

Salt-making in Northeast Thailand – An Ethnoarchaeological Study in Tambon Phan Song Khram, Nakhon Rachasima Province, Northeast Thailand

Andrea Yankowski ^{1*} and Puangthip Kerd sap ²

¹*San Francisco State University, USA*

²*Kasetsart University, Bangkok, Thailand and James Cook University,
Townsville, Australia*

**Corresponding author: a.yankowski@yahoo.com*

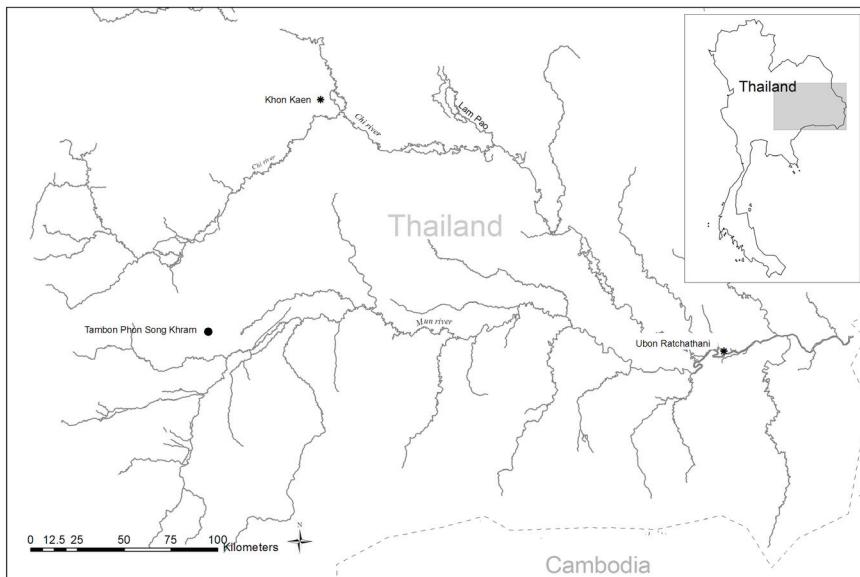
Introduction

The Mun River Valley of Northeast Thailand has been the focus of numerous archaeological excavation projects over the last two decades as part of the *Origins of Angkor* project, a multi-disciplinary, cooperative project between the Thai Fine Arts Department, the University of Otago, New Zealand, and James Cook University, Australia (Higham & Thosarat 2005; Higham, Kijngam & Talbot 2007; Higham & Kijngam 2009, 2010, 2012). Since 2002, the project has conducted excavations in the village of Ban Non Wat, a small rural community with cultural remains dating back over 4,000 years, exposing numerous archaeological features, burials and artifacts, and greatly contributing to our understanding of the development of the local society and economy over time. Over the last few seasons, under the direction of Dr. Nigel Chang, Dr. Kate Dommett, Dr. Bill Boyd, Dr. Warrachai Wiriyaromp and Dr. Amphan Kijngam, the project has expanded its scope to study the broader cultural landscape of the region and the changing interrelationship of humans with their natural resources and environment. This new direction has included ethnoarchaeological research on local salt resources and salt-making, in order to gain a greater understanding of the diachronic importance of this natural resource and commodity in the region.

This paper presents the results of a 2010 ethnoarchaeological study in Tambon Phan Song Khran, Nakhon Rachasima Province, Northeast Thailand. It is a small sample study of the local technology of salt making and the use and trade of salt in Northeast Thailand, as part of a broader on-going study on the history of salt production in Southeast Asia.

Background

Tambon Phan Song Khran is located on the Khorat Plateau, a large drainage basin for the Mun and Chi Rivers (see Map 1). This region is situated upon a Mesozoic sequence of rocks known as the Maha Sarakham Formation that consists primarily of sandstones, siltstones and thick beds of rock salts (Mongkosawat and Paiboonsak 2006). During the rainy season, much of the low-lying areas of this basin are flooded. Then, during the dry months, the water table drops and salt permeates up through the soil, crystallizing on the surface in exposed areas where there is little or no vegetation. Rural households subsequently collect these sediments and leach out the salt. This is an old tradition but little is known about the historical, social, technological, or economic significance of this resource in the region throughout time.



Map 1 The location of Tambon Phan Song Khram and the Mun River Valley Basin, Thailand.

Over the years, local archaeologists have noted the prevalence of salt making activities on a seasonal basis during the dry season, from January through April. Moreover, possible salt-making features have been noted in excavations, and numerous mound sites formed from the discarded soil from salt-making activities have been identified, some which are still in use today. Preliminary archaeological research suggests that some of these salt-making sites date back to the Iron Age, circa 500 BC, or even earlier (Rivett & Higham 2007; Nitta 1997; Cawte & Bongsasip 2009). It has also been suggested that salt was traded along the extensive Angkorian road system in the late first millennium and early second millennium AD (McNeill & Welch 1991; Welch 1998; Hendrickson 2007:224-226). If so, early salt production may have impacted land use and settlement patterns and played a role in the political and economic development of the region. The suggested importance of this commodity to the development of the region warrants greater research on this topic.

Study Area & Methodology

Most of the population of the study area are rice farmers who supplement their income with traditional crafts and/or seasonal employment in urban areas. This area was selected because many people in these communities continue to make salt using traditional methods for personal use and subsistence, or occasionally as a trade good or an additional source of income. This region is also part of the “Origins of Angkor” study area, where field excavations are currently taking place, providing an opportunity to undertake a socio-environmental study within the research area, as well as collect ethnoarchaeological data that may be directly relevant to the ongoing excavations.

During the month of January 2010, the authors visited 15 villages in Tambon Phan Song Khram. See Table 1 and Map 2. In each village, we arranged to speak to the local headman/woman, when available, as well as interview some of the salt makers. The main objectives of the research project were to 1) learn about present day methods of salt-making and the extent of salt production and trade in the region; 2) identify changes in technologies of salt production and/or the location of salt resources within recent memory (i.e., last couple generations); 3) Identify archaeological salt sites; and, 4) identify environmental, social and historical factors that have impacted salt production and trade in the region, past and present.

Additionally, during our study we became aware of some local health issues related to the consumption of locally made salt, which is not enriched with iodine. Subsequently, we reached out to the local health clinic to obtain more information on potential health problems and briefly addressed this in our research as well.

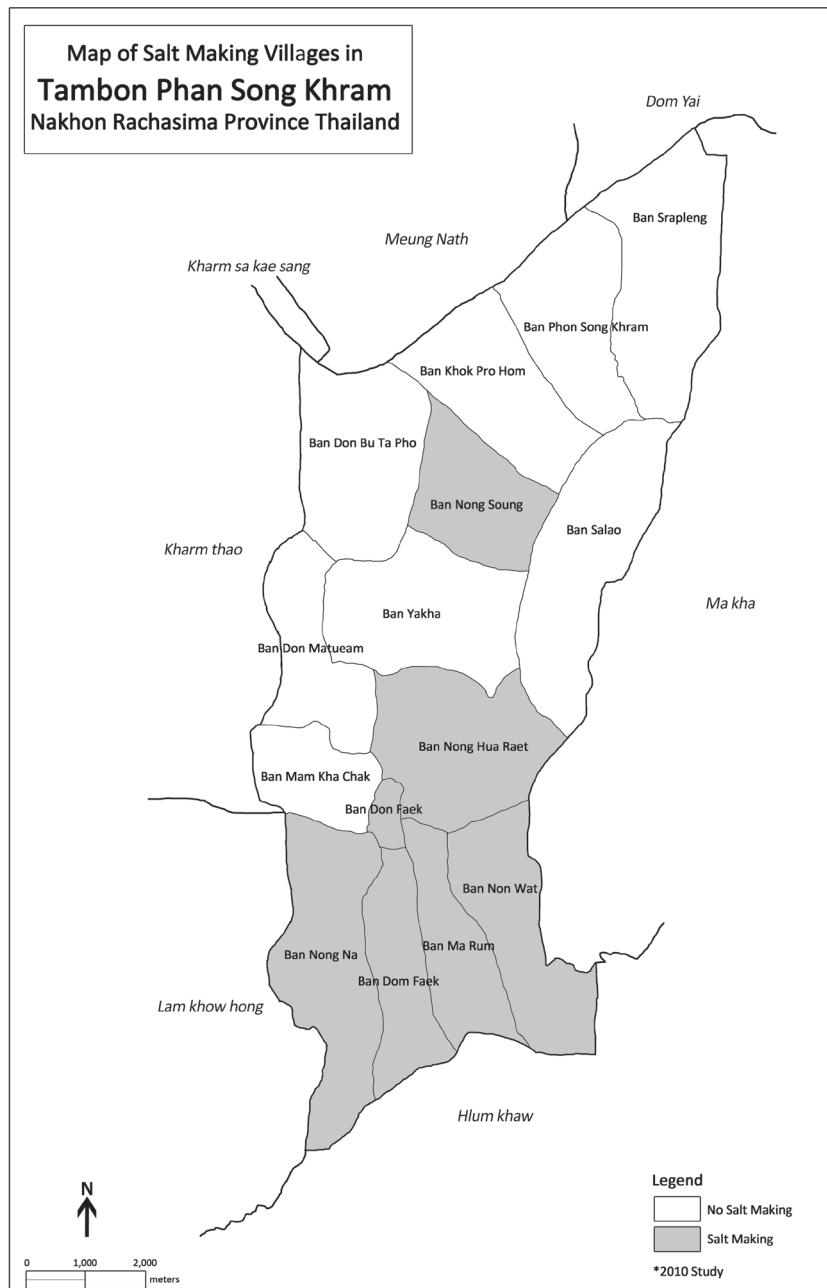
Table 1 Villages visited in Tambon Phan Song Khram

Village	Population*	Households*
1) Ban Sapeng (บ้านสารเพลง)	453/457	126
2) Ban Phon Song Khram (บ้านผลสัมภารม)	439/460	162
3) Ban Khok Pro Hom (บ้านเข้าภารม)	375/341	89
4) Ban Salao (บ้านเสลา)	334/312	115
5) Ban Yakha (บ้านหยาค)	464/451	146
6) Ban Nong Hua Raet (บ้านหนองหัวแรด)	191/184	67
7) Ban Ma Rum (บ้านมะรุ่ม)	270/253	92
8) Ban Don Faek (บ้านดอนแฟก)	322/366	127
9) Ban Nong Na (บ้านหนองนา)	353/395	152
10) Ban Don Mam Kha Chak (บ้านดอนมั่นกระชาก)	189/193	48
11) Ban Non Wat (บ้านโนนวัด)	117/129	48
12) Ban Nong Soung (บ้านหนองสรวง)	202/168	71
13) Ban Don Malueam (บ้านดอนมะเหลื่อม)	172/170	52
14) Ban Don Bu Ta Pho (บ้านดอนบุต้าฟอร์)	144/126	46
15) Ban Don Faek Pattana (บ้านดอนแฟกพัฒนา)	311/311	111

Methods of Salt Production

There are two basic steps to making salt in the study area. The first is to immerse the saline sediments in water to dissolve the soluble salts and create brine. Then, when the salinity of the water is highly concentrated, this brine is drained and slowly boiled to evaporate the water and recrystallize the NaCl.

One of the most common and traditional methods for preparing the brine is to dig a small square or circular basin to contain the sediment and water, approximately a meter to a meter and a half in diameter, in the ground or along a small mound or embankment. A second deeper hole is dug adjacent to this for draining off the brine. Traditionally, these are clay lined to make them impermeable, but nowadays, plastic sheeting is sometimes used, or a small ceramic pot is set in the hole to collect the brine. A small



Map 2 Map of Study Area (Tambon Phan Song Khram)



Figure 1 Piles of soil collected for processing



Figure 2 Empty salt processing basins



Figure 3 Basin filled with soil & water

bamboo feeder tube is inserted between the two pits for draining the brine. This remains sealed up until the salt has had ample time to dissolve in the water. Some bundled grasses are also placed in the bottom of the basin overlaid with a burlap bag and sometimes rice husks to help aid with draining the brine. The resulting product is a clear brine solution.

Once the brine is prepared, the next step is to boil the brine to evaporate the water and recrystallize the salt. Presently, all the salt makers in this area use metal sheeting to make a shallow tray for boiling the brine. This tray is placed over an outdoor hearth and the brine is boiled in multiple batches. It is then collected and put in baskets to further drain, and eventually stored in large stoneware jars. We suspect that in the past, earthenware jars, pans or basins were used, as has been noted in historical records (Aymonier 2000 [1895]) and was commonly done elsewhere in premodern contexts (Brown 1980; Bushnell 1907; Cassen et al. 2008; Chen 2004; Chen 2008; Flad 2009; Gouletquer 1975; Kondo 1975; MacKinnon et al. 1989; McKillop 2002; Yankowski 2008).



Figure 4 Boiling the brine



Figure 5 Basket of Salt



Figure 6 Processing soil using a burlap bag

There is another method of making brine that is used in some of the villages. Instead of digging a basin, a burlap bag is stretched over a wooden frame suspended over a bucket. The soil is placed in the burlap bag and water is added and allowed to drain through to the bucket. Several individuals we spoke to said they only recently began using this method after seeing others use it. For some of the older individuals, this is easier because it allows them to work standing up or seated, rather than having to kneel down.

Within the research area, we also learned about one couple (husband and wife) who collect brine water from evaporation ponds at a nearby industrial salt factory and boil this brine water to make salt, skipping the brine making process. However, their situation is unique, as they maintain a special arrangement with the factory due to a real estate transaction that involved the purchase of some of their land for the salt factory.

Lastly, the above-mentioned salt factory in the town of Ban Salao produces industrial grade salt (e.g., for detergents) that is sold throughout Thailand. The factory pumps brine from deep beneath the surface into a

series of evaporation ponds. The factory has become an important employer for the immediate region, but this has impacted the production of locally made salt.

Economics & Distribution of Salt

Our surveys revealed that only six of the fifteen villages within Tambon Phan Song Khram have households that continue to regularly make salt; however, salt was made in *all* of the villages within recent memory, i.e., the last couple generations. See Map 2. The biggest factor that has impacted the number of households making salt is the construction of the Ban Salow Salt Factory, particularly in the towns immediately surrounding the factory. The salt factory was built on the land that was formerly used for traditional salt-making, providing an alternative source of employment and income for the people in the local communities during the dry season. The headman of Ban Khok Pro Hom, Mr. Kleanklai Dokpikut, told us that when he was young approximately twenty people from his village made salt on the lands where the factory is now located. At that time, many of these households were trading salt for rice. After the factory was built, many people instead chose to work at the factory, which provides cash wages, and they abandoned their traditional salt making activities.

Today, the majority of salt makers make salt primarily for personal use and consumption; however, some individuals also sell their salt, or trade it for rice. For example, salt makers in the village of Ban Nong Hua Raet regularly sell their salt in neighboring towns, delivering it by truck. Traditionally, salt was distributed via handcarts, but in our surveys we learned of only one woman who continues to sell salt using this labor-intensive method.

There are standard prices and trade equivalents for salt, most of which are based on the size of locally available stoneware jars or baskets. On average, the price equates to 10-20 baht/kilo. Often times salt is traded for rice, with equal trade equivalents. We were informed that in the past, bamboo baskets were used, and late 19th century historical records indicate that salt was sold in small earthenware pots (Aymonier 1895).

Today, the most common use of locally made salt is for making *pla-ra*, fermented fish, which is a staple part of the local diet. To make *pla-ra*, fresh water fish is cleaned and put in a large jar with a generous amount of salt. The amount of salt varies based on the size of the fish and preferred taste. Three weeks later pounded roasted rice is added to the fish and salt mixture and is allowed to ferment for a minimum of six weeks up to six months. We were consistently told that local salt is preferred over commercial salt for *pla-ra*. We believe this may be due the specific minerals present in the local salt and the lack of iodine, which can inhibit fermentation. Local salt is also cheaper, so is often preferred for economic reasons. Consequently, the combination of these factors has helped preserve this local tradition.

Landscape & Environment

Today, salt is a relatively minor industry, but oral and historical records, as well as preliminary archaeological data, indicate it was an important economic activity in the past. If salt was one of the primary economic activities of the region, the availability of salt resources may have contributed to where people chose to settle, work (farm) and live. To investigate these questions, we examined the spatial distribution of salt sites and activities, mapping out current and past salt collection areas. We also inquired about how or why these areas may have been used in the past, or changed over time.

Only a limited number of areas are maintained for salt collection within Tambon Phan Song Khram. This is due to the limited availability of suitable lands and sediments as well as personal choices about land use. Geological, environmental and cultural factors that impact the high salinity levels within specific areas of the basin includes the relatively shallow depth of underlying salt bearing rocks combined with the low topography, poorly draining soils and relatively shallow water table, and the lack of vegetation cover, which encourages the upward movement of soluble salts following the wet season (Mongkolsawat and Paiboonsak 2006). These conditions often exist at the edges of the floodplains in areas that have not been developed for agricultural purposes, or on public lands, such as along the railroad tracks.

Some private lands are also made openly accessible for salt making, but changes in land ownership often results in the development of the land for other purposes.

Subsequent surveys by the authors within the greater administrative district have noted numerous areas with the distinct saline sediments that are characteristic of salt-making areas within the immediate region. Many of these areas continue to be used for salt making. Local farmers are readily aware of the debilitating effects of salt on rice agriculture and actively maintain these areas as environmental zones segregated from agricultural activities. Future archaeological research will need to investigate if these environmental zones existed in the past and how human modifications to the landscape impacted local land use for agricultural practices and salt exploitation.

Furthermore, nowadays, the region experiences distinct wet and dry seasons, which greatly impacts the types of agricultural, industrial and craft activities that occur throughout the year. Rice agriculture is the primary activity during the wet season, while salt production and many craft activities take place during the dry season. Research has demonstrated that the climate was wetter in the past and that the dryer conditions that are characteristic of the region today, developed by the Late Bronze Age circa 3000 – 2500 BP (Boyd 2008; Boyd and McGrath 2001). There is also some evidence of geomorphological changes around this time, including salt dome upwelling (Boyd 2008; Utha-Aroon 1993). It is likely that this increased aridity would have impacted agricultural cycles and other seasonal activities and created environmental, climatic and landscape conditions favorable for salt-production activities. Further research on these topics as well as the age of the salt sites should help clarify these questions.

Archaeological Sites

Previous archaeological surveys have identified numerous small mound sites generally ranging from 50 to 150 meters in diameter throughout Nakhon Rachassima Province believed to have been formed from salt-making activities. Archaeological deposits at these sites include large scatters of

earthenware sherds, which may have been used directly or indirectly for salt production. During our study, we were interested in identifying potential archaeological sites within the more immediate study area and inquired in each village about known salt collection areas and visited these areas that were not on private lands.

Among the villages we visited, large salt mound sites were lacking. Instead, people were collecting soils from large exposed salt flats, and bringing the soils back to their homes to process. As a result, discarded soils were not being accumulated into mound sites as is seen elsewhere in the region. However, we were told that in Ban Don Man Kha Chak there used to be a small hill site about 3 meters high where people made salt, but the new owner plowed the site. We suspect that this may be the case elsewhere, as well.

However, just outside the immediate study area in *the* neighboring district of Kharm Thao is an area known as Nong Song Pi Nong where people from Phan Song Khram, as well as some other neighboring towns, make salt. The site has two large mounds that are surrounded by saline soils as well as a local water source. There are also dense accumulations of potsherds eroding along the edges of parts of the mounds, likely the remnants of salt making activities. Families from Ban Don Faek and Bang Nong Na visit Nong Song Pi Nong each year to make brine, and transport the brine back to their homes to boil. Other families from the local communities make salt at the site. When we visited, a family was taking up temporary residence at the site to make salt for the season. We were told that this practice was common in the past before the availability of modern transport.

Other areas we surveyed included the public lands near the Ban Salao salt factory, salt flats near the village of Ban Hua Raet, Ban Marum and Ban Non Wat, as well as an area just outside the study area between Ban Makaa and Ban Maklua. Artifacts, including earthenware sherds, were found on the lands near the Ban Salao salt factory, and the large exposed areas in Ban Hua Raet are still used by many families. Both areas need further investigation.

Health Issues

Although not an initial focus of this study, it became apparent that many people in this region do not consume iodized salt. Only a handful of individuals we spoke to acknowledged the importance of iodine or regularly used commercial (iodized) salt. When acknowledged, it was generally noted that local salt is preferred for fermenting fish, while commercial salt is sometimes used for general cooking. But overall, there did not seem to be a concern for iodine deficiency in the community, even among those consuming strictly local salt.

The national rate of iodine deficiency in Thailand is 4.3% (Pandav et al. 1997). Statistics were not available for our local study area, but we did note some evidence of goiter among older members of the communities. As a result, we spoke to the Primary Care Unit for the region, located in the village of Ban Marum. We were informed that the government has an outreach program to provide free iodized salt in the villages once per year, and free testing of salt for iodine. Iodized salt is also used in the children's school lunches in order to reduce the prevalence of IDD (iodine deficiency disorder) throughout the province. However, at the clinic and in government outreach policies, there seems to be a lack of knowledge about the prevalence of local non-iodized salt production in the region, which is likely to be hampering outreach efforts, especially among the older members of the communities.

Summary/Further Research

The immediate objectives of this research were modest, i.e., to provide some preliminary information on salt production within these fifteen villages. From this research, we hope to be able to formulate more in-depth questions about the history of salt production and the long-term impact of this activity on the local environment and social landscape over time.

One important fact this study confirmed was that salt production was widespread in the region 20-30 years ago and that the widespread reduction in this activity is primarily due to changes in accessibility of resources. The most drastic example of this was the opening of the Ban Salow salt factory,

but there were other examples of changes in land ownership and land use for agricultural purposes that affected availability of resources. Yet, in areas that have remained public and accessible, the lands are generally maintained for salt collection and processing.

These results suggest that in order to learn more about the extent of salt production in the past, we need to gain a better understanding of the changes in the local environment and landscape throughout time. Was land set aside and maintained for salt-making in the past and/or were landscapes purposefully changed and modified over time for agricultural versus salt making activities? Some interviewees informed us that sediments are sometimes fertilized with rice husks to impede the upward movement of salts in the soils, thus improving the rice growing conditions. It is possible that the landscape has been historically shaped by this dichotomous use of land for rice agriculture versus salt making activities. We also need to consider if salt may have been used for other secondary purposes, such as for tanning or dying (Cawte & Bonsasip 2009). The 2010 excavation of a bone tool assemblage in the village of Ban Salao, a salt-rich area, may be evidence of such a complimentary industry.

One of the other primary aims of this research was to document the technologies of salt production and understand the range of material evidence and archaeological sites one would expect to find if similar technologies were used in the past. We found that there were many similarities in the methods across the region. Some people experimented with using modern materials, e.g., plastic lining and metal sheeting, or suspended filters, but these are all very recent modifications. The core method has been consistent for some time – using clay-lined reservoirs. Interestingly, we see similar clay lined features in the excavations at Ban Non Wat and other neighboring sites, which are filled with pinkish sandy sediments (Duke et al. 2010). These resemble what we would expect from household scale production. Landscape modifications one would expect as a result of large scale salt-making would include the formation of mounds from discarded soils; larger or more numerous clay lined salt processing basins as are known from other salt production sites in the region and around the world (Flad 2011;

Cassen 2008); and, the maintenance of large parcels of vegetation free land to encourage saline soil conditions.

While earthenware pottery is no longer used in salt production today, 19th century historical records indicate it was traditionally used for boiling brine and transporting salt in areas of Northeast Thailand (Aymonier 2000 [1895]). Earthenware sherds are commonly found scattered around the mound sites, and may represent remnants of salt making activities. If we can identify particular pottery types or forms that were used for salt making, as has been done elsewhere in Asia (Chen 2004; Flad 2011; Flad 2007; Yankowski 2008, 2010), it could provide us with an additional line of evidence for studying the scale of salt production and extent of salt trade In the region.

Lastly, the question remains as to whether salt was a commodity traded along the ancient Angkorian road system. A 245 km road provided a direct transportation link from Phimai to the Angkorian Empire from at least the 12th century, and probably earlier. It has been suggested that salt was one of the commodities traded along this route (Welch 1998; Hendrickson 2007, 224-227). Historically, there has been a strong trade relationship maintained between Phimai and the Tonle Sap region of Cambodia, with the exchange of metal bowls from Bangkok, silk and cotton cloth from Khon Kaen and salt from Korat traded along this route in exchange for Tonle Sap fish (McNeill & Welch 1991). Indications of large-scale production during the prehistoric and protohistoric period, more than would be needed to supply the local population, would provide additional evidence that Phimai was an early regional salt production center.

By studying the salt industry in Northeast Thailand, we have a unique opportunity to learn more about how this natural resource may have shaped the cultural and natural landscape of the region, as well as gain a better understanding of the inter-relationship of human societies with their environment throughout time. More in-depth archaeological and socio-environmental research should help us to further address these questions.

Acknowledgements

The authors would like to thank many individuals and institutions for the support of our research including the Royal Fine Arts Department of Thailand, the National Research Council of Thailand, the Earthwatch Institute and their volunteers, and the directors the “Origins of Angkor” project Dr. Nigel Chang, Dr. Kate Domett, Dr. Amphan Kijngam, Dr. Warrachai Wiriyaromp, and Dr. Bill Boyd. We also wish to thank a couple individuals who directly participated in our field research – our local guide Mrs Chumpi Jongpingkang from Ban Non Wat, and Earthwatch volunteer Vicky Jarvis. We are also grateful to all the salt-makers who took the time to share their knowledge, experiences and stories with us making this research possible.

References

Aymonier, Etienne. (2000) [1895]. *Isan Travels: Northeast Thailand's Economy in 1883-1884*. Trans by W. E. J. Tips. Bangkok : White Lotus Press.

Boyd, W. E. (2008) Social change in late Holocene mainland SE Asia: A response to gradual climate change or a critical climatic event? *Quaternary International*, 184: 11-23.

Boyd, W. E. and Nigel Chang. (2010) Integrating social and environmental change in prehistory: a discussion of the role of landscape as a heuristic in defining prehistoric possibilities in NE Thailand. In *Terra Australis: 21: Altered Ecologies - Fire, Climate and Human Influence on Terrestrial Landscapes*, edited by S Haberle, J Stevenson & M Prebble, pp. 273-297. Canberra : ANU E Press.

Boyd, W. E. and Roger J. McGrath. (2001) The geoarchaeology of the prehistoric ditched sites of the upper Mae Nam Mun Valley, NE Thailand, III: Late Holocene vegetation history. In *Paleogeography, Paleoceanography, Paleoecology*, 171: 307-328.

Brown, Ian W. (1980) *Salt and the Eastern North American Indian, an Archaeological Study*. Lower Mississippi survey, Bulletin No. 6 Series Volume ID: 6. Peabody Museum, Harvard University.

Bushnell, David I. (1907) Primitive Salt-Making in the Mississippi Valley. *Man*, 7: 17-21.

Cassen, Serge, Pierre-Arnaud de Labriffe and Loic Menanteau. (2008) Washing and heating on the Neolithic shores of Western Europe. An archaeological hypothesis on the production of sea salt. In *Sel, eau et forêt, d'hier à aujourd'hui*, edited by O. Weller, A. Dufraisse and P. Pétreguin, pp. 143-161. Paris : Presses universitaires de Franche-Comté.

Cawte, Hayden and Bhadravarma Bongsasip. (2009) Ethnoarchaeological investigations of household salt making in Northeast Thailand: A scalar hypothesis for prehistoric production. Paper presented at the 19th Indo-Pacific Prehistory Association Congress, December 3, 2009, Hanoi.

Chen, Pochan. (2008) Technical Changes in the Salt Production from the Neolithic Period to the Han Dynasty at Zhongba. In *Sel, eau et forêt D'hier à aujourd'hui*. O. Weller, A. Dufraisse and P. Pétrequin, editors, pp. 143-161. Paris : Presses universitaires de Franche-Comté.

Chen, Pochan. (2004) Salt Production and Distribution from the Neolithic Period to the Han Dynasty in Eastern Sichuan Basin, China. Unpublished PhD dissertation, University of California Los Angeles, Los Angeles, CA.

Duke, Belinda J, Alison K. Carter, and Nigel J. Chang. (2010) The Excavation of Iron Age Working Floors and Small Scale Industry at Ban Non Wat, Thailand. Papers from the Institute of Archaeology [Online], 20-22 December 2010.

Flad, Rowan W. (2011) *Salt Production and the Social Hierarchy in Ancient China: An Archaeological Investigation of Specialization in China's Three Gorges*. Cambridge : Cambridge University Press.

Flad, Rowan W. (2007) Rethinking the Context of Production through an Archaeological Study of Ancient Salt Production in the Sichuan Basin, China. In *Rethinking Craft Specialization in Complex Societies: Archaeological Analyses of the Social Meaning of Production*, edited by Z.X. Hruby and R.K. Flad, pp. 108-128. Berkeley : American Anthropological Association and the University of California Press.

Flad, Rowan, X. Wu, L. von Falkenhausen, S. Li, Z. Sun and P. Chen. (2009) Radiocarbon dates and technological change in salt production at the site of Zhongba in the Three Gorges, China. *Asian Perspectives*, 48(1): 149-182.

Gouletquer, Pierre Louis. (1975) Niger, Country of Salt. In *Salt: The Study of an Ancient Industry*, edited by K. W. deBrisay and K. A. Evans, editors, pp. 61-65. England : Colchester Archaeological Group.

Hendrickson, Mitch. (2007) Arteries of Empire. An operation study of transport and communication in Angkorian Southeast Asia (9th to 15th centuries CE). PhD. Dissertation, University of Sydney, Australia.

Higham, C. F. W and A. Kijngam, editors. (2012) *The Origins of the Civilization of Angkor; Volume 5: The Excavation of Ban Non Wat. Part 3: The Bronze Age*. Bangkok : The Fine Arts Department.

Higham, C. F. W and A. Kijngam, editors. (2010) *The Origins of the Civilization of Angkor; Volume 4: The Excavation of Ban Non Wat. Part 2: The Neolithic Age*. Bangkok : The Fine Arts Department.

Higham, C. F. W. and A. Kijngam, editors. (2009) *The Origins of the Civilization of Angkor; Volume 3: The Excavation of Ban Non Wat. Part 1: Introduction*. Bangkok : The Fine Arts Department.

Higham, C. F.W., A. Kijngam, and S. Talbot, editors. (2007) *The Origins of the Civilization of Angkor, Volume 2: Excavation of Non U-Loke and Non Muang Kao Wat*. Bangkok : The Fine Arts Department.

Higham, C. F. W. and Thosarat, R., editors. (2005) *The Origins of the Civilization of Angkor; Volume 1: The Excavation of Ban Lum Khao*. Bangkok : The Fine Arts Department.

Kondo, Yoshiro. (1975) The Ancient Salt Industry in Japan. In *Salt: The Study of an Ancient Industry*, edited by K. W. deBrisay and K. A. Evans, pp. 61-65. England : Colchester Archaeological Group.

MacKinnon, J. Jefferson and Susan M. Kepecs. (1989) Prehispanic Salt Making in Belize: New Evidence. *American Antiquity*, 54(3): 522-533.

McKillop, Heather. (2002) *Salt: White Gold of the Ancient Maya*. Gainsville: University Press of Florida.

McNeill, Judith R. and David J. Welch. (1991) Regional and Interregional Interaction on the Khorat Plateau. *Bulletin of the Indo-Pacific Prehistory Association*, 10: 327-340.

Mongkolsawat C. and S. Paiboonsak. (2006) *GIS Application to Spatial Distribution of Soil Salinity Potential in Northeast Thailand*. Khon Kaen : Geoinformatics Center for the Development of Northeast Thailand, Khon Kaen University.

Nitta, Eiji. (1997) Iron-Smelting and Salt-Making Industries in Northeast Thailand. *Bulletin of the Indo-Pacific Prehistory Association*, 16: 153-160.

Pandav, C. S., N. K. Arora, L. Pocatello-Rossi, M. G. Karmarkar, and B. S. Hazel. (1997) Report coordinated by The Ministry of Public Health, Thailand, International Council for Control of Iodine Deficiency Disorders and UNICEF, Thailand.

Rivett, P. and C. F. W. Higham. (2007) The Archaeology of Salt Production. In *The Excavation of Noen U-Loke and Non Muang Kao*, edited by C.F.W. Higham, A. Kijngam and S. Talbot, pp. 589-609. Bangkok : The Fine Arts Department of Thailand.

Welch, D. J. (1998) Archaeology of Northeast Thailand in Relation to the Pre-Khmer and Khmer Historical Record. *International Journal of Historical Archaeology*, 2: 205-233.

Yankowski, A. (2010) Traditional Technologies and Ancient Commodities: An Ethnoarchaeological Study of Salt Manufacturing and Pottery Production in Bohol, Central Philippines. In *Salt Archaeology in China volume 2: Comparative Perspectives*, edited by Shuicheng Li and Lothar von Falkenhausen, editors. Beijing : Kexue chubanshe (Science Press).

Yankowski, A. (2008) Salt and Salt Pots: A study of premodern salt production in Southeast Asia. Paper presented at the 4th Worldwide Conference of the Society for East Asian Archaeology, June 2-5, 2008, Beijing.