect (e.g.,

husbandry, butchery, cooking). By doing so, researchers may be able to track changes in the types or species of animals utilized by the people of Bagan over time.

More ethnoarchaeological-based studies, with specific questions directed towards animals and animal use, could also provide more pertinent insight into the archaeological analogues observed. Given the archaeological contexts and matrices (e.g., floors, hearths, pits) from which most of the animal bones were encountered, one can assume that the animals represented likely played a significant role in village life. To what extent is not likely to be viewed solely through analysis of the faunal remains. As has been discussed, some of the animal bone uncovered may be refuse deposited as pit fill, or alternatively, represent more socially charged components of a deposit representative of community-based food sharing marking the creation of new domestic space.

As outlined in the ethnological work on feasting in Southeast Asia by Hayden (2016:60-61), these practices may have socio-culturally specific protocols with regards to the type, number, and way in which an animal is slaughtered and processed. This may include granting specific cuts of meat to specific individuals, or the removal of meat from the initial feasting site, in turn effecting their deposition into the archaeological record (Hayden 2016:61; Lupo and Schmitt 2005:338). Others, such as Errington (1989:113), have pointed to a division of labour between men and women in the way that animals may be handled or processed. Ethnological studies in Southeast Asia have also highlighted the socio-economic and political contexts in which animals may become enmeshed in the daily operation of society, acting as markers of power, wealth, and status (Hayden 2016:68, 118-120, 248; Furer-Haimendorf 1962:37-42; Lupo and Schmitt 2005:338).

Ultimately, more research and analysis into the animal bones uncovered by the IRAW@Bagan team at Shwe Creek and Otein Taung is required to determine what animals were present in ancient Bagan, when and where they could be found, and how people interacted with them. Additional ethnoarchaeological-based studies should also be conducted that are more specifically focused on animals and animals use in the traditional villages of contemporary Bagan, especially since such villages are increasingly being drawn into the 21st century economy and way of life, thereby altering the longstanding character of human-animal relationships.

Conclusion

To conclude, this chapter provides analysis of the primary data obtained by IRAW@Bagan researchers in past field seasons, and secondary data gathered from retrospective historical chronicles, and translations of temple inscriptions. Though the data obtained was not collected with questions related the human-animal relationship in mind, information was none the less able to be queried from the data pertinent to answering the primary research questions posed by this thesis. Attempting to broadly highlight material correlates, and behavioural residues which could be discerned through understanding aspects of the human-animal relationship, and how it can inform future settlement archaeology at Bagan. Cattle were the most common animals observed in the house compounds surveyed by IRAW@Bagan researchers, with each house compound surveyed containing some structure related to animals, such as cow sheds, feeding areas, and other associated materials. Aside from the material associated with animal related

structures, many of the house compounds surveyed contained relevant material such as tools used in tandem with animals, tools like oxcarts, plows, and peanut grinders.

Though the analysis of retrospective historical chronicles and translations of temple inscriptions do not directly point to much regarding the care and material associated with the animals described, they do, point to animals that had been present, and utilized, in Old Bagan, particularly elephants and horses. The general, yet specific, requirements necessary to care for these animals may provide insight into what to look for regarding materials and structures associated with them. Both the retrospective historical chronicles and translations of temple inscriptions also appears to feature descriptions of water buffalo present and utilized in Old Bagan. Much of the faunal remains encountered by IRAW@Bagan researchers during excavations conducted at Shwe Creek and Otien Taung were highly fragmented, requiring more in-depth analysis to identify, though the partial mandibles of small ruminants, likely goats, had been uncovered.

The following chapter will conclude this thesis, utilizing this analysis to provide insight for answering the research questions which have been guiding it, and to formulate a discussion on how this information can provide further insight into future settlement archaeology projects conducted by the IRAW@Bagan project.

Chapter 6: Conclusion

The main goal of this thesis has been to provide insight for future settlement archaeology projects planned as part of the Integrated Socio-Ecological History for Residential Patterning, Agricultural Practices, and Water Management at the Medieval Burmese Capital of Bagan, Myanmar project (IRAW@Bagan). This is accomplished by observing facets of the human-animal relationship within the contemporary traditional village, and house compound contexts in the vicinity of Old Bagan's walled and moated royal epicenter, utilizing an ethnoarchaeological based research strategy, and applying a direct-historical approach. The purpose has been to emphasize aspects of the human-animal relationship that may be observable in the archaeological record, and to show how such relationships may benefit the larger IRAW@Bagan settlement study, with its greater goal of understanding the nature of the villages and/or neighborhoods that existed within the suburban and peri-urban (mixed urban-rural) settlement zones that surrounded Bagan's walled epicenter from the 9th to 14th centuries CE. These goals have primarily been accomplished by querying information obtained by IRAW@Bagan ethnoarchaeological researchers during the previous 2017 and 2019 field seasons.

This included data obtained through ethnoarchaeological based survey's, primarily focusing on the layout of the house compound and larger village (Talving-Loza 2019), agricultural practices (Macrae 2017), and water ritual and symbolism (Rivera-Borbolla 2019). Data was collected and observed in ten traditional villages chosen due to their proximity to Old Bagan and seeming adherence to traditional agrarian lifeways.

These villages include: Thae Pyin Taw; Shwe Hlaing; Zee Oo; Kon Sin Kyi; Kon Tan Gyi; Minnanthu; Hpauck Sein Pin; Thuhtaykan; East Pwa Saw; and West Pwa Saw, with the information obtained through interviews with local villagers and house compound residents, through participant observations of local village events, and while traveling from village to village.

Data has also been gathered from retrospective historical chronicles and translated temple inscriptions which discuss the animals that had been present in and around the area of Old Bagan, and those animals which had been utilized by humans, augmented by information derived from artistic representations and museum displays. Data pertaining to physical animal remains consisted of those which had been encountered by IRAW@Bagan researchers while conducting excavations at the sites of Shwe Creek, Unit 315a-1 and Unit 315a-2, and Otien Taung, Unit 748a-1 and Unit 748a-2.

It must once again be reiterated that this data was not collected with this researcher's research questions in mind. Due to the global COVID-19 pandemic, and the military take over of Myanmar's government in February 2020, the IRAW@Bagan project, and by extension this researcher, were not able to conduct the originally anticipated field research, and thus obtain data directly focused on human-animal relationships. However, thanks to the IRAW@Bagan project, the data collected by the project's researchers in previous field seasons, though not directly focused on the human-animal relationship, could be analyzed, highlighting relevant material which is used to answer the research questions directing this thesis. Those research questions being:

1) What are the material correlates of human-animal relationships in traditional house compounds in the area of Old Bagan?

2) What are the material correlates of human-animal relationships in traditional villages in the area of Old Bagan?
3) What might these look like many years from now?
4) How can these be used to inform future settlement archaeology in the area encompassing the ancient capital city?

Paired with these larger research questions are a series of subsidiary questions. These include:

1) How are animals procured?
2) Who owns them?
3) Who is involved in their care?
4) What is involved in their care?
5) How, and for what purposes, are animals used?
6) How, and where, is animal waste disposed?

With the data compiled from ethnoarchaeological surveys undertaken by IRAW@Bagan researchers in previous years field seasons, retrospective historical chronicles such as the *Glass Palace Chronicles* (Maung Tin and Luce 1923), and translations of temple inscriptions (Duroiselle 1919-1934; Frasch 2014), this researcher has attempted to mine information related to the human-animal relationship which may provide insight towards answering these research questions. The aim of this chapter is to address the research questions directly, with the information generated from the analysis of the data. One will leave the final main research question, "How can these be used to

inform future settlement archaeology in the area encompassing the ancient capital city?" to the last, as providing further insight towards this question formulates a discussion, drawing from each of the main research, and subsidiary questions asked.

Question 1: What are the material correlates of human/animal relationships in traditional house compounds in the area of Old Bagan?

Oxcart

Material related to cattle were the most commonly encountered by IRAW@Bagan researchers in ethnoarchaeological surveys associated with the human-animal relationship. This is likely due to cows/oxen being the most common animal observed in the traditional house compound. They are also the animal viewed most as being utilized for work and farming. Oxcarts were documented in many of the house compounds surveyed. Though the precise method of construction is unknown, each oxcart appeared to contain the same essential components, such as being mostly constructed of wood, including the wheels, hubs, axle, yoke, and main body area, with only some parts of these appearing to employ metal components. These vehicles were observed to be stored in their own designated spaces, or within the cow shed within the house compound.

Plows and Plowshares

Plows and plowshares were observed by IRAW@Bagan researchers, and much like oxcarts, their appearance and construction were consistent. The contemporary examples documented, however, appeared to have all their components made from wood. Examples of metal plowshares were photographed by IRAW@Bagan researchers while on a museum visit, though their context remains unclear. As mentioned in the previous chapter, metal artifacts assumed to be associated with plows were encountered by IRAW@Bagan researchers during their excavations at Shwe Creek (Tamura and Cheong 2019a:108), and Otein Taung (Rivera and Cheong 2019a:163). It may be likely that examples of metal plowshares, and other plow components, from the Bagan Period could be uncovered and identified in future settlement archaeology projects.

Cow Sheds and other animal related structures

The most prominent materials associated with the human-animal relationship within the traditional house compound observed by IRAW@Bagan researchers appear to be in and around the cow shed, the cow shed itself, and other animals related structures, such as feeding areas, fodder storage areas, animal pens, and chicken coops. Chicken coops themselves were seen to come in two forms, an under the house coop, observed in East Pwa Saw, and a "basket" style seen in Zee Oo and East Ywa Naung. Apart from providing shelter for animals, cow sheds may also act as storage for other animal related materials like oxcarts, plows, and feeding troughs. Feeding troughs were commonly constructed from a hollowed-out log, held up by Y-posts, or other materials such as

stones, stacked logs, and barrels, with one example seen in Kon Sin Kyi have a concrete or stone base.

Cow sheds have been observed to be constructed of acacia posts in a 3x4 post configuration and roofed with toddy palm, with the upper rafter's area utilized for storage. Though the main structure itself is comprised of perishable material, the imprint of the cow shed may archaeologically visible. The main posts supporting the structure are likely to leave behind post holes, while in images taken by IRAW@Bagan researchers compounds also appear to show the floor surface within the footprint of the cow shed appearing pock-marked with hoof prints, with a distinct color, likely caused by the animals sheltering in the structure, and the urine and feces excreted from them. Animal waste was cleaned up from the cow sheds, and often placed in manure piles which will be discussed further below.

Kitchens and Earth Ovens

Kitchens and earth ovens may contain evidence of the human-animal relationship primarily through the context of food. Much like how the cowsheds signal the presence of animals, so to does the kitchen point to human use of animals. Though parts of the kitchen itself may not overtly point towards animals, such as brick lined cooking areas, or earth ovens, their presence points to cooking, and cooking in turn to animal proteins used in dishes. Ceramic and metal cooking vessels observed by IRAW@Bagan researchers, over time and continuous use, may leave behind physical residues of previous meals

prepared within them, including trace amounts animal proteins. The presence of earth ovens in particular point to large quantities of food being prepared, and have been observed by the IRAW@Bagan researchers in their surveys to contain meat such as fish and port.

Question 2: What are the material correlates of the human-animal relationship in the traditional villages in the area of Old Bagan?

Oxcarts, both utilitarian and ceremonial, had been observed by IRAW@Bagan researchers while conducting ethnoarchaeological surveys within the ten case study villages, as well as while travelling between villages, and participating in local events. Oxcarts of different types appeared to be utilized, though one must say it is unclear if they had been truly different types of oxcarts, or if its construction is of a general design which could then be retrofitted to fit a specific need, like carrying material, people, or barrels as viewed in photographs taken by IRAW@Bagan researchers. Also, as discussed in the previous chapter, while at a toddy stop, the IRAW@Bagan team photographed an oxen powered peanut grinder, though more contextual information about it had not been directly observed aside from the material used to construct it. Humans and animals were also photographed by the IRAW@Bagan team while travelling, plowing agricultural fields.

Horses and elephants had been observed in ceremonial processions in Let We and Nyaung U; however, little information is known as to the material which may be directly

relevant from these which may add further insight to the correlates of the human-animal relationship within the traditional village context. Viewed and photographed though by the IRAW@Bagan team was a market in the village of Myinkaba. Apart from the animal products appearing to be processed and sold (including fish, chicken, and a yet to be unidentified type of meat), the market contained many materials are associated with these activities. These include such things as metal bowls and trays, baskets, wood boxes, tables and stands, and large wooden chopping blocks with different cutting and chopping utensils.

Question 3: What might these look like many years from now?

The animals themselves and their remains, under the right conditions, may be archaeologically relevant material to be uncovered, much like the faunal remains encountered by IRAW@Bagan researchers in their excavations at Shwe Creek and Otien Taung. Though not directly discussed, it was mentioned from ethnoarchaeological surveys that waste and food refuse would be collected and placed at the margins of the house compound or taken to a communal dump site on the outskirts of the village, and it may be that animals remains, from food refuse or otherwise, would also be disposed of here. Information with regards to what happened to animals after death, such as cows/oxen, horses, and elephants was not collected during the ethnoarchaeological surveys. However, with numerous village dogs viewed in photographs taken by the

IRAW@Bagan team, there may be a high likelihood that animal remains were scavenged, thereby complicating their deposition into the archaeological record.

Oxcarts, plows and plowshares, and the components involved in the construction of each observed in the contemporary house compound and traditional village contexts, being primarily made from perishable material, are unlikely to preserve in the archaeological record. However, if they contain metal components, it may be possible to encounter them in future excavations.

Though both the cow shed, and the main house of the traditional house compounds surveyed by IRAW@Bagan researchers utilize the 3x4 post configuration, the average footprint of the cow shed, and average post diameter of the structure, are smaller. With the cow shed being constructed primarily from perishable material, it is unlikely that material aspects directly related to the structure would preserve. Despite this, the cow shed may be the most recognizable component directly associated with animals within the traditional house compound. As previously discussed, the acacia posts framing the cow shed are likely to leave behind post holes. While the average depth of the post holes for the cow sheds themselves had not been recorded, the post hole measurements recorded by IRAW@Bagan researchers in their ethnoarchaeological surveys had been between 45.7 and 76.2 cm deep. Excavated post holes encountered by the IRAW@Bagan project had been observed to be dug an average of 12.4 cm into the ground. Though these are likely shallower than post holes associated with cow sheds, they may be related to the more crudely built structures associated with animals and documented in photographs taken within the traditional house compounds. The floor surface of the cow shed may also be distinguishable, as photographs appear to show them

marked with animal prints, as opposed to the surrounding smoother floor surface of the rest of the house compound, and though animal waste was also removed from these areas, trace amounts of urine and feces are likely to mix with the soil composition beneath.

Feeding areas and their components, such as troughs, will likely not preserve, but an imbedded impression may be left in the floor surface marking locations within the house compounds, and other materials are often associated with them, such as stacked logs, stones, tree stumps, and even a stone platform, as was seen in one house compound surveyed. Fodder storage areas, much like feeding areas, are unlikely to leave behind truly distinguishing archaeologically relevant material, however, as the plant material within decomposes, it may create a difference in the soil composition, thereby distinguishing this from other areas within the traditional house compound.

What would likely remain from structures such as kitchen, or earth ovens, are what would be closest to the floor surface. Observed in kitchens surveyed by IRAW@Bagan researchers were primarily smooth, beaten earth floors, on which would often be constructed cooking areas made from brick. These may preserve in the archaeological record, along with the charred, ash-like soil left behind by the cooking fires. Also, some of the kitchens surveyed featured a lining of stone, brick, or other hard materials along the perimeter of the kitchen structure as a deterrent for pests. Earth ovens, like those observed by IRAW@Bagan researchers, may also preserve and become archaeologically useful, pointing to food preparation, much like the one uncovered at the Otien Taung excavation, in Unit 748a-2 (Iannone et al. 2022:13).

Subsidiary Questions

How are animals procured? Who owns them?

Though not directly discussed within the ethnoarchaeological surveys conducted by IRAW@Bagan researchers in the traditional villages and house compounds, it is alluded to that livestock animals are reared by certain villagers. It had been mentioned that the occupant of the house compound surveyed at West Pwa Saw worked in rearing livestock, and that in Minnanthu, younger villagers would keep extra cows to sell. However, information on how they sold their stock was not provided. Also documented by IRAW at Bagan research was the presence of a village pig pen in Thuhtaykan, and the house compound surveyed in East Pwa Saw contained a goat pen. However, information on how such animals could be procured was not provided. Nor was information provided as to where and how animals such as horses and elephants were procured. It must be concluded that, though it appears there are animals within the traditional villages surveyed which are bought and sold, little information on the transactional process of procuring an animal had been given to the IRAW@Bagan team.

Though the question of ownership is also not directly discussed, it is alluded to in the ethnoarchaeological surveys that animals within the boundaries of the traditional house compound belonged to the occupants. It is not, however, discussed if animals were perhaps “loaned” out, either amongst villagers, or between villages. This may be likely for animals such horses and elephants, though it may also be so for working cattle.

The retrospective historical chronicles, and translations of temple inscriptions, describes animals "owned" by the ruling class of Bagan. Animals had also been donated to temples, primarily by those of the Bagans's ruling class, though it is not discussed as to what the animals had been donated for, aside from the accumulation of merit for the donor.

Who and what is involved in their care?

It appears, based on the information compiled from the ethnoarchaeological surveys, that it was the responsibility of the occupants of the house compound, and thus the owners of the animals, for their care. It also appears that most of the animals encountered by the IRAW@Bagan team required basic care needs, such as shelter (e.g., cow shed), and consistent access to food and water (e.g., fodder storage, feeding areas, grazing space). For horses and elephants, however, a degree of specialist care and knowledge of the animals one is working with is required, though further insight into this topic was not made available to the IRAW@Bagan team. One suspects that the needs of animal care may have been similar in Old Bagan.

How, and for what purposes are animals used?

From the observations made by the IRAW@Bagan researchers in their ethnoarchaeological surveys, it can be said that animals were utilized by humans for many purposes in and around the area of Old Bagan. Cattle were seen utilized for transportation, seen pulling oxcarts of various materials and people, and observed working in agricultural fields as draught animals pulling plows. Their use appears to be that of a living motor, capable of all purpose use like transportation, agricultural, and as viewed at a toddy stop, peanut grinding.

Cattle/oxen also appear to have filled this role in Old Bagan. Photographs taken by IRAW@Bagan researchers of temple murals, particularly at Shwe Hlaing, feature cattle utilized to pull a plow in the same way observed within the contemporary traditional village context. Models and figurines photographed on a museum visit also detail past use of cattle pulling oxcarts, though it must be said that it is unclear if these are representative of Bagan Period oxcarts. Cattle/oxen are also the animals which appears most frequently within the translated temple inscriptions, as animals donated to the temples. However, it is also unclear as to the degree to which cattle/oxen were being utilized as food in either the contemporary or past contexts.

Goats were observed by IRAW@Bagan researchers, though it is unclear as to their specific use. However, it may be that they were primarily utilized for food purposes. The same is also likely for the other domestic animals observed in the ethnoarchaeological surveys. Some researchers did note that fish, such as those photographed at the market in the village of Myinkaba, made up the bulk of the animal protein consumed in the traditional villages surveyed.

Horses observed by IRAW@Bagan researchers were shown to be ridden as part of a ceremonial procession in the village of Let We, and it had been mentioned that they had on occasion been utilized to pull carriages. Beyond this, however, little information was provided on their uses within the traditional village context. Horses, however, appear throughout the events taking place within the *Glass Palace Chronicles* and temple inscriptions, where they are utilized as mounts for transportation and military purposes, and listed as donations to temples. It appears from these sources that such animals are exclusive to Bagan's ruling class, or high-ranking military officials and cavalry.

Much the same goes for elephants. Though elephants were viewed as part of a ceremonial procession while visiting the village of Nyaung-U, not much else was provided as to their use in the traditional village context. Like horses, however, elephants appear throughout the retrospective historical chronicles and translated temple inscriptions. They are described as being utilized as transportations, and for military purposes, though, perhaps even more so than horses, their use appears exclusive to Bagan's ruling class. Elephants also appear as symbols, particularly of Buddhism and royal authority, with white elephants being representative of the Buddha, or the King of Bagan. Elephants are also listed among donated animals to temples, though this is primarily done so by the elite of Bagan's society.

How, and where is animal refuse deposited?

As observed in the ethnoarchaeological surveys of the traditional house compounds, manure was collected by the occupants of the house compound and often placed in designated collection areas on the boundaries of the property. These were also often cribbed with some sort of retaining wall constructed out of stacked stones, logs, bricks, wood, or whatever other material may be available. It was mentioned by all farmers surveyed that animal's dung was the preferred fertilizer to be used on agricultural fields. However, information on where faunal remains from meal preparation and cooking had been deposited was not provided.

It was also mentioned within ethnoarchaeological surveys of the traditional villages that villages maintained designated dump sites for refuse. However, whether animal remains had also been deposited here was discussed. Little information on what became of animal waste, or remains, is provided by the retrospective historical chronicles and translated temple inscriptions.

Question 4: How might this study inform settlement archaeology in the area encompassing the ancient capital city*?*

Being that the past ethnoarchaeological surveys conducted by IRAW@Bagan researchers had not been carried out with animals directly in mind, it is rather difficult to discern what parts of the data analyzed may be useful in terms of providing insights for future settlement archaeology in and around the area of Old Bagan. Some of the information that have been most useful for providing such insight are largely unavailable to this researcher. Perhaps most crucially, which animals had been utilized as food, and

what became of their remains was unclear. Though goats and pigs were observed and documented within the traditional villages and house compounds, it has not been directly discussed whether they had been used for food, and how they had been procured or processed.

Cattle were observed working with humans, and it had been mentioned in ethnoarchaeological surveys that they were favored by villagers more for their ability as a work animal, than their use as food. However, whether used for food or work, with rearing any livestock, inevitably comes dead stock. Though it had been observed in ethnoarchaeological surveys that refuse had been either collected on the perimeters of the house compound or taken to communal dumping site on the outskirts of the village, it was not discussed whether animal remains might be included in this refuse. It is perhaps unlikely that animal remains associated with food or work would be strewn throughout the traditional village and house compound or kept for very long in or around any structure commonly utilized by humans, such as the main house or kitchen, as this would also attract pests, though small bones and bone splinters may preserve. If animal remains had been deposited with other refuse, scavenging from pests and village dogs may complicated their archaeological deposition. One cannot also imagine large animals used to work with humans, such as the cattle, but also horses and elephants observed and photographed by IRAW@Bagan researchers, simply being left in place upon their deaths. These are not only physically large animals, but ones which also appear to hold a degree of reverence.

Faunal remains, however, have been encountered by IRAW@Bagan researchers in their excavations at the sites of Shwe Creek and Otien Taung, which date from the Pre

Bagan-Period (600-1044 CE), to the Early (1044-1113 CE), Middle (1113-1174 CE), and Late Bagan Periods (1174-1300 CE), and animals are mentioned throughout the *Glass Palace Chronicles* and translations of temple inscriptions, and they are also depicted in temple murals and other artworks. It is therefore likely that animals were utilized in Old Bagan in a manner like that observed on the Bagan plain today. In summary, data obtained by IRAW@Bagan researchers, though not directly focused on animals, still highlight aspects of traditional house compounds associated with animals that may inform settlement archaeology.

Cow sheds, and their associated material, having been observed and documented in nearly all the house compounds surveyed by the IRAW@Bagan team, may be the most archaeologically discernable feature in future excavations, along with kitchens and earth ovens. As outlined in the surveys of traditional house compounds, the average area of the cow shed encompassed 31.89 m^2, utilizing a 3x4 post configuration where the average post diameter had been measured at 15.4 cm in diameter. Though some cow sheds surveyed had other structures attached to them, such as feeding and fodder storage areas, the general outline of the cow shed itself remained consistent, save for some removing the interior posts to create more space. The floor of the cow shed also appeared considerably rougher than the rest of the surrounding floor surface, with small amounts of what appeared to be cattle feces and urine. It had also been observed that on average, cow sheds had been located 17.4 m from the main house within the compound, with half of those surveyed located in the northern end of the compound.

These may be useful parameters for future excavations. Should an excavator come across what is believed to be a cow shed, it would perhaps be useful to dig 1 x 1 m test

pits out from the structure every 5 m in north, south, east, and west directions to about 20 m. With this strategy, one might be likely to encounter the boundary of the house compound, or main house, and perhaps other animal related aspects of the house compound. These include such things as feeding areas, and areas dedicated to storing cow dung which had been observed to be constructed of materials like stones, stacked logs, and posts, perhaps leaving a discernable imprint in the floor surface.

Conclusion

Ultimately, though information was able to be gleaned from photos taken in and around traditional villages and house compounds surrounding Old Bagan regarding the human-animal relationship, more in depth and directed research on the subject must be conducted. Also, analysis of faunal remains recovered by IRAW@Bagan at the excavations of Shwe Creek and Otien Taung must be conducted to possibly further identify the species present, and to direct further ethnoarchaeological based questions and surveying of animal related material and structure within the traditional villages and house compounds in and around the area of Old Bagan to provide further useful insight towards relevant material correlates and behavioural residues beneficial to settlement archaeology in the area. This would certainly furthering the larger research goals of the IRAW@Bagan project.

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