The confluence of water and power: water management in the Brantas river basin from the tenth to the sixteenth century CE

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List of Abbreviations

ANU	Australian National University
BEFEO	Bulletin de l'École française d'Extrême-Orient
BKI	Bijdragen tot de Taal-, Land- en Volkenkunde
ENSO	El Niño Southern Oscillation
FIB	Fakultas Ilmu Budaya
IPPA	Indo-Pacific Prehistory Association
ISEAS	Institute of Southeast Asian Studies
JESHO	The Journal of the Economic and Social History of the Orient
KITLV	Koninklijk Instituut voor Taal-, Land- en Volkenkunde
LIA	the Little Ice Age
MBRAS	Malaysian Branch of The Royal Asiatic Society
MCA	Medieval Climate Anomaly
MKAW	Mededeelingen van de Koninklijke Akademie van Wetenschappen
MISI	Madjelis Ilmu Pengetahuan Indonesia
MKAW-L	Mededelingen van de Koninklijke Akademie van Wetenschappen, afd. Letterkunde
NUS	National University of Singapore
OV	Oudheidkundig Verslag

OD	Oudheidkundige Dienst
PNAS	Proceedings of the National Academy of Sciences of the United States of America
SEAMEO	Southeast Asian Ministers of Education Organization
SPAFA	SEAMEO Project in Archaeology and Fine Arts
TBG	Tijdschrift voor Indische Taal-, Land-, en Volkenkunde.
UGM	Universitas Gadjah Mada
VBG	Verhandelingen van het Bataviaasch Genootschap der Kunsten en Wetenschappen
VG	Verspreide Geschriften

Spelling

The romanization of Old Javanese characters used in this thesis is presented below.

Vowels	a, ā, i, ī, u, ū, ĕ, ö, e, ai, o, au
Consonants	
Gutturals	k, kh, g, gh, ṅ
Palatals	c, ch, j, jh, ñ
Cerebrals	ṭ, ṭh, ḍ, ḍh, ṇ
Dentals	t, th, d, dh, n
Labials	p, ph, b, bh, m
Semivowels	y, r, l, w
Sibilants	ś, ṣ, s
Aspirate	h
Anusvāra	ṁ
Visarga	ḥ

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Introduction

It was 2005, and I and my co-researchers were standing at the side of a small road in the centre of a village near Pare, in Kediri, East Java. As I looked around, I saw three different kinds of irrigation channels, all fairly close to each other. The first channel was relatively new, built in the period of the *Orde Baru* ("New Order"); the second was constructed during the Dutch colonial period; the third was an underground water tunnel believed to have been built at the time of one of the ancient kingdoms of East Java. These three channels seemed to represent three different agricultural systems.

They were situated in an extremely fertile area. The locals have used *sawah* (wet-rice field) agriculture to make a living for centuries, and the village is now also part of a fishery centre in the province of East Java. Not far from us, there was a pond with a natural spring that had been turned into a modern swimming pool. Considering how these different types of water channels acted as conduits for the village's water resources, I started to wonder how its water management may have changed over the centuries.

As an archaeologist, I was most fascinated by the ancient underground tunnel, and particularly how people in the past looked after the tunnel and how they were able to build one that has proved so durable that the community still makes use of it today. Since then, I have had an irresistible urge to explore the origins of this water system; hence, it is the subject of this dissertation. As the underground tunnel was just one part of a much larger water management system, I decided to expand my

research to encompass the entire basin of the Brantas river—the longest river in East Java, draining the entire central region—from the tenth to the sixteenth century CE.

FOCUS OF RESEARCH

There are many definitions of water management, both ancient and modern, but simply put, water management can be defined as *the planned development, distribution, and use of water resources*. The latter itself can be defined as *any source of water that is useful to people (for example, for drinking, recreation, irrigation, livestock production, industry)*; this is how Michael Allaby and Chris C. Park define it.[1] Another definition, longer and more detailed, has been proposed by Milan K. Jermar:

> Water management is a complex of activities, designed to meet the demands of economic development and aiming at an optimum development and utilization of water resources, depending on their quality and availability in space and time, and at the creation of an optimum living environment, through the conservation of water resources, their protection against exhaustion and deterioration, and through the protection of human society against the harmful effects of water.[2]

Vernon L. Scarborough sees two aspects of water management: its physical properties and as a driving force by which economic and political force is used to create and maintain order.[3]

These various definitions have inspired me to create my own definition of water management, one that is suited to and more applicable for my research. My definition is that water management is the act of a society to plan, organize, direct, or control the use of water resources with or without the involvement of a political power. The use of water resources is not limited to irrigation and consumption but also encompasses other activities, such as transportation and religious activities.

The Brantas river basin is located within the province of East Java, in Indonesia. The area of its drainage basin covers approximately 11,800 km^2, makes up 24.6% of East Java's landmass, and lies between 110°30' and 112°55' east longitude and 7°01' and 8° 15' south latitude. In terms of both geographical change and the ways in which its inhabitants have dealt with the question of water management, the Brantas river basin has been a dynamic region since prehistoric times. Some scholars believe

1 M. Allaby and C.C. Park. *A Dictionary of Environment and Conservation,* 2nd ed. (Oxford: Oxford University Press, 2013): 882.

2 M.K. Jermar, *Water Resources and Water Management* (Amsterdam: Elsevier 1987): 341.

3 V.L. Scarborough, "Water Management Adaptations in Nonindustrial Complex Societies: An Archaeological Perspective", *Archaeological Method and Theory* 3 (1991): 101-154; V.L. Scarborough, "Ecology and Ritual: Water Management and the Maya", *Latin American Antiquity* 9 (1998): 135-159; V.L. Scarborough, *The Flow of Power*: *Ancient Water Systems and Landscapes* (Santa Fe: School of American Research, 2003): 4.

that the role of the Brantas river in the past was closely related to the political growth of the states in its basin between the tenth and the sixteenth centuries. This is part of a wider debate about the state's role in water management within the basin, and in particular how political power was shared between the court and the local communities when managing water in the river basin, something that will be explored in this thesis.

Given the ongoing debate on the state's role in water-management (Chapter 1), my research will focus in particular on the relationship between the central court and local communities in the construction of systems in the Brantas river basin between the tenth and the sixteenth centuries CE. This issue will be explored with a close eye on the temporal and spatial dynamics of the system. In other words, I will address the extent to which the Brantas river evolved over time and how it compares to earlier Javanese systems (Chapter 3) and those of other, comparatively proximate systems employed in mainland Southeast Asia (Chapter 2). Although employing a comparative approach, the main thrust of my research is about Java itself. Indeed, even more important than the comparative approach (Chapter 2)—and arising from it—is the question of how far Java's specific *longue durée* conditions of topography and climate (Chapter 3) have determined its system. In the next part of this dissertation, I will study the relevant inscriptions (Chapter 4) and archaeological finds (Chapter 5) to understand the dynamics of state and local community interactions in the construction of the system in successive East Javanese kingdoms. Finally, Chapter 6 brings together the findings and conclusions of the individual chapters.

PREVIOUS RESEARCH

The first detailed research on the role of the Brantas river was conducted by P.V. van Stein Callenfels and L. van Vuuren. Their article touches on inland water traffic along the Brantas river by identifying the ancient names of river ports along the Brantas and the Bengawan Solo rivers.[4] In two subsequent publications, Van Stein Callenfels continued to analyse ancient toponyms.[5] These works highlight that the Brantas river played an important role in the economic development of East Java through its role as a transport artery. By identifying the ancient ports and adding historical information on the basis of epigraphic evidence, it has been shown that,

4 P.V. van Stein Callenfels and L. van Vuuren, "Bijdrage tot de Topographie van de Residentie Soerabaia in de 14de Eeuw", *Tijdschrift van het Koninklijk Nederlandsch Aardrijkskundig Genootschap* 41/1 (1924): 57-81.

5 P.V. Van Stein Callenfels, "Bijdragen tot de Topographie van Oost-Java in De Middeleeuwen II" *OV 1926*, Bijlage E: 81-87; P.V. van Stein Callenfels, "Bijdragen tot de Topographie van Java in de Middeleeuwen", *Feestbundel Uitgegeven Door Het Koninklijk Bataviaasch Genootschap Van Kunsten en Wetenschappen bij Gelegenheid van zijn 150 Jarig bestaan 1778-1928 Deel II* (Wel Tevreden: G. Kolff & Co., 1929): 370-392.

in the fourteenth century, the Brantas river not only played an important role in supplying water for agricultural irrigation but also in increasing hinterland-coastal trade and human traffic.

The first report describing archaeological findings related to the irrigation of ancient East Java was published in 1926 by Maclaine Pont, an architect of European descent born in Indonesia. He wrote a report in *Oudheidkundig Verslag* about ancient dams in Trik (Mojokerto) and the surrounding area. He identified 18 *wadoek* (dams) from the slopes of the Arjuna-Welirang ranges south to the Brantas river, and—with the help of the Agricultural Counsellor of Eschauzier Companies *(Landbouwkundig Adviseur der Eschauzier-fabrieken)*, Mr. Alberti, and earlier reports from the-then Regent of Mojokerto—he included in his report a map of 18 ancient dams. The report also had a short description of the landscape, Majapahit's waterworks, and historical information related to the sites.[6] This report can be regarded as the earliest relatively comprehensive article on waterworks in East Java. As indicated within it, these ancient dams were viewed as remarkable findings at the time. Although the remains of several of them are currently difficult to locate, the maps and some existing ancient dams have proved very useful for my research by providing me with a broad overview of dam distribution during the period under investigation.

Ancient water management could also be on a very small scale, such as within a single religious foundation. W.F. Stutterheim—a historian, archaeologist, and Dutch civil servant—started to discuss this in 1937 when he published an article on the water system of the Jolotundo temple in Trawas, East Java. He described the waterworks of the Jolotundo temple in significant detail, from its engineering to the builder's intention when constructing it.[7] 45 years later, J. Dumarçay—an architect experienced in restoring Southeast Asian temples—highlighted a similar example of a water system within a temple, using the Tikus temple as part of a comparative study of the architecture of Javanese and Cambodian temples.[8] These micro-scale studies of water systems help constitute a central tenet of my research topic: that ancient East Javanese water management was not solely concerned with large water systems but also with much smaller-scale aspects, such as how it could be used within the religious context of a small single temple.

In 1938, F.H. van Naerssen, an Old Javanese epigraphist, published a short article entitled "De Brantas en haar waterwerken in den Hindu Javaanschen tijd" (The Brantas and its waterworks in the Hindu Javanese period). This provided a

6 H. M. Pont, "Eenige Oudheidkundige Gegevens Omtrent den Middeleeuwschen Bevloeiïngstoestand van de Zoogenaamde 'Woeste Gronden van de Lieden van Trik' voor zoover zij wellicht van belang zullen kunnen zijn voor eene herziening van den tegenwoordigen toestand", *OV 1926*, Bijlage G: 100-129.

7 W.F. Stutterheim, "Het Zinrijke Waterwerk van Djalatoenda", *TBG* 77 (1937): 21-50.

8 J. Dumarçay, "Notes d'architecture Javanaise et Khmère", *Bulletin de l'Ecole française d'Extrême-Orient* 71 (1982): 91-94.

broad overview of the surviving waterworks within the Brantas river basin on the basis of East Javanese inscriptions such as the Hariñjing inscription (784 CE), the Kamalagyan inscription (dated 1037 CE), and the Kandaṅan inscription (1350 CE).[9] Because the historical information available to him was limited, his exploration of the Brantas waterworks was rather superficial. However, it cannot be denied that his publication provided more information about the Brantas river basin waterworks than had been available before. He also placed considerable emphasis on the importance of their historical role within the Brantas river basin.

The first Indonesian historian and archaeologist to investigate ancient irrigation and agricultural development was Sutjipto Wirjosuparto. He provided a lengthy historical description of the Kediri area of East Java and pointed out—on the basis of information gathered from ancient inscriptions, mythology, and his analysis of Kediri geomorphology— that Kediri has always been a very fertile region and that it played an important role in the history of Java. In his article, a hypothesis regarding the role of the Brantas river was put forward—particularly on the basis of the Kamalagyan inscription—in which he argued that, for a considerable time, the inhabitants of Kaḍiri and their rulers managed to tame the Brantas river from at least the Kaḍiri kingdom period (1045-1222 CE) to the Majapahit period, reaching its zenith during the twelfth and thirteenth centuries CE.[10] His perspective on the sources is intriguing, particularly when he combines and then interprets information collected from both inscriptions and the geomorphology of the Kediri region with mythological tales related to the Brantas river. He argues that the significance of the Brantas for the Majapahit kingdom and, in particular, for the farmers who lived along it led to the creation of the Brantas river tale, which was used then by Majapahit as a political myth. The resulting story related the tale of the division of the Airlaṅga kingdom into the Jeṅgala kingdom and the Pañjalu kingdom (later known as Kaḍiri) by Mpu Bharāda, a powerful Buddhist priest.

Research on the water infrastructure of ancient Java is still in its infancy, particularly as regards archaeological records. Within the limited corpus of published research, most of it deals with the waterworks around Trowulan, and more specifically the man-made dams and canals. Trowulan was the capital of the Majapahit kingdom from the thirteenth to the sixteenth centuries, an archaeological urban site covering an area measuring 9 x 11 km^2 south-west of Mojokerto city. In 1977—almost a half century after H. Maclaine Pont published his work on ancient *waduks* (dams)—A.S. Wibowo, an Indonesian classical archaeologist, published an

9 F.H. van Naerssen, "De Brantas en Haar Waterwerken in den Hindu Javaanschen Tijd", *De Ingenieur* 35/7 (1938): A65-A66.

10 S. Wirjosuparto, "Apa Sebabnja Kediri dan Daerah Sekitarnja Tampil Kemuka dalam Sedjarah", *Kongres Ilmu Pengetahuan Nasional I* (Djakarta: Madjelis Ilmu Pengetahuan Indonesia, 1958).

article on the man-made dams of Trowulan.[11] He argued that these were intended to cope with and control the flooding that occurred regularly in the area.

Other research on water in ancient Java has focused on religious aspects. In her 1979 dissertation, Judith Ann Patt explored the diversity of the use and symbolism of water in ancient Java and Bali. She concluded that, in ancient sacred water structures within Java, the symbolism of water was united with technical achievements, and that this symbolism was combined in the art, architecture, and function of the water systems.[12] Applying these approaches, she substantially developed Stutterheim's and Dumarçay's previous research on temple water systems through use of a broader and deeper analysis. Her idea of an integrated micro-scale water management—with its symbolic, architectural, and functional angles—has enriched my perspective when analyzing the evidence found in the sources.

In the same year, 1979, N.C. van Setten van der Meer published a book—based on her M.A. Asian Studies thesis that she submitted to the Australian National University—entitled *Sawah Cultivation in Ancient Java: Aspects of Development during the Indo-Javanese Period, Fifth to Fifteenth Century*. In this, as well as analyzing the development of *sawah* cultivation over the course of ten centuries, she emphasizes that *sawah* agriculture at the village level and its religious aspects were supervised by the *Kraton* (the ancient Javanese court).[13] The most interesting part of her book is her postulation of the early development of *sawah* cultivation, as found in the conclusion:

> *Sawah* cultivation, directed by the ruler or by religious bodies, was based on a foundation of purely indigenous irrigation organization already established before the arrival of Indian influence. This conclusion is supported by the fact that all agricultural terms, as well as the titles of various rural officials are Javanese and occur in inscriptions dating from the earliest period of Indianization.[14]

Although her conclusion—that the early development of irrigation was indigenous, after which it came under the influence of the "Indian type" of court administration—may be doubted because the influence of Indian irrigation techniques on the ancient Old Javanese administration is extremely difficult to prove, her book is an important piece of work on *sawah* development in ancient Java because no previous research had been conducted on the subject on the basis of epigraphic evidence. One of her

11 A.S. Wibowo, "Fungsi Kolam-Buatan di Ibukota Majapahit", *Majalah Arkeologi* 1/2 (1977): 41-49.

12 J.A. Patt, *The Use and Symbolism of Water in Ancient Indonesian Art and Architecture,* PhD diss. University of California, Berkeley, 1979.

13 N.C. van Setten van der Meer, *Sawah Cultivation in Ancient Java: Aspects of Development during the Indo-Javanese Period, Fifth to fifteenth Century* (Canberra: Australian National University Press, 1979).

14 Van Setten van der Meer, *Sawah Cultivation in Ancient Java:* 133.

most interesting ideas is that East Java was the main area for *sawah* development in ancient Java.[15] Part of my research is closely related to ancient Javanese *sawah*, because the wet-rice field played a dominant role in water management.

With a rather different perspective from that of Van Setten van der Meer, in 1992 Jan Wisseman Christie—an expert in Old Javanese epigraphy—put forward the view that the ancient Javanese court had very little involvement in "the pragmatic aspects of water management", something she restated in two subsequent articles.[16] She made use of more inscriptions than did Van Setten van der Meer and compared ancient central South Java, the Brantas river area, and southern Bali. In her comparison between the Balinese and early Javanese irrigation management systems, she explains:

> In neither early Balinese kingdoms nor those of early Java was the state centrally involved in irrigation. The driving factors for the development of irrigation systems appear, both in Java and in Bali, to have come from below rather than from above. In Central Java and the uplands of East Java – with relatively under populated landscapes, gentle inclines and easily accessible surface water – farmers were never placed in the position of needing to create institutions to coordinate inter-community irrigation systems.[17]

Christie's conclusion regarding the limited involvement of the court and the lack of need for supra-village organizations for irrigation system issues is more convincing than that of Van Setten van der Meer because she observed the trend across dozens of inscriptions related to water control issues in ancient Java. Moreover, by her long-term approach—from the seventh to the fifteenth century—and by comparing the water management systems of Central Java, East Java, and Bali, she provides a coherent and convincing argument regarding the development of the ancient Javanese water management system. However, none of the vast quantity of archaeological records were used to support her analysis because, she claims, they are either difficult to date (in the case of East Java) or buried under lava (in Central Java).[18] However, archaeological records regarding irrigation systems do have the potential to be a source of information on the irrigation technology of ancient Java, and especially East Java, which she could have used to provide further evidence

15 Van Setten van der Meer, *Sawah Cultivation in Ancient Java:* 134.

16 J.W. Christie, "Water from the Ancestors: Irrigation in Early Java and Bali", in: *The Gift of Water: Water Management, Cosmology and the State in South East Asia*, ed. Jonathan Rigg (London: School of Oriental and African Studies, University of London, 1992): 19; J.W. Christie, "Water and rice in early Java and Bali", in: *World of Water: Rain, Rivers and Seas in Southeast Asian Histories*, ed. Peter Boomgaard (Leiden: KITLV, 2007): 250; and J.W. Christie, "The Agricultural Economies of Early Java and Bali", in: *Smallholders and Stockbreeders. History of Foodcrop and Livestock Farming in Southeast Asia*, ed. Peter Boomgaard and David Henley (Leiden: KITLV Press, 2004): 47-67.

17 Christie, "Water and Rice in Early Java and Bali": 255.

18 Christie, "Water from the Ancestors: Irrigation in Early Java and Bali": 8.

for her conclusions. The question of whether the ancient East Javanese court was involved in water management or not will be one of the main points of discussion of this thesis. I will review the debate on the basis of information in recently-discovered Old Javanese inscriptions and archaeological records.

In 1986, research on the dams and canals of Trowulan was presented by Karina Arifin, an archaeologist at the Universitas Indonesia, at a conference on Indonesian archaeology. She argued that the reservoirs were constructed to cope with flooding while the canals were used as a means of transporting small boats. She also described other waterworks in Trowulan.[19] Her research refined the interpretations on the function of the Trowulan dams and canals that had been put forward by Maclaine Pont in 1926. However, in 2013 Indonesian classical archaeologist Agus Aris Munandar argued that, in fact, there were no canals in the Trowulan site and that they were, instead, ancient roads and settlements. His interpretation is based on the fact that archaeological remains have been found within the "canals", meaning that they cannot in fact have been canals, as was believed in the past.[20] Yet, a geo-archaeologist from Universitas Gadjah Mada, J.S.E. Yuwono, has questioned Munandar's interpretation, stating that more comprehensive research into the canals needs to be conducted because previous research has probably misinterpreted the aerial photographs and there is, thus far, no convincing evidence from the field.[21] This debate and Yuwono's suggestion form the basis of my intention to review the archaeological urban water infrastructure findings from Trowulan as part of an attempt to understand its urban water management system.

As sacred bathing sites were one aspect of water management in ancient East Java, the publication *Patirthān, Masa Lalu dan Masa Kini*, by Ninie Susanti *et al*., is a central reference work for my research. This book contains a description of the *patirthāns* (water temples) of Central and East Java and an interpretation of their functions in both the past and the present.[22]

JAVANESE ANTECEDENTS

For a full understanding of the water management system of East Java, it will also be

19 K. Arifin, "Sisa-sisa Bangunan Air Zaman Kerajaan Majapahit di Trowulan," in: *Pertemuan Ilmiah Arkeologi IV. Buku I Evolusi Manusia, Lingkungan Hidup, dan Teknologi* (Jakarta: Pusat Penelitian Arkeologi Nasional, 1986): 169-187. Her research was based on and developed from her Bachelor's thesis; see: K. Arifin, *Waduk dan Kanal di Pusat kerajaan Majapahit Trowulan-Jawa Timur*, Universitas Indonesia (Jakarta).

20 A.A. Munandar, *Tak Ada Kanal di Majapahit* (Jakarta: Penerbit Wedatama Widya Sastra, 2013).

21 J.S.E. Yuwono, *Menelisik Ulang Jaringan Kanal Kuna Majapahit di Trowulan*, 2013. (http://geoarkeologi.blog.ugm.ac.id/files/2013/03/2013_kanal-trowulan1.pdf).

22 N. Susanti, *et al*., *Patirthān. Masa Lalu dan Masa Kini* (Jakarta: Wedatama Widya Sastra, 2013).

useful to examine historiographical discussions regarding Central Java.[23] Thanks to recent findings, we have a much clearer idea about the political context of the society that created colossal monuments such as the Borobudur temple and the various temple complexes at Prambanan. But what about water management in Central Java? What does modern scholarship tell us about the state's role in the construction of what seems to be an at least equally impressive system of waterworks? At the same time, was this really as dense and extensive as its eastern counterpart? And what can be said about the agency of local communities in Central Java: what was their role in this process?

Before 1983, the chronology of the Central Javanese rulers had been established on the basis of the Mantyāsiḥ I inscription, in which a passage lists the former rulers of the ancient Javanese (Mataram) kingdom.[24] The names of these kings are also mentioned in many other inscriptions. The sequence of the ancient Javanese rulers taken from the inscription—running from King Sañjaya to king Balituṅ has proved valuable for reconstructing the history of the ancient Central Javanese period. Unfortunately, however, the list does not provide dates for these kings' reigns. Following the discovery in 1983 of the Wanua Tṅaḥ III inscription, from 908 CE, we have a more complete list of the early ancient Javanese kings along with detailed dates of their accession to the throne.[25] The information contained therein leads to the following list of the kings of the ancient Central Javanese kingdoms:

23 N.J. Krom, *Hindoe-Javaansche Geschiedenis* ('s-Gravenhage: Nijhoff, 1931); Marwati Djoened Poesponegoro and Nugroho Notosusanto, *Sejarah Nasional Indonesia II* (Jakarta: Balai Pustaka, 1990); J.G. de Casparis, *Prasasti Indonesia I: Inscripties uit de Çailendra-tijd* (Bandung: Nix, 1950); J.G. de Casparis, *Prasasti Indonesia II: Selected Inscriptions from the 7th to the 9th Century A.D.* (Bandung: Masa Baru, 1956); Boechari, *Melacak Sejarah Kuno Indonesia Lewat Prasasti. Tracing Ancient Indonesian History through Inscriptions* (Jakarta: Kepustakaan Populer Gramedia, 2012).

24 The ancient Central and East Javanese kingdom (prior to the Kaḍiri period) is variously called the Mataram kingdom, the ancient Mataram kingdom, and the Hindu-Mataram kingdom. In fact, only a few inscriptions record the name "Mataram," so it is debatable whether the name was used in the past. I will use the terms ancient Central Javanese kingdom and East Javanese kingdom in this thesis.

25 For detailed deciphering of the Wanua Tengah III inscription see: J.W. Christie, "Revisiting early Mataram", in: *Fruits of Inspiration: Studies in honour of Prof. J.G. de Casparis, retired Professor of the early history and archeology of South and Southeast Asia at the University of Leiden, the Netherlands on the occasion of his 85th birthday*, ed. Marijke J. Klokke and Karel R. van Kooij (Groningen: Egbert Forsten, 2001): 25-55; Kusen, "Raja-raja Mataram Kuna dari Sanjaya sampai Balitung; Sebuah Rekonstruksi Berdasarkan Prasasti Wanua Tengah III", *Berkala Arkeologi* 14 (1994): 82-94; Boechari, "Tafsiran Atas Prasasti Wanua Tengah III", in: *Melacak Sejarah Kuno Indonesia Lewat Prasasti, Tracing Ancient Indonesian History Through Inscriptions*, Boechari, (Jakarta: Kepustakaan Populer Gramedia, 2012): 467-472.

King	Accession Date
Rakai Panaṅkaran	October 7, 746 CE
Rakai Panaraban	April 1, 784 CE
Rakryan Warak dyaḥ Manara	March 28, 803 CE
Dyaḥ Gula	August 5, 827 CE
Rakai Garuṅ	January 24, 828 CE
Rakai Pikatan dyaḥ Salaḍū	February 22, 847 CE
Rake Kayuwaṅi dyaḥ Lokapāla	May 27, 855 CE
Dyaḥ Tagwas	February 5, 885 CE
Rake Panumwaṅan dyaḥ Dawendra	September 27, 885 CE
Rake Gurunwaṅi dyaḥ Bhadra	January 27, 887 CE
Seven years of interregnum	
Rakai Wuṅkalhumalaṅ dyaḥ Jěbaṅ	November 27, 894 CE
Rakai Watukura dyaḥ Balituṅ	May 23, 898 CE

To make a complete sequence of the kings we must add both Rakai Mataram Saṅ Ratu Sañjaya—the first king of Mataram, mentioned in the Mantyāsiḥ I inscription—and the ancient Javanese kings who came to the throne after Rakai Watukura dyaḥ Balituṅ, namely Śrī Dakṣottama Bahubajra Pratipakṣākṣaya, Rakai Layaṅ dyaḥ Tulodoṅ and Śrī Mahārāja dyaḥ Wawa. These names are taken from those kings mentioned in various inscriptions dated between 910 and 928 CE. In 929 CE, Rakai Hino pu Siṇḍok ascended the throne, but since all the inscriptions issued by him have been found in East Java, it is generally accepted that he moved his court to that region.

From the first king of the Central Javanese kingdom—Sañjaya—to the last— Śrī Mahārāja dyaḥ Wawa—that state experienced significant changes in its political system and its territorial division. On the basis of Central Javanese inscriptions containing information on the development of the relationship between the royal court and villages, it seems that there were two distinct periods. The first of these ran from the early eighth to the middle of ninth century (from Sañjaya to Rakai Pikatan) while the second was from the middle of the ninth to the middle of the tenth century (from Rakai Kayuwaṅi to Dyaḥ Wawa). This periodization is based solely on the administrative bond between the court and the villages, as described in the inscriptions that have been found. This is, however, different from the political chronological frameworks that have been constructed by historians and archaeologists of ancient Indonesia and which derive from observing and interpreting the dynamics of the political development of the ancient Central Javanese kingdoms.[26]

26 For example, Jan Wisseman Christie poses a Central Javanese chronological framework

In the first period, the state's administrative structure was court-*watak*-*wanua* (village). The village, the smallest unit in the structure, had a *rāma* as its leader and contained *anak wanua* (villagers). It seems that the *wanua* were relatively self-sufficient villages, but it did have to pay taxes and a labour *corvée* to the state. In return, the state gave it protection and security. The *watak* was a supra-village structure that encompassed a number of villages and had a head called a *rakai* or *rakryān*. According to Christie, the *watak* originated in prehistoric times in the form of a "pre-state" and "proto-state" that was then absorbed into the Central Javanese state.[27] The villages merged into a *watak* for specific reasons, in particular as a means of cooperation to solve economic and social problems, including those related to water management. The *watak* had several officials who worked for the *rakai*, one of whom was an official called a *nayaka*, who was probably responsible for collecting the land-tax.[28] The court was governed by the king and royal officials. The ancient Central Javanese state's finances came directly from taxes and *corvée*. The bureaucratic bond between the court and the *watak* was by no means strong and the state never seems to have been perfectly centralized.

However, in the second period, after Rakai Kayuwaṅi had ascended the throne, the *rakai* administration was increasingly incorporated into the royal administration. Epigraphical records show that the locations of villages under a *watak* were spread across different areas of Central Java rather than being in a specific region.[29] Stutterheim argues that this case correlated with an effort by the king to decrease and thereby control the *rakai*s' power over their region so that the latter would not grow too powerful,[30] and that the bond between the court, *watak*s, and *wanua* was generally more centralized than it had been in the past. However,

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that consists of four phases, namely: Foundation Phase (716-746 CE), Expansion and Consolidation Phase (746-827 CE), New Direction and Eastward Expansion Phase (828-885 CE), and Political Turbulence (885-898 CE). See: Christie, "Revisiting Early Mataram": 32-47.

27 J.W. Christie, "Rāja and Rāma: The Classical State in Early Java", in: *Centers, Symbols, and Hierarchies: Essays on the Classical States of Southeast Asia*, ed. Lorraine Gesick (New Haven: Yale University Southeast Asia Studies, 1983): 17.

28 The function of *nāyaka* is intrepreted by De Casparis, see: J.G. de Casparis, "Some Notes on Relations between Central and Local Government in Ancient Java", in: *Southeast Asia in the 9th to 14th centuries*, ed. David G. Marr and A.C. Milner (Singapore - Canberra: Institute of Southeast Asian Studies [ISEAS] - Research School of Pacific Studies, Australian National University, 1986): 57.

29 J.W. Christie, "Theatre States and Oriental Despotisms: Early Southeast Asia in the Eyes Of The West", *Occasional Paper No. 10* (The University of Hull, Centre for South-East Asian Studies, 1985): 13. See also: J.G. de Casparis, "The Evolution of the Socio-Economic Status of the East Javanese Village and its Inhabitants", *Papers of the Fourth Indonesian-Dutch History Conference* (Yogyakarta: Gadjah Mada University Press, 1986): 15.

30 W.F. Stutterheim. "Een Oorkonde op Koper uit het Singhasarische", *TBG 65* (1925): 208-281.

this view is not shared by Boechari, an Indonesian epigraphist, who has stated:

> What remains unchanged during the whole period [of ancient Java] is that there has never been a centralized government. The kingdom was divided into a large number of autonomous areas, governed by rakais or rakryāns, usually a member of the royal family.[31]

He believes that, during the whole of the classical period, Java was ruled by non-centralized states.

Indeed, whether or not the ancient Javanese state was, in general terms, centralized continues to be debated. L.C. Damais and J.G. de Casparis support the centralization view. Damais argues that the existence of a central authority in ancient Java was a certainty on the basis of his analysis of epigraphic records that show the authority of the dynastic rulers who governed the whole of Java via a centralized system.[32] De Casparis argues that, because there was increased centralization of administrative control by the court over the villages, the system of political administration in the Central Javanese period was probably not centralized, but that after the Kaḍiri period (c. 1100 CE) the villages were incorporated into the central administration. As he put it, there is "a strong indication that the village communities had come under much more direct supervision by the central government".[33] There are other opponents of the idea that there was a centralized system within the ancient Javanese state, and these include F.H. van Naerssen, Boechari, and Jan Wisseman Christie. As can be seen in the quote from Boechari above, on the basis of epigraphic and textual evidence he believes that there was no centralization across the whole history of the ancient Javanese state. A somewhat more nuanced view has been taken by Van Naerssen, who has written: "I expressed the opinion that, before the reign of Śrī Mahāraja Rakai Kayuwaṅi, no centralized power, ruling over a large territory, yet existed in Java".[34] Moreover, on the basis of epigraphic evidence, he suggests that there were many independent rulers at that time and that this, in turn,

31 He says "Although the villages appear to have possessed a considerable degree of autonomy as far as purely village matters were concerned, we also get the clear impression that the authority of the central government penetrated everywhere and no doubt functioned as a check to the decisions taken by local authorities", see: Boechari, "A Preliminary Note on the Study of the Old-Javanese Civil Administration", in: *Melacak Sejarah Kuno Indonesia Lewat Prasasti, Tracing Ancient Indonesian History Through Inscriptions*, Boechari (Jakarta: Kepustakaan Populer Gramedia, 2012): 108. The article was originally published in *MISI* 1/2 (1963): 122-133.

32 L.C. Damais, "Epigrafische Aantekeningen," *TBG* 83 (1949): 23-26.

33 De Casparis,"The Evolution of the Socio-economic Status of the East Javanese Village and its Inhabitants": 17. See also: De Casparis, "Some Notes on Relations between Central and Local Government in Ancient Java": 49.

34 F.H. van Naerssen, "Twee koperen oorkonden van Balitung in het Koloniaal Instituut te Amsterdam", *BKI* 95 (1937): 441-461, esp. 446- 449.

demonstrates the existence of autonomous polities.[35] Likewise, Christie had stated that, by the tenth century, the decentralized nature of the ancient Javanese state meant that its economic structure became increasingly autonomous from the centre

> The villages [under the Ancient Javanese State] were largely self-sufficient, the administrative hierarchy consisted largely of self-supporting units with strong internal loyalties, and even the religious foundations collected their own taxes.[36]

As regards water management, the relationship between political power and water control was more complicated. Regarding the development of water management in Central Java, Van Naerssen proposes that the emergence of *sawah* cultivation was connected to political power and supra-village cooperation over water control. He argues that the introduction of the irrigated rice field led to cooperation between villages along the same river and any tributaries because controlling water was a complicated matter, and management of it would be easier if it were done by numerous villages working together.[37]

A small number of inscriptions related to water management have been found in Central Java, most of which only provide information about water officials, including the *hulair, lab-lab,* and *airhaji*. There is only a small amount of information about water management itself. Table 1.1 lists 41 inscriptions from Central Java, dating from the seventh to the ninth century, that record the names of water officials, water infrastructure, and activities relating to water management.

The information provided by the inscriptions in this table leads to the conclusion that water management did exist in Central Java but only on a limited scale. From the 200+ inscriptions found in the region, less than a quarter contain information related to water management.[38] However, in 2002, two inscriptions were discovered in the Kedulan temple in Kalasan (Yogyakarta), near the main

35 F.H. van Naerssen, "Tribute to the God and Tribute to the King", in: *Southeast Asian history and Historiography: Essays Presented to D.G.E. Hall,* eds. C.D. Cowan and O.W. Wolters, (Ithaca, NY [etc.]: Cornell University Press, 1976): 297, and see also: F.H. van Naerssen, "Some Aspects of the Hindu-Javanese *Kraton,*" *Journal of the Oriental Society of Australia* 2/1 (1963): 14-19.

36 Christie, "Rāja and Rāma": 20.

37 Van Naerssen, "Tribute to the God and Tribute to the King": 297-298, and F.H. van Naerssen, "The Economic and Administrative History of Early Indonesia", in: *The Economic and Administrative History of Early Indonesia,* ed. F.H. van Naerssen and R.C. de longh (Brill: Leiden, 1977): 1-84.

38 We do not know the exact number of inscriptions found in Central Java so far, since the inscriptions are dispersed in state and local museums, state archaeological institutions and, especially, remain in situ or in personal collections, some of which have not been registered to date. However, Christie lists 200 inscriptions while Kōzō Nakada registers about 121 dated inscriptions. See: J.W. Christie, Register of the Inscriptions of Java, working draft, unpublished (1999); K. Nakada, *An Inventory of Dated Inscriptions in Java* (Tokyo: Toyo Bunko, 1982).

Table 1.1. Central Java inscriptions on water management. Inscriptions that were issued by the Central Javanese state and found in the region of Central Java.

No.	Inscriptions	Śaka	CE	Water management-related Content
	Tukmas	n.d.	ca. mid seventh century	Mentions a spring
	Waṅwaṅ Baṅen	746	824	*airaji*
	Tulaṅ Air	772	850	*hulair*, *matamwak*
	Siwagṛha	778	856	Shifting of a river flow
	Sumuṇḍul	791	869	Construction of a *ḍawuhan* (dam).
	Panaṅgaran	791	869	Construction of a *ḍawuhan* (dam).
	Tunahan	794	872	*hulair*
	Humandiṅ	797	875	*hulair*
	Juruṅan	798	876	*hulair*
	Haliwaṅbaṅ	799	877	*hulair*
	Mulak I	800	878	*huler*
	Taragal	802	880	*hulair*
	Ratawun II	803	881	*huler*
	Ratawun	803	881	*huler*
	Salimar III	804	882	*hulair, hulu wuattan*
	Salimar II	804	882	*hulair, hulu wuatan*
	Salimar I	804	882	*hulair*
	Wurutuṅgal	807	885	*huler*
	Kuruṅan	807	885	*huler*
	Er Haṅat	n.d.	Issued during the reign of King Tagwas (885)	*air haji*
	Muṅgu Antan	808	886	*huler*
	Baliṅawan	813	891	*hulu wuattan*
	Ayam Teas	822	900	Mentions a ship-trading tax
	Tluron	822	900	Construction of a *ḍawuhan, pañcuran,* and *wĕluran* (dam, bathing place, and small canal).
	Watukura I	824	902	*airhaji, lab*
	Kembaṅ Arum	824	902	*airhaji, lab*
	Telaṅ	825	903	Boat and river crossing port building through a corvee. *airhaji*
	Rumwiga I	826	904	*ḍawuhan, huler*
	Poḥ	827	905	*airhaji*
	Rumwiga II	827	905	*huler*

	Rukam	828	906	*airhaji*
	Palepaṅan	828	906	*huler*
	Saṅsaṅ	829	907	*airhaji* Tax restrictions for trade by boat
	Mantyāsiḥ I	829	907	*airhaji*
	Mantyāsiḥ II	829	907	*airhaji*
	Sinaguha	n.d.	Issued during the reign of King Balituṅ (898-910)	*huler*
	Wanua Tṅaḥ III	n.d.	Issued during the reign of King Balituṅ (898-910)	*huler*
	Timbaṅan Wuṅkal	693 Sj	913	*erhaji*, Tax restrictions for trade around a dam.
	Tihaṅ	836	914	*airhaji*
	Lintakan	841	919	*huler* Irrigation *sawah* through a ditch

Notes:
n.d.: no date
Sj : Sañjaya era
Hulair/huler: A local official who took charge of maintaining irrigation system and distributing water.
Matamwak : a person who was in charge of dykes and dams.
Airhaji/airaji/erhaji: A court official who was a head of royal holy water officials, in charge of holy water and bathing places.
Lab lab/ lěbalěb: A court official in charge of irrigation water.
Hulu wuatan/hulu wuattan: An official in charge of supervising bridges and causeways.

temple: the Panaṅgaran inscription from 869 CE and the Sumuṇḍul inscription from 869 CE. In these, mention is made of the construction of a dam (*ḍawuhan*) at Panaṅgaran so that water could be channelled to the arid land of Parhyaṅan, in Tigaharyyan. Furthermore, another inscription was found recently, in 2015, in the same temple complex, named the Tluron inscription. It dates back to 900 CE and relates an order of king Balituṅ to restore a religious foundation, convert a dry field to a *sawah*, and construct a dam and canal to irrigate this new *sawah*.[39]

39 T. Prasodjo and J.S.E. Yuwono, "Ḍawuhan, Wluran, dan Pañcuran: Penelusuran Aspek Hidrologi terhadap Isi Prasasti Tlu Ron", in: *Menggores Aksara, Mengurai Kata, Menafsir Makna*, ed. Tjahjono Prasodjo and D.S. Nugrahani, (Yogyakarta: Departemen Arkeologi, FIB-UGM, 2019): 8-31. See also: A. Griffiths, N. Habibah, and Z.P. Aminullah, *Three Inscriptions about the Temple of 'Triple Leaf' (Modern Candi Kedulan)*, unpublished draft July 26, 2017.

Certainly, the number of inscriptions that have been discovered does not reflect the available potential and quality of information on water management, and detailed evidence from the Central Java inscriptions admittedly does not prove that the communities there managed water intensively. In the preceding paragraph, I mentioned that the *hulair*—a water official who managed water directly for irrigation—as well as certain others—particularly the *lab-lab* and *airhaji*, as can be seen in Table 1.1—were court officials who dealt solely with water supervision or administration. Dam and canal construction are only recorded in three inscriptions from Kedulan temple. As well as irrigation management, there were also rules related to trading boats, especially the taxes for which they were liable, and river-crossing ports, which implies the existence of a water transportation system in the Bangawan Solo river, which flows from Central Java and has its mouth in East Java.[40]

Following Balituṅ's death around 910 CE, no inscriptions related to water management were issued by his successors in Central Java, with the exception of one: the Lintakan inscription, which records that a *huler* official was obliged to irrigate *s*īma *sawah* through a ditch. The almost total absence of inscriptions relating to water management in the Balituṅ period is difficult to understand because water, for either irrigation or transportation purposes, requires continuous management. There are three possible explanations for this phenomenon. One is that no inscriptions were produced by kings or royal officials as a result of turmoil or instability within the Central Javanese state. The second possibility, it was not found necessary to document water management on copper plates; it was documented on palm leaves and these have not survived. The third is that an environmental disaster, such as severe climate change, occurred at that time.[41] The third possibility seems more plausible. Even though the state saw political turmoil in the reign of Rakai Layaṅ dyaḥTlodhong, for example, that king issued the Lintakan inscription of 919 CE for a *s*īma, in which it was also ordered that a *sawah* belonging to the *sīma* from a ditch be irrigated. Similarly, in 912 CE the Hariñjing inscription was reissued containing a *sīma* right to Bhagawānta Bāri, who had constructed a dam in the past.[42] An environmental disaster explanation will be discussed in more detail in the following chapter.

From the beginning of the early Central Javanese state, its water management was on a smaller scale than that of East Java in the years after the tenth century

40 W.F. Stutterheim, "Een Vrij Overzetveer te Wanagiri (M.N.) in 903 A.D.", *TBG* 74 (1934): 269-295.

41 Significant political turmoil occurred in this period of time; see: Bambang Sumadio, *Sejarah Nasional Indonesia II* (Jakarta: Balai Pustaka, 1990): 147-155.

42 Lintakan transcription can be seen in: Boechari, *Prasasti Koleksi Museum Nasional I* (Jakarta: Proyek Pengembangan Museum Nasional, 1985/1986): 122-123. The Hariñjing transcription and its Dutch translation can be found in: P.V. van Stein Callenfels, "De Inscriptie van Soekaboemi" *Med. Kon. Akad. van Wetenschappen* 78, serie B, no. 4 (1934): 116-119.

CE. It could be assumed that the intensity of water control was less than it was in East Java, where there are many more surviving inscriptions dealing with water management. However, the development of water management within Central Java was an important aspect of the development of water management in East Java. Although the Central Javanese water management system had a lower level of complexity than that of East Java, it is undeniable that the political structure of the Central Javanese water management system—which had been employed by the state from the beginning of its rule in East Java, long before the shift of the state capital to East Java in the tenth century—influenced the subsequent development of water management in East Java.

USE OF PRIMARY SOURCES

There are two main types of primary sources I will employ, namely Old Javanese inscriptions and archaeological records. For the former, I employ around 80 such inscriptions, all of which relate to water management in ancient East Java. Most of them have already been transliterated, although not all of the transliterations have been translated. Moreover, while I use the transliterations by earlier researchers, I provide my own translations. A large number of these inscriptions are *sīma* grants, in which a village or part of one was given tax reductions or exemptions, meaning information on water management is relatively limited and sometimes difficult to interpret more broadly. Undated inscriptions are another problem, although these are few in number; the date of the inscription can be approximated by the name of the ruler who issued it or by conducting paleographical analysis.

The second group of sources I use are archaeological records. The archaeological remains I employ within this dissertation are mainly found in the Brantas river basin, from its headwater to its delta, both in the highland and the lowland zones. The type of archaeological evidence examined within this thesis includes canals, dams, reservoirs, tunnels, underground tunnels, ditches, wells, water pipes, water-spouts, and temple reliefs. These archaeological records were acquired through field surveys in 2016 (in Trowulan, Mojokerto, Sidoarjo, Pare, Kediri, and Malang) and through library research using academic studies, Dutch colonial reports, and related books.

Chapter 1

Approaches to Early Southeast Asia Polities and Their Water Management

This chapter will explore three important aspects of the development of the polities of Southeast Asia. The first part contains an explanation of the models or approaches that have been proposed by scholars regarding the process of "Indianization". The explanation of the process is important for determining the structure of the majority of the states of Southeast Asia. The second part elucidates models of early state formation applied to ancient Southeast Asia states. The third part will focus on the concept of water management and some of its practices in Southeast Asia.

1.1. THE PROCESS OF "INDIANIZATION"

The most widely-discussed issue related to the emergence of early states in Southeast Asia is the influence of Indian polities and culture on the region. The interactions between the Indian subcontinent and Southeast Asia from the start of the first century have, in the past, been interpreted in various ways as colonization, localization, convergence, or internal development. Some scholars have seen this as a process termed "Indianization," which Cœdès defined as "the expansion of an organized culture that was founded upon the Indian conception of royalty, was characterised by Hinduist or Buddhist cults, the mythologies of the *Purāṇas,* and the observance of the *Dharmaśāstras,* and expressed itself in the Sanskrit language."[1]

1 G. Cœdès, *Indianized States of Southeast Asia* (Honolulu: East-West Center Press, 1968): 15-16.

The colonization theory emerged in the early twentieth century in the work of some Indian scholars of the "Greater India" movement,[2] such as R.C. Majumdar, R.G. Bhandarkar, and R. Mookerji. Majumdar emphasized that "Hindu" colonists transplanted their civilization to the colonized areas and, according to him, Indian "colonization" in Southeast Asia started in the first century CE or even earlier. On the basis of his study of the writing style of the Kalasan inscription and the abundant Hindu-based findings in Central Java, Bhandarkar claimed that Indian people, from both north and south India, migrated to and settled in Southeast Asia over time. Similarly, he posited that Cambodia was colonized by south Indians.[3] In 1912, Radha Kumud Mookerji suggested that the colonial expansion of India into Southeast Asia was related to the role of Kalinga and Gujarat, and provided as one example of the impact of Indian colonization the Borobudur temple in Central Java, a piece of Indian art transplanted into Java.[4]

At about the same time Dutch academics such as C.C. Berg, J.L. Moens, N.J. Krom and F.D.K. Bosch discussed this topic of Hindu colonization as well. Berg and Moens argued that Hindu culture was brought to Java by Indian colonizers. Berg, based upon his assumption derived from Javanese Panji narratives, stated that the Indianization of Java was initialized by a foreign warrior who came to Java and married to a noble woman either by a coercive force or by a peaceful way.[5] The warrior's postery became dynastic rulers of Java. Similar to Berg's arguments, Moens also proposes that the colonization of Java occurred when defeated rulers from India migrated to Java to establish a new ruling class which then became the ancestor of Javanese dynasties.[6] Krom and Bosch on the other side refused the idea of Hindu colonization of Java. Krom postulated the role of traders as important agents in transferring Hindu culture to Java, many times by marrying native inhabitants of higher Javanese ranks. Therefore, according to Krom the Hindu colonization of Java occurred in a peaceful manner, far from a violence colonization.[7] Bosch writes that a

2 The theory of *kṣatriya* is one of example of colonization theory; this states that warriors brought Indian influences to Southeast Asia. See: J.L. Moens, "Srivijaya, Yava en Kataha", *TBG*, 77/3 (1937): 317-487; C.C. Berg, *Hoofdlijnen der Javaansche Litteratuur-Geschiedenis* (Groningen, 1929); R.C. Majumdar, Hindu Colonies in the Far East (Calcutta: K.L. Mukhopadhyay, 1944/1963); R.C. Majumdar, *Ancient Indian Colonies in the Far East*: Vol. 2, Suvarnadvipa, Part 1, *Political History* (Dacca: Asoke Kumar Majumdar, 1937); Part 2, *Cultural History* (Dacca: Asoke Kumar Majumdar, 1938).

3 R.G. Bhandarkar, "A Sanskrit Inscription from Central Java", *Journal of the Bombay Branch of the Royal Asiatic Society* 17/2 (1889): 1-10.

4 R. Mookerji, *A History of Indian Shipping and Maritime Activity from the Earliest Times* (Bombay: 1912): 45.

5 C.C. Berg, *Hoofdlijnen der Javaansche Litteratuur-Geschiedenis* (Groningen: J.B. Wolters, 1929).

6 Moens, "Çrīvijaya, Yāva en Kaṭāha": 317.

7 N.J. Krom, Inleiding tot de Hindoe-Javaansche kunst. Eerste Deel ('s-Gravenhage: Martinus Nijhoff, 1923): 45; N.J. Krom, Hindoe-Javaansche Geschiedenis ('s-Gravenhage:

"Hindu colonization" can no longer be accepted. Moreover, Bosch himself proposes that monks and brahmanas ("clerks") were "the bringers" of Hindu culture to Java.[8] He also uses a metaphor "fecundation" to describe the process of Hinduisation:

> Only if we clearly realize that the awakened Indian spirit fecundated the living matter of Indonesian society, thus procreating a new life that was predestined to develop into an independent organism in which foreign and native elements were to merge into an indissoluble entity, only then does it become clear how it was possible that a small number of 'clerks', bearers of the Indian civilisation, without taking recourse to force of arms and without striving after material profits, could bring about the unparalleled development of hitherto latent forces, as we see before us in the growth and efflorescence of Hindu-Indonesian culture.[9]

One example of how scholars have attempted to view this cultural transformation from India can be found in the work of I.W. Mabbett, who tried to explain "Indianization" in terms of a cultural process over time, the result of which was two phases of "Indianization" in Southeast Asia. He states:

> It is probable that when we speak of 'Indianization' we are referring to two distinct processes that took place at different times. The first was the appearance of principalities or city states with Indian culture in the first two or three centuries after Christ; the second was the growth of peasant societies supporting civil, priestly and military elites in the latter half, largely perhaps in the last quarter, of the first millennium, and then only in relatively few place[10].

He postulates that these two stages differed in how their local organizational capacity and the social structures of Southeast Asia developed. Related to the two types of polities, Anthony Reid put forward slightly similar types for the period after the tenth century in both mainland Southeast Asia and the Indonesian archipelago.[11] He sees two distinct polities, *nagara* and *negeri*. *Nagara* refers to a cultural and sacred centre that was shared by several small polities, that had no boundaries, and that was based mainly on the production of rice, such as Angkor, Pagan, or Majapahit. *Negeri*, on the other hand, he defines as "rival ports strategically situated as gateways for upriver communities along the trade route of the Malacca Straits and the mountainous eastern coast of the mainland."[12] Moreover, after considering the means by which Indian influence was spread and its extent, Mabbett concludes

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Martinus Nijhoff, 1926): 34-62.

8 F.D.K. Bosch, "The Problem of the Hindu Colonisation of Indonesia", in: *Selected Studies in Indonesian Archaeology*, ed. F.D.K. Bosch (The Hague: Martinus Nijhoff, 1961): 1-22.

9 Bosch, "The Problem of the Hindu Colonisation of Indonesia": 20-21.

10 I.W. Mabbett, "The 'Indianization' of Southeast Asia: Reflections on the Prehistoric Sources", *Journal of Southeast Asian Studies* 8 (1977): 13.

11 A. Reid, *A History of Southeast Asia: Critical Crossroads* (Chichester: Wiley Blackwell, 2015): 39-46.

12 Reid, *A History of Southeast Asia*: 45.

that Indian influence in Southeast Asia is evident only in cultural transformation, not in politics.[13]

As scholars have explored "Indianization" from the Indian side, so they have also pointed out the role played by locals in receiving, adopting, and employing the coming culture. This view is expressed by Monica Smith, who has emphasized the importance of viewing the "senders" and recipients of Indian influences in Southeast Asia alongside each other.[14] Like Mabbett, she believes that the sources of the Indian influences were very diverse and, furthermore, that their adoption by local recipients was varied and very much dependent on circumstances and need.[15] Smith concluded that the motivation for adopting Indian culture was primarily related to attempts to imitate Indian cultural and political power as a means of legitimatizing rule, and in some cases was related to attempts to show cultural autonomy in order to resist Chinese expansion in Southeast Asia.[16]

On the other hand, and in contrast to the "colonialist" approaches, some scholars have proposed a number of different scenarios, ones which focus more on the role of the Southeast Asians in developing their own culture. One such scholar is O.W. Wolters, who has introduced the concept of selective localization of Indian cultural elements and has emphasized the innovative and dynamic character of Southeast Asian societies. "Localization" is a term he used to explain how foreign elements were absorbed by the local culture(s).[17] Consequently, the "new" culture—or, as he puts it, the "local cultural statements"—that was produced by the meeting between the local and the foreign is something different, while the process of the encounter would be varied as well.[18]

The role of the recipients in adopting Indian culture is also illustrated by Quaritch Wales. While his hypothesis is that migration from India happened in four main waves from the second to the early tenth century, he believes that this

13 Mabbett, "The 'Indianization' of Southeast Asia: Reflections on the Prehistoric Sources": 161.

14 Monica L. Smith, 'Indianization' from the Indian Point of View: Trade and Cultural Contacts with Southeast Asia in the Early First Millennium C.E.", *Journal of the Economic and Social History of the Orient* 42/1 (1999): 1-26.

15 Mabbett, "The 'Indianization' of Southeast Asia: Reflections on the Prehistoric Sources": 160. See also Himanshu Prabha Ray, "Early Maritime Contacts between South and Southeast Asia", *Journal of Southeast Asian Studies* 20 (1989): 42 and 54.

16 Smith, "'Indianization' from the Indian Point of View": 19.

17 The term "localization" is often associated with Wolters in his explanations of acculturation in Southeast Asia, as are other terms such as "*mandala*" and "man of prowess". See Craig J. Reynold, "The Professional Lives of O.W. Wolters", in: *Early Southeast Asia. Selected Essays*, ed. Craig J. Reynold (Ithaca, New York: Southeast Asia Program Publications, Southeast Asia Program, Cornell University, 2008): 19.

18 O.W. Wolters, *History, Culture, and Region in Southeast Asian Perspectives* (Ithaca, New York: Southeast Asia Program Publications Cornell University, 1999): 67.

invasion forced people to migrate to Southeast Asia from South Asia.[19] However, when emphasizing the role of the recipients, he put forward the theory of the "local genius" as playing an important role in the transformation of Indian culture to Southeast Asia which he explains in the following way:

> This local genius can be destroyed by extreme acculturation. Alternatively, as a result of a lesser degree of acculturation, it can undergo more or less change. But in the latter case some of its features will remain constant, revealing themselves as a preference for what are evidently the more congenial traits of a new cultural pattern, and a specific way of handling the newly acquired concepts. *These features will determine the reaction to the new culture and give direction to subsequent evolution*.[20]

His conclusion stressed that the local genius was not the cause of every vicissitude in the cultural evolution within Southeast Asia; instead, it only gave direction to the evolutionary process.[21]

To sum up, the approach that places more emphasis on the local culture in the reception of Indian influences can be termed the "internal development" approach. The first essential aspect of this approach is to ignore the over-emphasis, seen in most of the Indianization theories, on the role of Indians in dispersing their influence in Southeast Asia. Therefore, this approach presumes that, even before the beginning of Indian cultural influence in Southeast Asia, the region had its own socio-political organization into which Indian elements were later adapted.[22] P. Wheatley suggests that the concentration of power in, for instance, the Khmer, Cham, Burmese, Mon, and Javanese kingdoms was rooted in prehistoric times, before Indian elements arrived in those regions, and that this was a prerequisite for the later developments that took place when Indian culture entered Southeast Asia. Indian cultural components—such as language, script, architecture, mythology, and beliefs—fused with the local culture "to create the new and distinctive syntheses."[23]

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19 H.G. Quaritch Wales, *The Making of Greater India* (London: Bernard Quaritch Ltd., 1974): 29-31. What he called the "Four Main Waves of Indian Cultural Expansion" was a series of expansions which overlapped with each other: the Amarāvatī (2nd to 3rd centuries), the Gupta (4th to 6th centuries), the Pallava (ca. A.D. 550-750), and the Pāla (ca. A.D. 750-900). He also explained that there is the possibility of additional cultural expansion after the fourth wave, but that it was minor or less obvious.

20 Wales, *The Making of Greater India*: 18.

21 Wales, *The Making of Greater India*: 227-234.

22 R.R. Hagesteijn, *Circles of Kings. Political Dynamics in Early Continental Southeast Asia* (Dordrecht: Foris Publications, 1989): 61-63.

23 P. Wheatley, *The Kings of the Mountain. An Indian Contribution to Statecraft in Southeast Asia* (Kuala Lumpur: University of Malaya, 1980): 26. See also research on prehistoric Southeast Asia: Charles Higham, "The Later Prehistory of Mainland Southeast Asia", *Journal of World Prehistory* 3/3 (1989): 235-282; Charles Higham, "Mainland Southeast Asia from the Neolithic to the Iron Age", in: *Southeast Asia. From Prehistory to History*, ed. Ian Glover and Peter Bellwood (London and New York: Routledge Curzon, 2004):

This "internal development approach'' as visible in the work of Wolters and Wheatley, has been criticized by Sheldon Pollock, who states that "the conceptual framework" shaping such scholars "was itself shaped by a civilizationalist indigenism with its roots as deeply sunk into the political realities of its time as was the first, colonialist phase of research" and was generated by decolonization and new state-building.[24] He emphasizes instead the importance of transculturation at work in what he calls the Sanskrit cosmopolis.

Recently, different approaches have been posited that have resulted in various new interpretations and concepts. These are a consequence of two factors. First, because archaeological research into prehistoric and protohistoric Southeast Asia has produced many new findings, and second, because new methods for interpreting the archaeological and historical data have been developed. As such, Hermann Kulke suggests that both should lead to a re-evaluation of the early history of South and Southeast Asia.[25] Kulke refers to the "convergence" hypothesis. This differs from the Indianization concept because it gives more space to the actions of the indigenous people and interprets the development of South and Southeast Asian societies via a unified historical process. Kulke builds his theory on De Casparis, who has, Kulke says, given the Indianization theory a "*coup de grâce"* (a final blow). J.G. de Casparis, who does not agree with the idea of Indianization, explains that the complicated process of interaction between the influence of Indic culture within Indonesia and Southeast Asia should be seen as an involvement of multiple interactions within South Asia and Southeast Asia creating "a lasting relationship".[26] This hypothesis suggests the existence of socioeconomic and political convergence as a mechanism for solving social and political problems in both regions. Kulke explains:

> Whereas Indianization presumes social distance as a major cause of acceptance of Indian influences in South-East Asia, the convergence hypothesis postulates social nearness as the promoter of social change under -undoubtedly- Indian influences in South-East Asia.[27]

As such, this hypothesis highlights as an explanation for the influence of Indian

41-67; Donn Bayard, "The Roots of Indochinese Civilisation: Recent Developments in the Prehistory of Southeast Asia", *Pacific Affairs* 53 (1980): 89 -114.

24 S. Pollock, *The Language of the Gods in the World of Men: Sanskrit, Culture, and Power in Premodern India* (Berkeley and Los Angeles: The University of California Press, 2006): 531-533.

25 H. Kulke, "Indian Colonies, Indianization or Cultural Convergence? Reflections on the Changing Image of India's Role in South-East Asia", in: *Semaian 3. Onderzoek In Zuidoost–Azie Agenda's Voor De Jaren Negentig. H Schulte Nordholt* (Leiden: Vakgroep Talen en Culturen van Zuidoost-Azie en Oceanie Rijksuniversiteit te Leiden, 1990): 21.

26 See: J.G. de Casparis, "India and Maritime South East Asia: A Lasting Relationship", *Third Sri Lanka Endowment Fund Lecture* (Kuala Lumpur: University of Malaya, 1983).

27 Kulke, "Indian Colonies, Indianization or Cultural Convergence?": 32.

culture in Southeast Asia that there was a complex network of exchange relations that occurred in a mutual process.

Such an approach has been taken by Bérénice Bellina and Ian Glover, who are convinced that trade networks and maritime routes played an important role in diffusing Indian culture within Southeast Asia.[28] Furthermore, they affirm that in order to understand the history of the development of trade networks and maritime routes—through which the diffusion of Indian influence occurred—one also has to study the formation and evolution of these networks and routes from India to the various regions of Southeast Asia. By analyzing new archaeological data, especially the items that were traded between the fourth century BC and the fourth century CE, and by providing comparative data from both Southeast Asia and India, they conclude that interactions between India and Southeast Asia happened in two phases: Phase I (fourth century BCE to second century CE) and Phase II (second to fourth centuries CE). They conclude that: "by the late centuries BC, Southeast Asia was already part of a world trading system linking the civilizations of the Mediterranean basin and Han China. Thus, the process of Indianization had long roots reaching back into prehistory".[29]

Regarding the Chinese expansion into Southeast Asia, it cannot be denied that China also had cultural contacts with the region. This fact has been rather neglected in previous research, but it is a potential explanation for the transcultural interactions between Southeast Asia and the surrounding regions. On the basis of Chinese accounts, some scholars have suggested that Chinese knowledge of the Malay peninsula began at the start of the Common Era.[30] During the early Han dynasty, there was regular exchange of goods between the Chinese elite and Southeast Asian societies, while at the same time the elites of Southeast Asia had to send gifts and goods to the Chinese emperor as a sign of their subordination. The study by Wang Gungwu on the Nanhai Trade examines the early movement southward of Chinese political power into Southeast Asia.[31] On the basis of this

28 B. Bellina and I. Glover, "The Archaeology of Early Contact with India and the Mediterranean World from the Fourth Century BC to the Fourth Century AD", in: *Southeast Asia. From Prehistory to History*, ed. Ian Glover and Peter Bellwood (London and New York: Routledge Curzon, 2004): 4-20.

29 Bellina and Glover, "The Archaeology of Early Contact with India and the Mediterranean World from the Fourth Century BC to the Fourth Century AD": 83.

30 P. Wheatley, "References to the Malay Peninsula in the Annals of the Former Han", in: *Southeast Asia – China Interactions: Reprint of Articles from the Journal of the Malaysian Branch, Royal Asiatic Society* (Singapore-Kuala Lumpur: MBRAS and NUS Press, 2007): 1-7; D. Henk, *Sino-Malay Trade and Diplomacy from the Tenth through the Fourteenth Century*, (Athens: Ohio University Press, 2009): 21; G. Wang, "The Nanhai Trade", in: *Southeast Asia – China Interactions: Reprint of Articles from the Journal of the Malaysian Branch, Royal Asiatic Society* (Singapore-Kuala Lumpur: MBRAS and NUS Press, 2007): 55.

31 Wang, "The Nanhai Trade": 51-166.

Chinese account, relations between China and Southeast Asia occurred over a period of at least ten centuries, from the first century BCE to 960 CE. But also later, Southeast Asia's maritime interaction with China only began in the first millennium CE after China had enacted a policy of exploring and expanding its commercial and political power over the areas to the south of China, including those in Southeast Asia.[32]

1.2. MODELS OF EARLY STATE FORMATION

Discussions of how relations between Southeast Asia, India, and China impacted the development of the classical states of Southeast Asia led to another debate, one focused on the growth of those states. Their characteristics have been proposed by a number of scholars on the basis of a number of different perspectives. When researching the development of these states, two topics are commonly discussed: the form of the polities and their nature.

The categorization of the polities of early Southeast Asia remains sketchy, and most scholars refer to them as states, kingdoms, chiefdoms, or city-states, with "states" being the term employed most regularly. However, the use of the term "state" overlaps with the other aforementioned terms and is sometimes used interchangeably. Some scholars use a different term, such as Wolters, who suggests using "political system" as an alternative for "state". The problem resulting from this confusing use of the terms is that the definitions for each are too broad and general. The other reason is that some of the terms were influenced by western concepts and approaches that these scholars introduced to understand Southeast Asia.[33] As such, K.D. Morrison recommends seeking the origins of Asia (or, in this case, Southeast Asia) by employing the definitions related to Southeast Asia on the basis of the terms that are found in the sources.[34] V. Lieberman describes this approach as "autonomous historiography," one which is a reaction against Indian historians' approaches that overemphasize the Indian elements in Indonesian culture. This perspective of polity categorization has begun to influence other Asianists, particularly since 1950 when Van Leur's and Schrieke's writings were translated into English.[35]

32 Henk, *Sino-Malay Trade and Diplomacy*: 21; P. Wheatley, *The Golden Khersonese. The Studies in the Historical Geography of the Malay Peninsula before A.D. 1500* (Westport: Greenwood Press, 1973): 5.

33 Hagesteijn, Circles of Kings: 146; K.D. Morrison, "States of Theory and States of Asia: Regional Perspectives on States in Asia", *Asian Perspectives* Vol.33(2), Fall 1994: 183-196.

34 Morrison, "States of Theory and States of Asia": 191.

35 V. Lieberman, *Strange Parallels: Southeast Asia in Global Context, c. 800-1830. Vol. 1: Integration on the Mainland* (Cambridge: Cambridge University Press, 2007): 9-10.

As well as explaining the process of "Indianization" and how external factors influenced the emergence of states in Southeast Asia, many researchers have tried to explain the states' structures and organization. In attempting to do so, the concepts of *maṇḍala, cakravartin,* and galactic polity have been proposed by scholars.

The *maṇḍala* pattern has been very popular ever since O.W. Wolters used it to explain the structure of states in Southeast Asia.[36] *Maṇḍala* is a cosmological scheme in which an "organization" is a representation of the universe (the macro cosmos) on earth (the micro cosmos). The universe is seen as a spatial entity with Mount Meru as its centre, with gods and deities believed to surround Mount Meru from where they rule the universe. The universe itself is divided into several sections, each of which has its own god. The conceptual universe is viewed by the rulers or kings on the earth as being the equivalent of a god in the centre as the ruler of the universe.

Empirically, the boundaries of a *maṇḍala* are unfixed and thus its size could expand or contract. Each *maṇḍala* consists of several polities, and any one polity could be the centre should it attain sufficient power to form another *maṇḍala*. According to O.W. Wolters, a *maṇḍala* is not based on coercion—although sometimes victory in war causes a vassal to become obligated to the centre—but, instead, vassals often join a *maṇḍala* due to "security" needs or the influence of a spiritual or political power. The existence of a *maṇḍala* depends on how a central ruler obtains information on its vassals and how effectively diplomacy is used.[37]

Wolters' idea of the *maṇḍala* is accepted by many scholars, although it is criticized by numerous others. Christie suggests that the model of the *maṇḍala* cannot be accepted as a whole, especially for Java, and she also believes that the model is a historically static concept showing a Weberian influence.[38] Sunait Chutintaranond differentiates the *maṇḍala* model from the *cakravartin*, stating that the *maṇḍala* was a foundation for the *cakravartin*. *Cakravartin* means a "cakra/wheel turner," and it refers to a universal rule in which the king governs a territory either by coercion or through peaceful means. He states that "in the new system, boundaries were fixed rather than flexible, rituals of alliance were replaced by international law and foreign policy, and local autonomy was totally overshadowed by central authority".[39] It seems that the *cakravartin* model involved more coercion in its operation than did the *maṇḍala*.

Another model with similarities to the *maṇḍala* is that of the "galactic polity,"

36 O.W. Wolters, *History, Culture, and Region in Southeast Asian Perspectives* (Singapore: Institute of Southeast Asia Studies, 1982).

37 Wolters, *History, Culture, and Region in Southeast Asian Perspectives*: 27-29.

38 J.W. Christie, "Negara, Mandala, and Dispotic State: Images of Early Java", in: *Southeast Asia in the 9th to 14th Centuries*, ed David G. Marr and A.C. Milner (Singapore: Institute of Southeast Asia Studies, 1986): 85-86.

39 S. Chutintaranond, *Cakravartin: The Ideology of Traditional Warfare in Siam and Burma, 1548-1605* (Dissertation, The Faculty of the Graduate School of Cornell University, 1990): 296.

proposed by Tambiah.[40] Essentially, this model was based on both the *maṇḍala* model and *cakravartin*. The galactic polity model sees Southeast Asian polities as being arranged in centre-oriented galactic schemes, with the smaller polities surrounding the centre being united with it. The galactic polity—which was a characteristic of several Southeast Asia states—was, according to Tambiah, based on "indigenous" Southeast Asian concepts. However, this leads to the question of what "indigenous concept" refers to, and particularly whether it came from the prehistoric Southeast Asia or was originally Indian-influenced. In his article, this is extremely unclear.

Although the *maṇḍala* model of the Southeast Asian polity may seem ideal, its application provokes debate. One of the most debated cases is that of the Ayutthaya polity, which has seen discussions between Wolters and Chutintaranond. According to Wolters, Ayutthaya was a perfect example of a *maṇḍala* in Southeast Asia—at least, after 1350 CE, when the Ayutthaya king brought the Thai rulers into his centralized polity[41]—yet Chutintaranond suggests that Ayutthaya used the *cakravartin* concept, rather than the *maṇḍala*, as its basis.[42] Sumatra and Java are often used as the prime examples of the *maṇḍala* model, but scholars like Christie refuse to classify them as *maṇḍala* polities. The states of Java, Christie argues, were not as integrated, either politically or economically, as the *maṇḍala* model claims they should have been.[43]

Another model with a similar centre-periphery approach is that of the "upstream-downstream" network. This model was formulated for the first time by Bennet Bronson, and in it he admitted that his proposed model was merely speculative, with little supporting data.[44] In essence, the model suggests there was a process of exchange along a river between the upstream and the downstream polities. The centre of the network was located at or near the mouth of the river, which also had overall control of the whole network. Besides the centre, other parties who took part in the operation of the network included lower-level trading

40 S.J. Tambiah. "The Galactic Polity: The Structure of Traditional Kingdoms in Southeast Asia", *Annals of the New York Academy of Sciences* 293/1 (1977): 69-97. See also: S.J. Tambiah, *World Conquerer and World Renouncer: A Study of Buddhism and Polity in Thailand against a Historical Background* (Cambridge: Cambridge University Press, 1976): 128-131.

41 Wolters, *History, Culture, and Region in Southeast Asian Perspectives*: 31.

42 Chutintaranond, *Cakravartin*: 287-295.

43 Christie, "Negara, Mandala, and Dispotic State": 75, 85-86.

44 B. Bronson, "Exchange at the Upstream and Downstream ends: Notes towards a Funcional Model of the Coastal States in Southeast Asia", in: *Economic Exchange and Social Interactions in Southeast Asia. Perspectives from Prehistoric, History, and Ethnography*, ed. Karl L. Hutterer (Ann Harbor: Centre for South and Southeast Asia Studies University of Michigan, 1977): 38-52. See also: K.R. Hall, *A History of Early Southeast Asia. Maritime Trade and Societal Development, 100-1500* (Lanham: Rowman and Littlefield Publishers Inc., 2011): 22-23.

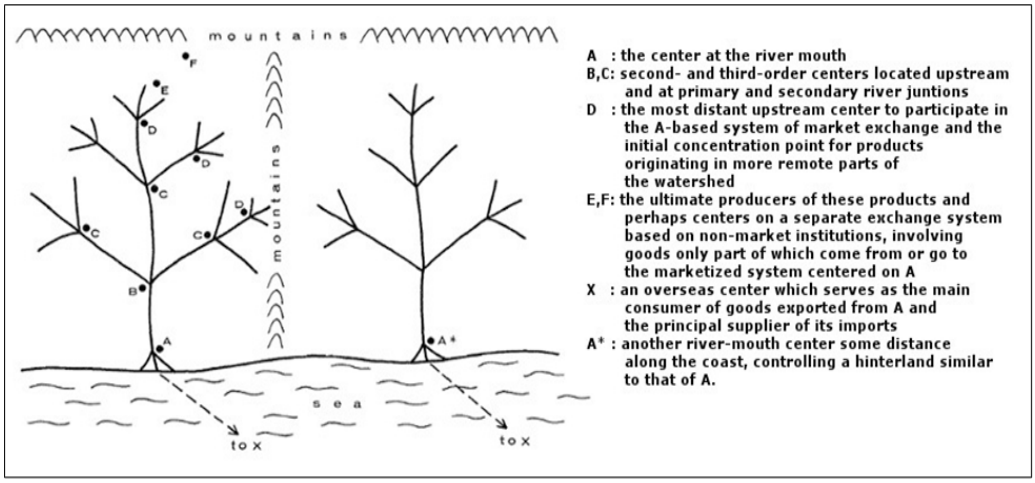

Fig. 1.1. Model of Bronson's upstream-downstream exchange network. (Source: Bennet Bronson, 1977: 42-43)

centres located upstream, a main upstream centre, the ultimate producers of the products traded, and the overseas consumers. Bronson assumes that the model would operate in two circumstances: a river as the main transportation route for the state, and an overseas consumer that has both a larger population and more advanced technology. He stresses that the relationships between upstream and downstream polities were more egalitarian and less coercive than those used in ordinary networks. He designed the model especially for certain areas in Southeast Asia, such as Sumatra, insular and peninsular Southeast Asia, and western Indonesia, although not Java or mainland Southeast Asia.

Although Bronson formulated this as a hypothetical, Aung-Thwin employed a similar model to analyse a network focused on the Ava and Pegu kingdoms of Myanmar. His article is a history of the "upstream–downstream" relationship between Ava and Pegu.[45] After Pagan had declined in the fourteenth century CE, Myanmar was dominated by the two polities of Ava and Pegu. Each had distinct characteristics, as Ava was an agrarian polity located in upstream Myanmar while Pegu was a commercial polity situated downstream. Aung-Thwin termed the relationship between Ava and Pegu as being "symbiotic dualism" in which they generally maintained their economic symbiosis; Ava supplied lower Myanmar with its basic needs—especially rice—while Pegu provided upper Myanmar with luxury or imported goods and maritime delicacies. Their relationship was very special and they always maintained the status quo, never seeking to destroy each other during

45 M. Aung-Thwin, "A Tale of Two Kingdoms: Ava and Pegu in the Fifteenth Century", *Journal of Southeast Asian Studies* 42 (2011): 1-16.

their alternating periods of control of Myanmar.[46] Coercion-less relations between upstream and downstream polities also happened with the two polities of Sriwijaya and Samudra Pasai—the latter of which was a new Islamic polity in Sumatra with origins in the fifteenth century—which also had an upstream-downstream relation based on an exchange; the upstream communities supplied products from the land to the downstream settlers and, conversely, the downstream polity provided luxury imported goods to that upstream.[47]

The upstream-downstream relations approach essentially examines exchanges or trade—in a geographically narrow sense—in what may be termed a local-to-local network, although sometimes they could be drawn into a relationship with another trading network. However, many scholars employ the trade approach in a broader sense to create a model to explain the emergence and development of the Southeast Asian states. One of the most comprehensive approaches was proposed by Kenneth Hall in his book *The History of Early Southeast Asia. Maritime Trade and Societal Development, 100-1500*, in which he explains how the function and consequences of both regional and international economic developments influenced Southeast Asian social organization and polities.[48] By examining local, regional, and international trade among Southeast Asia polities—like Champa, Vietnam, Pagan, Angkor, Sriwijaya, and Java—he was able to detail the different levels of trade and of both economic and socio-cultural exchange between the Southeast Asian states. In this way, trade led to the development of polities while trading networks generated relations between those polities, especially the ones based on or near rivers.

In the global-local perspective, it is useful here to put forward Sheldon Pollock's idea of the Sanskrit Cosmopolis.[49] Pollock argues that in the first half of the first millennium Sanskrit literature (*kāvya* and *praśasti*) began to spread in both South and Southeast Asia which Sanskrit literature got a new function as important to the state before then generating regional vernacular literature in the first half of second millennium. In this way, he emphasises the superordinate and universal qualities of Sanskrit and links it to the political power and aesthetic expressions used by the elites of South and Southeast Asia. Over time, the (regional) vernacular rose to a higher linguistic register through the use of Sanskrit and arrived at a phase of new vernacular production of *kāvya* and *praśasti*, and this led to new processes of regional centralization as, for instance, began to occur in Kannada, South India, in

46 For the concept of upper and lower Myanmar, see: Michael Aung-Thwin, "Lower Burma and Bago in the History of Burma", in: *The Maritime Frontier of Burma. Exploring Political, Cultural and Commercial Interaction in the Indian Ocean World, 1200-1800*, ed. Jos Gommans and Jacques Leider (Leiden: KITLV Press, 2002): 30-31.

47 Hall, *A History of Early Southeast Asia*: 114 and 306.

48 Hall, *A History of Early Southeast Asia. Maritime Trade and Societal Development, 100-1500*.

49 S. Pollock, *The Language of the Gods in the World of Men: Sanskrit, Culture, and Power in Premodern India* (Berkeley and Los Angeles: The University of California Press, 2006).

the late ninth century.[50] However, Pollock disagrees that this Sanskrit Cosmopolis is the same as the concept of one-directional Indianization because Sanskrit was adopted consciously by those participating in the Sanskrit Cosmopolis.

1.3. APPROACHES TO WATER MANAGEMENT AND STATE DEVELOPMENT

Another model of Southeast Asian state development focuses on the interplay between irrigation and the centralized-decentralized administration which is known as the "hydraulic society" model. The most important work on this is Wittfogel's *Oriental Despotism*,[51] is which it is posited that largescale irrigation had to be coordinated and supervised by a centralized state administration. These activities, in turn, gave rise to a more systematized and centralized political system. In other words, irrigation is believed to have been a prime mover of the emergence of a civilization, one labeled a "hydraulic society" or an "irrigation civilization".[52] It is important to note here that the hydraulic society was seen in China during both the Qin dynasty (221-206 BCE) and the Han dynasty (206 BCE-220 CE).

This model for analyzing Southeast Asian state development during the medieval period has been applied by a number of scholars, resulting in two opposing opinions regarding its suitability for explaining state development. On the one hand, Harry J. Benda believes that oriental despotism is more apt for developments in mainland Southeast Asian states than China,[53] and a similar view has been put forward by Van Naerssen, who used hydraulic theory to support ideas surrounding the emergence of the first polities in parts of Southeast Asia.[54] On the other hand, various criticisms have been made of this model, including those by Jan Wisseman-Christie and Janice Stargardt. Christie wrote an article entitled "Water from the Ancestors: Irrigation in Early Java and Bali," in part of which she examined the role of the court in water management and in the construction and maintenance of hydraulic infrastructure on the basis of epigraphic records.[55] She concluded that

50 Pollock, *The Language of the Gods in the World of Men*: 338.

51 K.A. Wittfogel, *Oriental Despotism: A Comparative Study of Total Power* (New Haven: Yale University Press, 1957).

52 Julian Steward used the term "irrigation civilization" on the basis of his research in Mesopotamia, Mesoamerica, South America, China, and Egypt; see: J. H. Steward, *Irrigation Civilizations: A Comparative Study. A Symposium on Method and Result in Cross-Cultural Regularities* (Washington D.C.: Social Science Section, Department of Cultural Affairs, Pan American Union, 1955).

53 H.J. Benda, "The Structure of Southeast Asia History: Some Preliminary Observations", *Journal of Southeast Asian History* 3/1(1962): 113.

54 F.H. van Naerssen, *The Economic and Administrative History of Early Indonesia* (Leiden: Brill, 1977): 69.

55 Christie, "Water from the Ancestors": 7-25.

water management in early Java was mostly undertaken by local agency or "the village with its large territory holdings".[56] On Wittfogel's *Oriental Despotism*, she states in another article that:

> Java's aristocracy was too strong and its royalty too weak, its villages too hierarchical and its regions too well integrated, its economy too sophisticated but too decentralized, its religion too unfocused, and its history too linear for any of its states to qualify as an "Oriental Despotism". [57]

Similarly, Stargardt's research has confirmed the autonomy of the local community in water management. This research was conducted in Satingpra, south Thailand, a site which has many hydraulic works from the period of *c.* the sixth to the mid-thirteenth centuries, but which is situated on secondary alluvial tracts, suggesting that local social structures were more active than was royalty in managing the hydraulic works.[58]

If we extend this conclusion more widely, the local autonomy seen in the examples of how Southeast Asian polities in managing water control could also have occurred in many other ancient polities around the world. It is certain that ancient local communities had the skill, capability, and social capital to build infrastructure and to control the water, despite their varying levels of political authority. Research by Vernon L. Scarborough on irrigation-based polities in both the Old World and the New World over a period from hundreds of centuries BCE to 1200 CE seems to confirm this.[59]

Regarding the role of the state in water management, it will be useful to explore relations between the development of river basin-based societies and the ecological characteristics of its river basin. Janice Stargardt has emphasised the importance of analyzing the physical geography of the landscape and the social systems of riverine societies. Moreover, on the basis of her research on the Satingpra site in south Thailand, which has been compared with sites in Cambodia, Vietnam, and Indonesia, she explains:

> In attempting to establish the real character of this part of man's dialogue with his environment, namely the reciprocal influences exerted by societies on hydraulic systems and vice versa, we need to look in detail at the way these systems operated. In particular, factors such as water volumes, water retention of the soils, equality or inequality of man's water access, and the

56 Christie, "Water from the Ancestors": 19.

57 Christie, "Negara, Mandala, and Dispotic State": 85; see also: J.W. Christie, "Theatre States and Oriental Despotisms: Early Southeast Asia in the Eyes of the West", *The University of Hull Centre for South-East Asian Studies Occasional Papers* No. 10 (1985).

58 J. Stargardt, "Hydraulic Works and Southeast Asian Polities", in: *Southeast Asia in the 9th to 14th Centuries*, ed. David G. Marr and A.C. Milner (Singapore: Institute of Southeast Asian Studies and Research School of Pacific Studies ANU, 1986): 32-33.

59 V.L. Scarborough, *The Flow of Power. Ancient Water Systems and Landscapes* (Santa Fe: School of American Research, 2003): 102-103 and 151-165.

> presence or absence of social mechanisms of inter-village co-operation in water management are those which are useful in understanding why larger polities developed in certain areas and not others and what larger polities developed part was played in the process by hydraulic works.[60]

In addition to the physical geography of the river basin—and in particular the river itself—rivers have, in various ways, helped to shape the characteristics of the Southeast Asian societies along it, based on the geographical conditions and the river itself. Kenneth Hall has noted that Southeast Asian river systems can be divided into two different types, both of which occur in mainland and island Southeast Asia.[61] The first system sees numerous streams flow from the mountains of the interior to the sea, and in this the coastal polity dominated due to its accessibility; as a result, the upstream polity controlled those downstream due to its control of the river because it could also control the exchange of goods from the inland. Its hegemony over the river consequently structured the polities along the whole river.[62] This type of river system occurred in Sumatra, Borneo, and Malaysia.

The second type depended on a major river system forming a very fertile basin in which people cultivated rice, as the rich rice-producers created centres of political power in that basin. Examples of this type of river system are those around the Irrawaddy, Mekong, and Salween rivers in mainland Southeast Asia, and the Solo and Brantas rivers in East Java.[63] Within these diverse topographies and river systems each polity and society developed its own water management strategy in order to maintain its socio-economic and political growth. Therefore, there was always a correlation between diversity in ecology and diversity in the inventions in the field of water management technology and strategy. Charles R. Ortloff has validated this correlation through an examination of the various strategies and technologies developed by ancient societies in the New World, Old World, and Southeast Asia.[64]

60 J. Stargardt, "Hydraulic Works and Southeast Asian Polities" in: *Southeast Asia in the 9th to 14th Centuries*, ed. David G. Marr and A.C. Milner (Singapore and Canberra: Institute of Southeast Asia Studies and Research School of Pacific Studies Australian National University, 1986): 37.

61 K.R. Hall, *A History of Early Southeast Asia: Maritime Trade and Societal Development, 100–1500* (Plymouth: Rowman & Littlefield Publishers, Inc., 2011): 12-13.

62 See also: J. Wisseman Christie, "State Formation in Early Maritime Southeast Asia: A Consideration of the Theories and the Data", *BKI* 151 (1995): 270.

63 Kenneth Hall suggests Central and East Java were part of a similar river system, but they were different; see: Hall, *A History of Early Southeast Asia*: 12.

64 C.R. Ortloff, *Water Engineering in the Ancient World. Archaeological and Climate Perspective on Societies of Ancient South America, the Middle East, and South-East Asia* (New York: Oxford University Press, 2009): 383-400.

1.4. CONCLUSION

For the most part, the models put forward by scholars are useful, but debates remain on the question whether they do indeed explain the real circumstances. In the case of the emergence and growth of the Javanese polities, the application of these models above is not very convincing, nor are the attempts to explain the development of Javanese states by using them. Some scholars have misapplied the concept of generalization by applying to Javanese state development a model that was generated from other examples, places, or times, while the main problems for each explanation are insufficient evidence and the misinterpretation of data used to present the development of the Javanese polities. The other problem that has arisen when using these models to explain the Javanese polities is a failure to understand the particular geographical characteristics of Java, such as the local climate and geomorphology of the island. As such, when explaining the development of the Javanese polities I propose that a new model is required, one based specifically on evidence from Javanese archaeological and historical records and the geographical data of the island. On the other hand, it should be underlined that some of the concepts surrounding water management proposed by scholars are of some use when explaining the practice of water management within East Javanese polities and society.

Chapter 2

River Polities in Mainland Southeast Asia

This chapter attempts to explore the relationship between rivers and polities through an examination of water management in mainland Southeast Asia which then I can use as a comparison to the East Javanese water management. It suggests that the development of polities within river basins in the Southeast Asian mainland was greatly facilitated by the existence of the river(s). Therefore, this chapter places significant emphasis on how the river basins' physical geography has shaped the political geographies of mainland Southeast Asia. Moreover, a comparison will be made between ancient Burmese, Thai, and Cambodian polities regarding how the physical geography of the river basins contributed to shaping river-basin polities.

I deliberately chose the three locations for comparison because all three have large rivers with fairly wide drainage basins and tributary systems: the Irrawaddy in Burma, the Chao Phraya in Thailand and the Mekong in Cambodia. In addition, all these rivers were used for upstream-downstream transportation routes and vice versa. Like the Brantas, all three large river systems have similar physical and ecological features which also decisively shaped the polities that surrounded them.[1] Hence, I have made no systematic comparison with other river basins in Indonesia which may be less distant but have altogether different characteristics. Bali, for example, has been relatively well studied, but its smaller basins are narrower and

1 H. Sutherland, "Geography as Destiny? The Role of Water in Southeast Asian History", in: *A World of Water. Rain, Rivers and Seas in Southeast Asian Histories*, ed. Peter Boomgaard (Leiden: KITLV Press, 2007): 32.

its rivers steeper than in the Brantas river system. For a different reason, I have not used the Musi and Batanghari basins in Sumatra because these simply lack the archaeological and historical data to make a comparison fruitful.

Southeast Asia consists of a large variety of geomorphological areas. While some of these are unsuitable for human settlement, its river valleys offer good opportunities for human settlement by providing nutrient-rich water and alluvium which people can use to carry out agricultural activities. In the valleys of the Irrawaddy, Chao Phraya, and Mekong, the people were dependent on those rivers and their valleys to carry out their agricultural activities and also, in many cases, as a means of transportation. These rivers make many parts of Southeast Asia more easily accessible, especially the hinterlands.[2]

In what follows, I will look at the development of these three river-basin societies in mainland Southeast Asia. Moreover, I will also compare the development of a number of polities within the river basins on the basis of a dialogue between the people and the rulers, on the one hand, and their environment, especially with its river basin environment, on the other. Three regions will be explored and compared, those comprising modern Burma, Thailand, and Cambodia.

2.1. THE IRRAWADDY BASIN: UPPER BURMA AND LOWER BURMA

Today, Myanmar (Burma) is the largest country in Southeast Asia, stretching from the isthmus of the Malay Peninsula in the south up into Central Asia. As it lies on a number of different latitudes, it has a wide variety of flora, fauna, and climates. Most of Myanmar, including its northeastern area, Arakan, the delta, and along the coast of the Malay Peninsula, sees 1,000 mm to 2,000 mm of rainfall annually. However, the heartland of the country, surrounding the Irrawaddy River, has a Dry Zone climate with no more than 1,000 mm of annual rainfall.[3] Although it is an arid region, almost all Burmese polities were based in and centreed on this region of Upper Burma.[4] Aung-Thwin has explored why almost all ancient civilizations were based in this area and has shown that it has long and wide plains that were easy for people to move through, both south to north and vice versa. In contrast, it was more difficult for people to move west to east or east to west due to the presence of mountains.

2 J. Rigg, *Southeast Asia. A Region in Transition* (London and New York: Routledge, 1991): 12.

3 The reason that there is less rainfall in Upper Myanmar is the existence of Rakhine Mountain, which creates a barrier that prevents rain from reaching the Irrawaddy basin. See: E. H. Moore, *Early Landscape of Myanmar* (Bangkok: River Books, 2007): 33. See also: A. Gupta. "Landforms of Southeast Asia", in: *The Physical Geography of Southeast Asia*, ed. Avijit Gupta (Oxford: Oxford University Press, 2005): 46.

4 J. Stargardt, *The Ancient Pyu of Burma, Volume One, Early Pyu Cities in A Man-made Landscape* (Cambridge: PACSEA, 1990): 3.

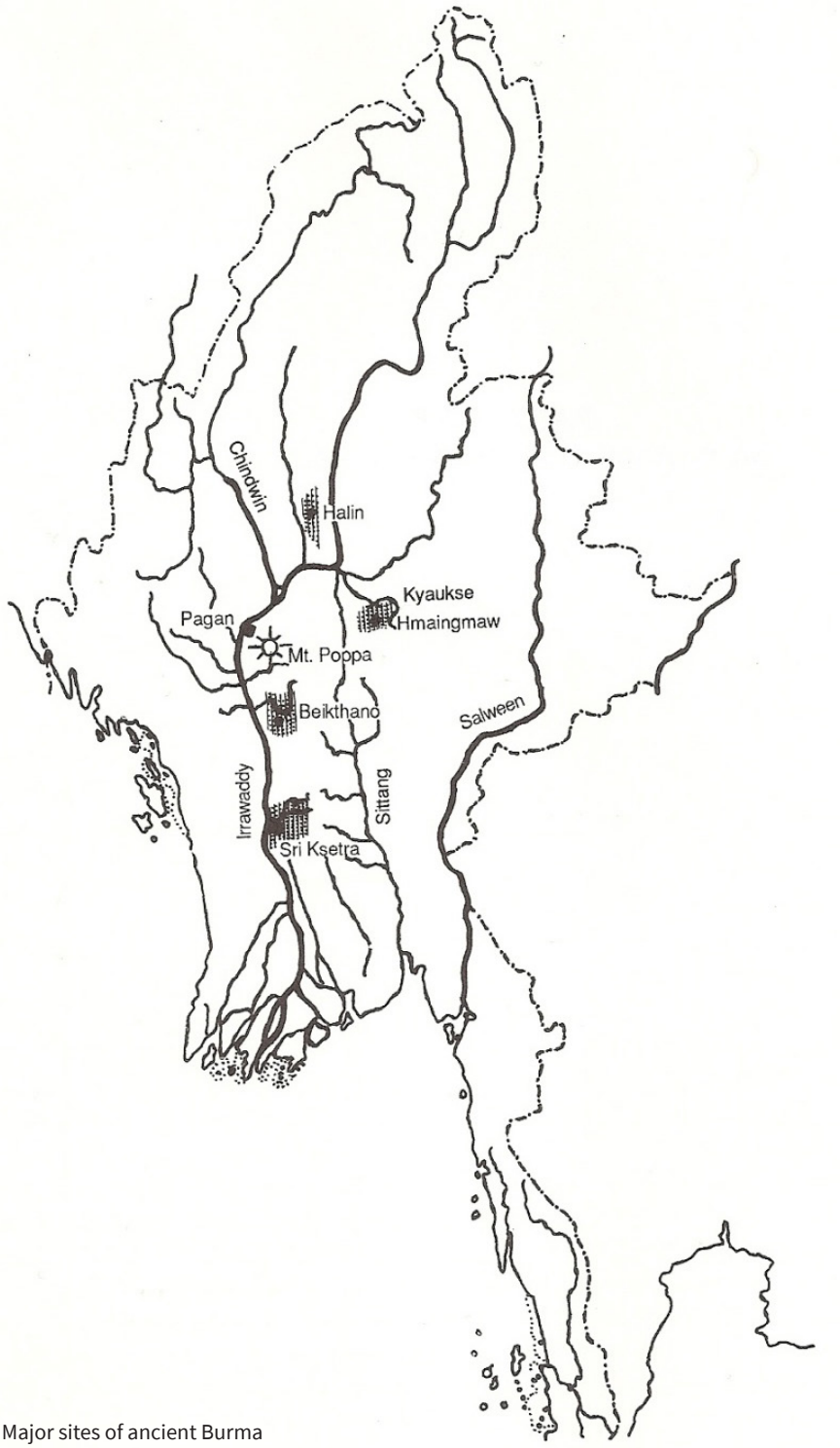

Fig. 2.1. Major sites of ancient Burma
(Source: Stargardt, 1990: 2)

Moreover, he explains that every polity that was able to control this area of Upper Burma could also control the rest of the country.[5]

In the Arid Zone of Upper Burma, ancient settlements did exist near various rivers, but not near the main one, the Irrawaddy, except Bagan. Instead, they existed in the vicinity of its tributaries. This is fascinating. Most of the ancient sites of Upper Burma were located inside the Irrawaddy valley where there is less alluvial land rather than on the Irrawaddy's banks. The reason for the creation of this type of settlement pattern was to avoid large floodplains, by settling on smaller ones one would be able to manage floodwater more easily. On the other hand, settlements still needed to be "not too far" from the main river because it was needed for transportation.

The Arid Zone around the Irrawaddy has been inhabited from prehistoric times, but cities began to emerge around 200 BCE as the Pyu culture started to dominate the area. The Pyu period dates from approximately 200 BCE to the ninth century CE. The Pyu migrated south from southern China, entered the Irrawaddy Valley, and then settled along tributary rivers in Upper Burma, including the Sittang, Chindwin, and Mu rivers.[6] The ancient Pyu were known for their mastery of water control techniques, brick making, and ironworking, and their skill in water management. As the Pyu settlements were located in valleys to the side of the great Irrawaddy Valley, they were compelled to construct extensive irrigation networks.[7] Of the Pyu urban centres, Halin, Beikthano, and Śrī Kṣetra were the most important.

Śrī Kṣetra

Śrī Kṣetra (Thiri Khittaya in Burmese) is situated near the Navin river—a highly seasonal but perennial tributary of the Irrawaddy—at a distance of 5 km from this main river. Śrī Kṣetra was the largest brick-walled city in ancient Southeast Asia, the walls of which enclose an area of 17 km^2, which is twice as large as any other walled site in Burma. The features that archaeological studies have found within it include earthen embankments and water control channels, brick water control channels and wells, brick-bounded platforms, and more than 250 brick religious monuments.[8] The chronology of Śrī Kṣetra is still debated. According to the Burmese chronicles,

5 M. Aung-Thwin, "Irrigation in the Heartland of Burma: Foundations of the Pre-Colonial Burmese State", *Occasional Paper No. 15, Northern Illinois University Center for Southeast Asian Studies* (1990): 2.

6 W.J. Topich and K.A. Leitich, *The History of Myanmar* (Santa Barbara: Greenwood, 2013): 16.

7 Stargardt, *The Ancient Pyu of Burma*: 3.

8 B. Hudson and T. Lustig, "Communities of the Past: A New View of the Old Walls and Hydraulic System at Sriksetra, Myanmar (Burma)", *Journal of Southeast Asian Studies* 39 (2008): 271.

the city dated from 443 BCE to the second century CE,[9] but many scholars have dated it from the fifth to the ninth century CE.[10] Lwin, Kyaing, and J. Stargardt have divided the development of Śrī Kṣetra into three periods, namely: (1) Early-Phase Śrī Kṣetra, from the second century BCE to the fourth century CE; (2) Phase I of Pyu Buddhism at Śrī Kṣetra, from the fourth to the sixth century CE; and (3) Phase II of Buddhist Culture at Śrī Kṣetra, from the seventh the ninth century CE.[11] I will focus my explanation on the final phase of Śrī Kṣetra's development, from the seventh to the ninth centuries, as it is a foundation for the later developments of the Bagan period (849-1287 CE).

Śrī Kṣetra city was an irregular oval or squarish space with rounded corners surrounded by walls and moats that suffered severe damage not long after they were built, perhaps as the result of human actions. On each side of the enclave there is a different number of walls; for instance, there were three walls on the southeast side while the eastern part of the city was protected by only one. Both inside and outside the enclave there are many ancient water tanks that have long been viewed as hydraulic works. Small tanks, some of which form a pattern, are associated with the ancient burial terraces. Besides the tanks, there are also ancient canals. Recent research has revealed that these canals together form a network, being connected to each other and to the tanks both inside and outside the enclave. The canal network has seven outflow points and the direction of the water flow was from the north and east of the city to the fields outside it.[12] Furthermore, Janice Stargardt has calculated that the tanks and moats at Sri Ksetra could hold about 9,502,000 m^3 of water.[13]

The function of Śrī Kṣetra's waterworks is also significant. The high level of technical expertise and management skill required to maintain these water networks suggest a strong desire to achieve their goal. Their prime function was related to irrigation, through which the rice fields were watered. However, another function was the religiously symbolic meaning of both water and waterworks through the belief that water infrastructure symbolized the city as being a macro-cosmos. Recent

9 G.H. Luce and B. B. Shin, *Old Burma: Early Pagán. Volume One: Text* (New York: Artibus Asiae and The Institute of Fine Arts, New York University, 1969): 6-7.

10 Aung Thaw, *Historical Sites in Burma* (Rangoon: Ministry of Union Culture, 1972): 16; J. Stargardt, "The Great Silver Reliquary from Sriksetra: The Oldest Buddhist Art in Burma and One of The World's Oldest Pali Inscriptions", in: *Fruits of Inspiration: Studies in Honour of Professor J. G. de Casparis*, ed. Marijke Klokke and Karel R. van Kooij (Groningen: Royal Netherlands Academy of Arts and Sciences, Egbert Forstern, Gonda Indological Studies, 2001).

11 T. Lwin, W. Kyaing, and J. Stargardt, "The Pyu Civilization of Myanmar and the City of Śrī Kṣetra", in: *Lost Kingdoms: Hindu-Buddhist Sculpture of Early Southeast Asia*, ed. John Guy (New York: The Metropolitan Museum of Art, 2014): 64-68.

12 Stargardt, *The Ancient Pyu of Burma*: 84-90.

13 With the estimation of the average depth of the canals being 3m. See: Stargardt, *The Ancient Pyu of Burma*: 101.

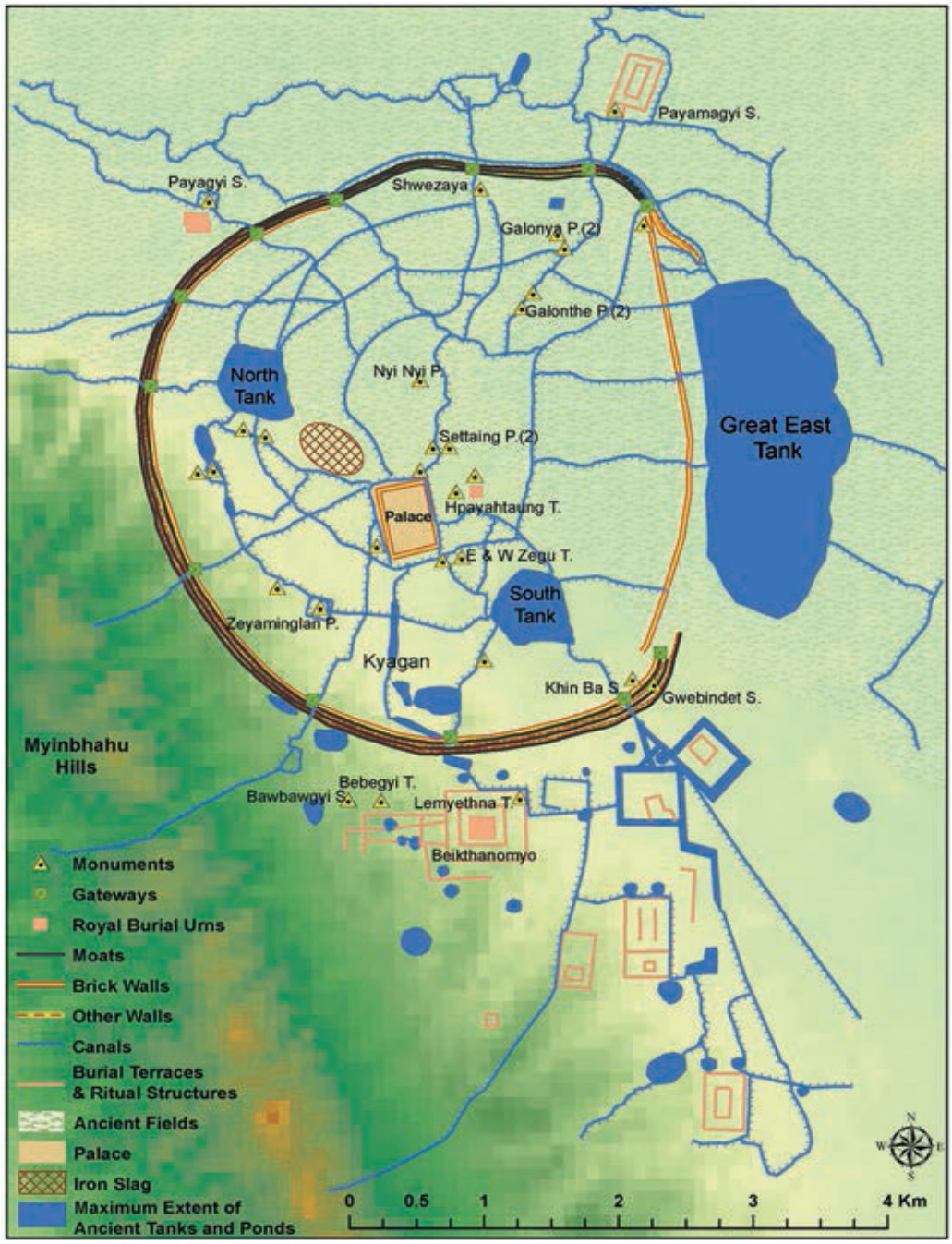

Fig. 2.2. Map of Śrī Kṣetra (Source: Lwin, Kyaing, and Stargardt 2014: 63)

studies of the waterwork networks using multi-temporal and multi-spectral satellite imagery confirm that there were close links between the water networks and ancient ritual ponds and burial terraces in Śrī Kṣetra (Fig. 2.2).[14] The practical and symbolic functions of water merged neatly into the religious, political, and economic structures.

With its fortified city, monumental buildings, and dense system of hydraulic networks, Śrī Kṣetra was most certainly an urban settlement of a strong socio-political polity. However, like other urban settlements in Pyu-period Burma, Śrī Kṣetra has not provided us with many textual sources. Using only local chronicles, Chinese chronicles, and a small number of inscriptions—supported by remote sensing data, archaeological features, and artefacts—researchers have agreed that Śrī Kṣetra was one of the greatest urban settlements of early Southeast Asia. It had a highly advanced and aesthetically sophisticated waterwork network, as well as other important elements of urban life—such as skills in iron-working and brick-making—which were maintained by the well-organized social, economic, and political structures of the polity.[15]

The water management processes of Śrī Kṣetra and their relationship to the city's political dynamics, however, have not been explored in any great detail because evidence is lacking. What can be said, though, is that the management of Śrī Kṣetra's water was in the hands of the city council. As there is no information on the council itself or on the officials whose task it was to manage the water, it may be assumed that the city's leaders and inhabitants worked together to construct and manage the water infrastructure. In Toshikatsu Ito's view, Pyu's irrigation was organized at village level and, because it was small-scale infrastructure, there was no need for a large labour organization.[16]

It cannot be denied that the Pyu polity was the forerunner of its successor in Myanmar in terms of its economic, cultural, and political development. It is clear that Pyu's achievements were continued and developed by the next polity, for instance in the construction of water works. Bagan, its successor in the Irrawaddy basin, followed the approach it had forged.

14 J. Stargardt, G. Amable, and B. Devereux, "Irrigation is Forever: A Study of the Post-Destruction Movement of Water Across the Ancient Site of SriKsetra, Central Burma", in: *Satellite Remote Sensing. A New Tool for Archaeology*, ed. Rosa Lasaponaral and Nicola Masini (Dordrecht: Springer, 2012): 247-268.

15 See: Lwin, Kyaing, and Stargardt, "The Pyu Civilization of Myanmar and the City of Śrī Kṣetra"; and also: J. Stargardt, "The Great Silver Reliquary from Sriksetra", and J. Stargardt, "From the Iron Age to Early cities at Sri Ksetra and Beikthano, Myanmar", *Journal of Southeast Asian Studies* 47/3 (2016): 364–365.

16 T. Ito, "Pagan and the Kharuin Irrigation System in the Ayeyarwady Basin", *The Journal of Sophia Asian Studies* 18 (2000): 80.

Bagan

The origin of the Bagan polity is still debated. The Glass Palace chronicle states that it was founded in 849 CE, during the reign of Pyinbya (*c.* 846-878 CE), although other traditions claim that Bagan was established by a Pyu king in the first century CE.[17] Some researchers, including G.H. Luce, date its beginnings to the eleventh century CE.[18] Recent research by B. Hudson has suggested that the domination of Bagan culture and politics over the Pyu probably did not occur suddenly, but was more gradual.[19] Indeed, the beginning of Bagan's dominance came in the middle of eleventh century when Anawrahta, the king of Bagan, ascended the throne. As well as unifying Burma, he also expanded the cultural life of Bagan, which became an important centre of religious study in Southeast Asia, while the architecture of Bagan grew in both quality and quantity. During the reigns of his successors, Kyanzittha (1084-1112 CE) and Alaungsithu (1112-67 CE), there were more than 2,000 temples and pagodas, and thousands of stupas, surrounding the city. Its decline began in the early twelfth century CE, but the beginning of the end for Bagan came in 1287 CE, when the Mongols invaded. This was not, in fact, the primary cause of Bagan's demise; instead, it was the result of a long-term process involving other factors including economic depression and environmental stress.[20] Subsequently, Bagan broke up into the smaller kingdoms that had revolted against its rule.[21]

Bagan authority covered the whole area of Upper Burma—at least in the eleventh and twelfth centuries—while in the thirteenth century it expanded to the area of modern Myanmar. It also seems that Bagan's hegemony was seen primarily in big Pyu cities—like Halin, Beikthano, and Śrī Kṣetra —as they remained inhabited during Bagan rule.[22] The only newly-incorporated territory was the region of Kyaukse, which has more irrigation features and was an important agricultural area for Bagan. Indeed, many scholars claim that Kyaukse had the most advanced and efficient water management system in Burma during the Bagan period.[23]

Kyaukse covers an area of 1,460 km^2 and is located south of Mandalay and west of the Shan hills. It has four rivers, namely the Zawgyi, the Panlaung, the Samon,

17 Topich and Leitich, *The History of Myanmar*: 23.

18 B. Hudson, *The origins of Bagan* (Ph.D. diss., University of Sydney, 2004): 182.

19 Hudson, *The Origins of Bagan*: 153 and 182.

20 P. Gutman and B. Hudson, "The Archaeology of Burma (Myanmar) from the Neolithic to Pagan", in: *Southeast Asia from Prehistory to History*, ed. Ian Glover and Peter Bellwood (London and New York: Routledge Curzon, 2004): 169-170. See also: D.M. Stadtner, *Ancient Pagan. Buddhist Plain of Merit* (Bangkok: River Books, 2005): 26-27.

21 Topich and Leitich, *The History of Myanmar*: 24-28.

22 Hudson notes that there are Bagan style buildings at Sri Ksetra, Bagan inscriptions at Halin, and Bagan style temples at Beikthano; see: Hudson, *The Origins of Bagan*: 128, 132, 137 and 184.

23 M. Aung-Thwin, *The Origins of Modern Burma* (Honolulu: The University of Hawaii Press, 1985); M. Aung-Thwin, "Irrigation in the Heartland of Burma": 14.

and the Myitnge. Its sophisticated water management system used technology such as canals, weirs, and tanks. Besides the four perennial rivers, the Kyaukse water network was supported by roughly 14 canals, 16 weirs, and 4 tanks. Weirs were invented sometime during the Bagan period, likely in the tenth or eleventh century. Aung-Thwin describes them in this way:

> The weirs were constructed by forming rows of stakes driven across the riverbed and tied together with cross pieces of palmyra or bamboo. The spaces between the rows of stakes were filled in with stones picked up in the riverbed or neighborhood, covered with a layer of larger stones brought specially for the purpose.[24]

Moreover, Aung-Thwin calculates that the Kyaukse water network irrigated over 460 km^2 of agricultural land.[25]

The increased attention paid by the Bagan authorities to the development of irrigation infrastructure shows the important role of agriculture in the state. The innovation in, or at least improvements to, earlier water control technology demonstrates how Bagan adapted to and adjusted the Dry Zone environment in order to enhance agricultural productivity. Aung-Thwin argues that Bagan paid more attention to agriculture than trade because agriculture was more important for economic stability than was trade. Moreover, he argues that irrigated agriculture provided economic stability, consistency, and predictability. That is why the Burmese polity's centre returned to Upper Burma after a period of around sixty years based in Lower Burma.[26] However, Hudson has a rather different view: that the development of irrigation infrastructure was also related to the development of water transportation, and that the former also led to the trade, military dominance, and administrative system of the Bagan polity. His argument is based on the fact that Bagan sites are spread all along the river.[27] In my opinion, the Bagan polity used both strategies: maintaining agricultural productivity and increasing water transportation. Agriculture was found in all the productive perennial river watersheds in Upper Burma while, on the other hand, the role of water transportation was increased through the location the centre of the polity near the main river or right on the bank of the Irrawaddy.

Bagan's agricultural production was mainly concentrated in three regions: Kyaukse, Minbu, and Taungbyon. On the basis of epigraphic records, Ito divides the land into three types of agriculture, namely *lay* (rice fields), *ryā* (upland), and *kuiṅ* (seasonally flooded land). Because rich soil from upstream of the Irrawaddy was deposited in *kuiṅ* areas, *kuiṅ* was a suitable place to grow rice and other crops. Rice, however, can only grow in *kuiṅ* areas when the water is not too deep. In Kyaukse,

24 Aung-Thwin, "Irrigation in the Heartland of Burma": 17.

25 Aung-Thwin, "Irrigation in the Heartland of Burma": 19.

26 Aung-Thwin, "Irrigation in the Heartland of Burma": 62-63.

27 Hudson, *The Origins of Bagan*: 185.

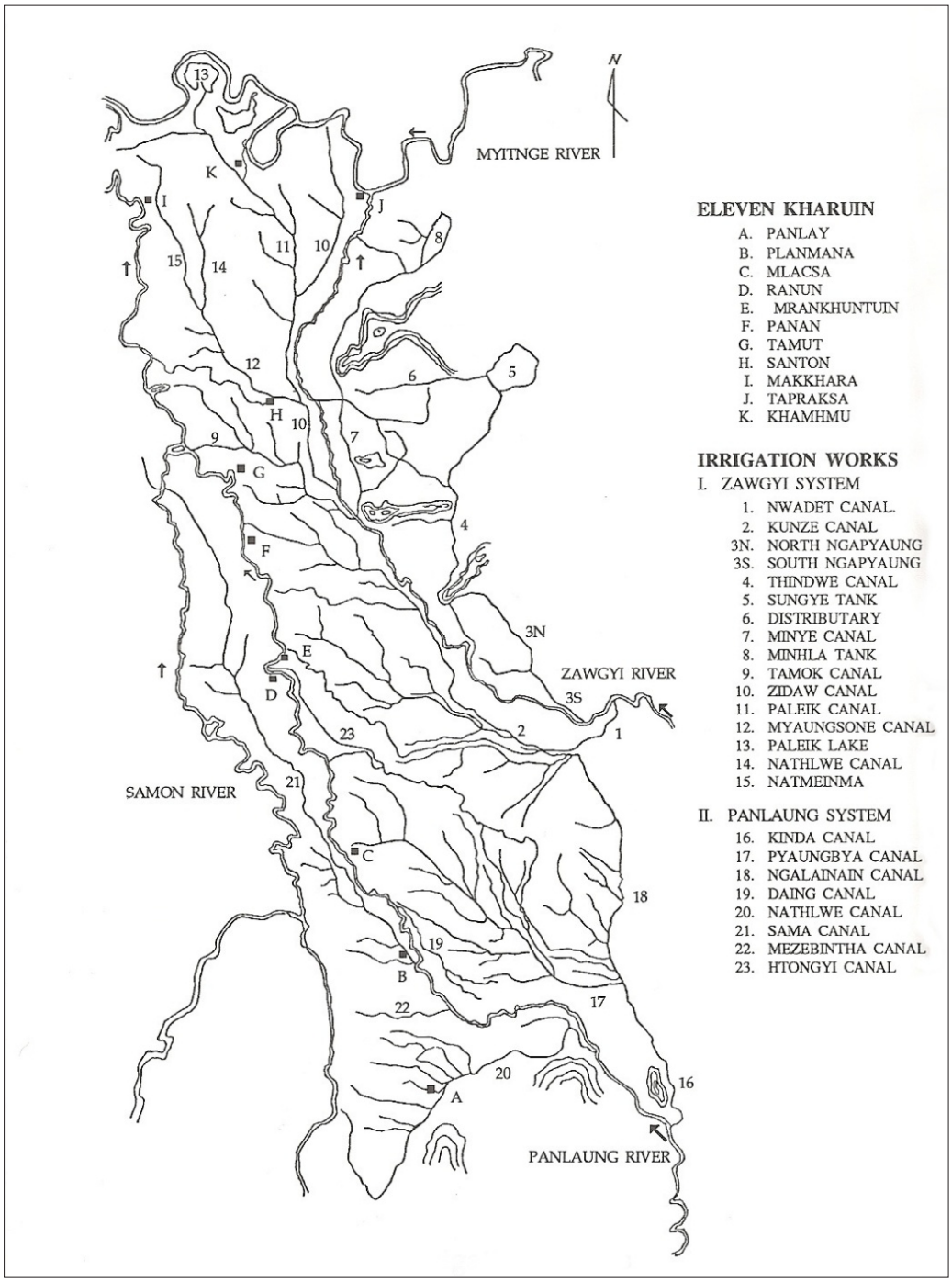

Fig. 2.3. Map of the irrigation works at Kyaukse. (Source: Aung-Thwin 1990: 70)

rice planting was dependent on rainfall or irrigation, and this was supported by a nearby river that acted as a water source for that irrigation.[28] From the middle of the Bagan period, there was an irrigation system based on the *kharuin*—a hydro-agricultural core area surrounding the capital—which produced a surplus of food and supported the economy of the kingdom.[29] The *kharuin*s were under the direct supervision and administration of the royal court because they were the main economic foundation ensuring the continuing existence of the Bagan kingdom. Therefore, it had a centralized water management system that was under the direct control of the court.

After the Bagan polity weakened and then collapsed around 1287, the Irrawaddy basin split into at least two main kingdoms, the Hanthawaddy Pegu (1287 to 1540) and the Ava kingdom (from 1364 to 1555). When the Ava kingdom declined in 1555, the Toungoo emerged and succeeded in reunifying the former territories of the Bagan.[30]

In the period *c.* 1300-1550—or, as Lieberman terms it, the era of fragmentation—agriculture was relatively stagnant in the basin, except along the southern fringes of the Dry Zone and in some cities that had older irrigation systems, as new canals and water tanks were constructed and old irrigation structures renovated in those areas.[31] This development of the water infrastructure resulted in an increased variety of crops and higher yields of those crops.

The Irrawaddy with its tributaries, as Aung-Thwin has noted, was the decisive factor in defining the cultural and geopolitical regions of Burma.[32] The river split Upper Burma and Lower Burma into two distinct geopolitical and cultural regions, excluding ethnicity. Yet in addition, other differentiating factors include the various geographic locations, the environment, and the climate. Although in one sense it divided upstream and downstream Burma, the Irrawaddy also formed a riverine link between the two regions, and thus shaped the whole geopolitical scene of the region.[33] Similarly, many other large rivers in mainland Southeast Asia also linked disparate regions.

28 Ito, "Pagan and the Kharuin Irrigation System in the Ayeyarwady Basin": 67-69.

29 N. Tarling, *The Cambridge History of Southeast Asia, Volume One. From Early Times To c.1800* (Cambridge: Cambridge University Press, 1999): 240-241.

30 Topich and Leitich, *The History of Myanmar*: 26-36.

31 V. Lieberman, *Strange Parallels. Southeast Asia in Global Context, c.800-1830. Volume 1: Integration on the Mainland* (New York: Cambridge University Press, 2003): 139-148.

32 M. Aung-Thwin, "Lower Burma and Bago in the History of Burma", in: *The Maritime Frontier of Burma. Exploring Political, Cultural and Commercial Interaction in the Indian Ocean World, 1200-1800*, ed. Jos Gommans and Jacques Leider (Amsterdam and Leiden: Koninklijke Nederlandse Akademie van Wetenschappen and KITLV Press, 2002): 30-31.

33 T. Frasch, "Coastal Peripheries during the Pagan Period", in: *The Maritime Frontier of Burma. Exploring Political, Cultural and Commercial Interaction in the Indian Ocean World, 1200-1800*, ed. Jos Gommans and Jacques Leider (Amsterdam and Leiden: Koninklijke Nederlandse Akademie van Wetenschappen and KITLV Press, 2002): 59-78.

2.2 THE CHAO PHRAYA BASIN: DVĀRĀVATĪ, LANNA, SUKHOTHAI, AND AYUTTHAYA

The Chao Phraya river basin is the largest in Thailand, draining an area of 157,924 km^2. As such, it covers approximately 30% of the nation's land. It originates in the mountains of northern Thailand and flows through the Ping, Wang, Yom, and Nan rivers. The Chao Phraya begins at the confluence of the Ping and Nan rivers at Pak Nam Pho, in Nakhon Sawan Province, and flows southwards for 370 kilometres from the central plains to the Gulf of Thailand. In Nakhon Sawan, the Chao Phraya is 23.5 metres above sea level and, at Ayutthaya, where the Pa Sak river joins the Chao Phraya, it is only 3.5 m above sea level.[34]

Its basin is relatively isolated from the surrounding areas, except to the southeast. The western and northern parts are bordered by mountains—Burma to the west and southern China to the north—while the eastern part of the basin forms a boundary with the western margin of the Khorat Plateau and the Gulf of Siam is to the south. The easiest access to the basin is from the southeast, the western regions of modern Cambodia. This environment has shaped the characteristics of the social and political development of Thailand from prehistoric times.[35] As in all mainland Southeast Asia, the movement of social, economic, and political power has generally occurred in a north-south rather than a west-east direction.

Yoshikazu Takaya divides the basin into three areas: the mountains, the floodplain, and the delta.[36] The area of the mountains has two different systems, a tributary system on the mountains themselves and a distributary system in the area between them. While the tributary system is characterised by streams that have eroded the sides of the mountains and by paddy fields, the distributary system is typified by shallow streams that can be easily used as irrigation channels by farmers. Through this distributary system, the Chiangmai and Sukhothai polities increased their power in these areas—which, according to Takaya, tended to be "traditional rice growing regions"—via a process of centralization.[37]

34 A. Gupta, "Rivers of Southeast Asia", in: *The Physical Geography of Southeast Asia, ed. Avajit Gupta* (Oxford: Oxford University Press, 2005): 74-75.

35 Charnvit Kasetsiri terms this specific geographical character a "natural geopolitical unit", see: C. Kasetsiri. *The Rise of Ayudhya. A History of Siam in the Fourteenth and Fifteenth Centuries* (Kuala Lumpur: Oxford University Press, 1976): 12.

36 Y. Takaya, "An Ecological Interpretation of Thai History", *Journal of Southeast Asian Studies* 6 (1975): 190-195. Other scholars divide Thailand into five geographical regions: The Northern regions (mountainous region stretches along the northern border of Thailand), the Central region (Chao Phraya basin and the delta), the Northeastern regions (Khorat Plateau), the Southeastern region (between Sankamphaeng range and the Gulf of Thailand), and the South (Thailand Peninsula or part of Malay Peninsula). See: C. Higham and R. Thosarat, *Early Thailand: From Prehistory to Sukhothai* (Bangkok: River Books, 2012): 15.

37 Takaya, "An Ecological Interpretation of Thai History": 193.

To the south of the mountains is the floodplain, characterised by heavy flooding during the rainy season. However, these floods benefit the region and its communities because they provide an easy means of transportation, water for paddy fields, and fish. A number of polities emerged from this rich land from the fourteenth to the eighteenth centuries, one of which was Ayutthaya. Takaya has suggested that there were different water control systems in the pre-Ayutthaya period from the Ayutthaya polity. Whereas the pre-Ayutthaya kings built irrigation canals, the Ayutthaya kings themselves dug short canals to facilitate the movement of water into the gulf. In consequence, the earlier polity put significant efforts into managing the irrigation system while the latter was more ignorant of water control matters and, as such, the farmers were more independent from the authorities.[38]

The delta area is flat land that is covered by floodwater during the rainy season but which dries up in the dry season. Takaya explains that these conditions were manipulated by the digging of canals in order to construct waterways and help grow places of habitation along the banks of canals, and to provide drinking water. The polities of the Bangkok period did exactly the same, and as such Bangkok became the centre of rice production and its trading ports grew rich during this period.[39]

The following exploration will be focused on the Chao Phraya basin area. I will explore the development of the polities within it from the tenth to the sixteenth century, in the period of Dvārāvatī, Lanna, Sukhothai, and Ayutthaya. However, since the pre-tenth century development of Thailand cannot be separated from the rest of Thai history, I will begin my narrative in the sixth century, which is the background and marks the starting point of Thailand's history.

The emergence of culture in the Chao Phraya basin began around the sixth century, when Dvārāvatī culture began to spread in central Thailand. Dvārāvatī sites can be found all across the central plain of Thailand—especially in the Chao Phraya basin—and most sites have an encircling moat located in or near a stream or river.[40] The Dvārāvatī polity was based on three main aspects: its cultural dominance, *muang*, and the role of streams and rivers.

Dvārāvatī culture spread across the whole of the Chao Phraya basin region, mainly in the form of Buddhist art and culture. Archeological findings have highlighted that Lopburi, Nakhon Pathom, Uthong, and Suphanburi were the main cities and that they formed the centre of Buddhist culture in the Central Plain.[41]

38 Takaya, "An Ecological Interpretation of Thai History": 194.

39 Takaya, "An Ecological Interpretation of Thai History": 195.

40 It seems that this type of site emerged long before the Dvaravati period, not only in the Central Plain but also in the Khorat Plateau. O'Reilly and Scott's archaeological research has described sites in the Mun and Chi valleys of the Khorat Plateau that flourished from 500 B.C. to A.D. 600. See: D.J.W. O'Reilly and G. Scott, "Moated Sites of the Iron Age in the Mun River Valley, Thailand: New discoveries using Google Earth", *Archaeological Research in Asia* 3 (2015): 9–18.

41 Higham and R. Thosarat, *Early Thailand*: 223-334.

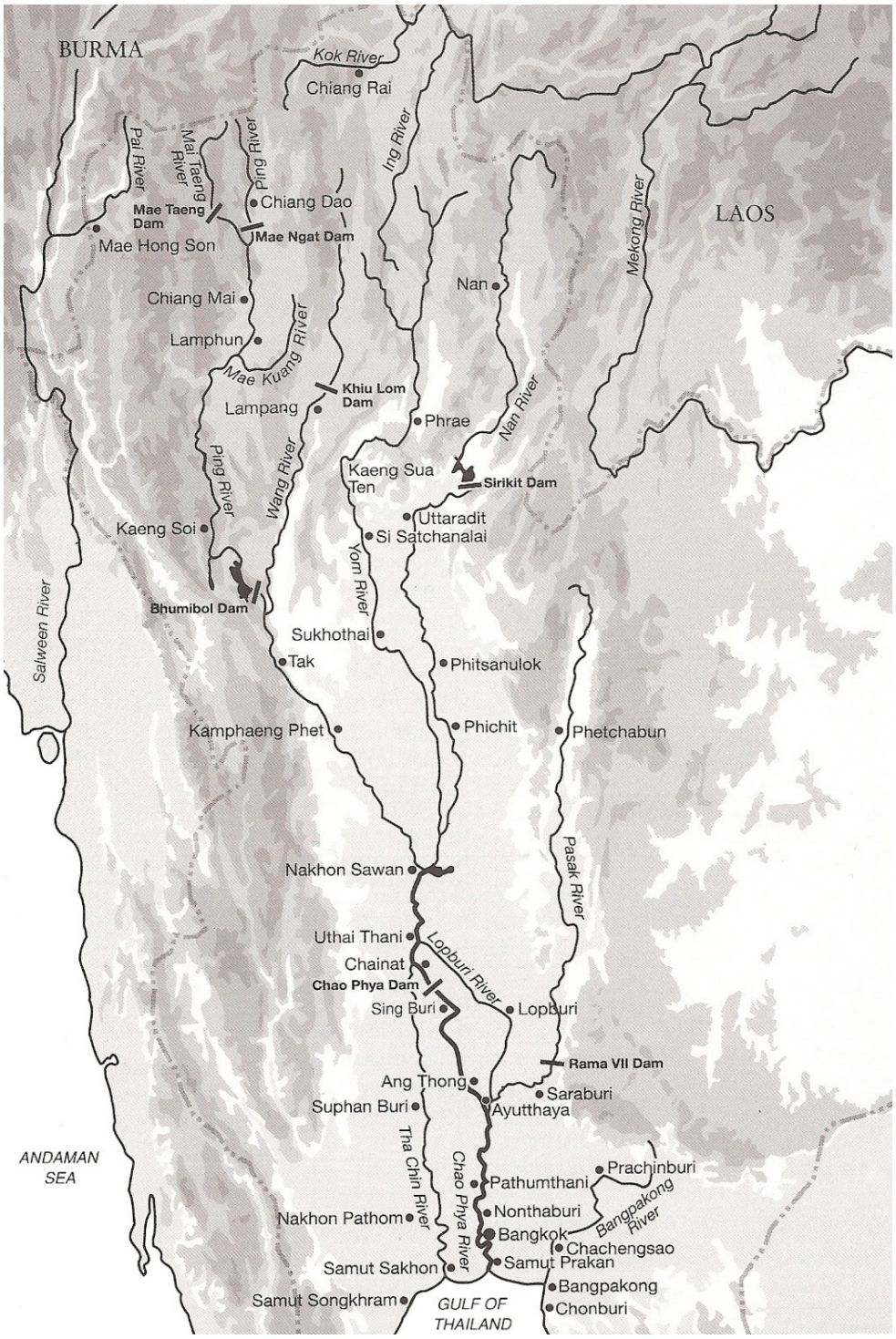

Fig. 2.4. The Chao Phraya basin. (Source: Van Beek 1995: xii)

Although the influence of Dvārāvatī culture stretched over the whole area, no one kingdom came to dominate. The unity of Dvārāvatī depended more on an alliance of cities known as *muang* in Thai, which was formed through marriage ties and cultural relations.[42] Higham views this as a Dvāravatī form of *maṇḍala*s, which, he believes, existed from the seventh century.[43]

Another important characteristic was the role played by streams and rivers in the development of the cultural, economic, and political Dvārāvatī *muang*. Most of the streams and rivers—principally the Chao Phraya and its tributaries—flow from north to south, thereby making movement between the northern and southern parts easy. Some of Chao Phraya's tributaries also flow slightly to the east and west, thereby also allowing access to the western and eastern regions of the Central Plain; in some cases, this could even reach as far as some of the outer regions of the Central Plain. The consequence of this was that, when Dvārāvatī culture reached its peak, it could be easily disseminated in all directions. Politically, this accessibility also played a significant role in controlling the *muangs* that were situated along the Chao Phraya river and its tributaries. The distribution mechanism for the culture and power of the Dvārāvatī *muang* was then increasingly utilized and exploited by successor polities after Dvārāvatī collapsed. As a result of the Chao Phraya river and its tributaries, its basin is a tremendously fertile agricultural area that produces huge quantities of rice, not only for the population of the basin itself but also for export.[44] The combination of control of rice production and the ability to control communication routes between the hinterland and the coast meant that Dvārāvatī was the first polity in the Chao Phraya basin to have a powerful culture, economy, and politics.

The collapse of Dvārāvatī is still debated, but most scholars agree that its power diminished in the eleventh century. The region came under the control of the Khmer Empire, which, from the ninth century, had slowly expanded its territory and, by the eleventh and twelfth centuries, occupied the Central Plain as well as north-eastern, northern, and southern Thailand.[45] At the Khmer Empire's peak during the reign of Jayavarman VII, it controlled almost all of present-day Thailand.[46] Archaeological evidence shows that Khmer culture spread through the Chao Phraya

42 Kasetsiri, *The Rise of Ayudhya*: 16.

43 C. Higham, *The Archaeology of Mainland Southeast Asia* (Cambridge: Cambridge University Press, 1989): 269-279. Phasook Indrawooth argues that the term used by Dvaravati to refer to "state" was Cakravartin; see: P. Indrawooth, "The Archaeology of the Early Buddhist Kingdoms of Thailand", in: *Southeast Asia. From Prehistory to History, ed. Ian Glover and Peter Bellwood* (London and New York: Routledge-Curzon, 2004): 138-140.

44 Kasetsiri, *The Rise of Ayudhya*: 18-19.

45 Indrawooth, "The Archaeology of the Early Buddhist Kingdoms of Thailand": 140-142.

46 D.F. Rooney, *Ancient Sukhothai. Thailand's Cultural Heritage* (Bangkok: River Books, 2008): 18.

and its surrounding areas, especially from the final decade of the twelfth century.[47] However, the historical sources are of limited help in explaining the socio-political processes of the period.

After Jayavarman VII, the Khmer king, died around 1219 AD, the power of the Khmer over the Thai polities weakened, and new polities arose in Thailand: Lanna in the north and Sukhothai in the Central Plain. The most important aspect is that Thai people, who entered the region from the north, became dominant and pushed back the Mon (who are still an ethnic group in present-day Burma/Myanmar) and ended Khmer power in the region, marking the starting point of the rise of Thai power in the area that has continued until today. The origins of the Thai and how they came to occupy these regions are still debated, but most scholars agree that they came from north of the Chao Phraya basin.[48] Kasetsiri argues that the coming of the Thai was part of a much longer historical process, one facilitated by rivers—namely the northern tributaries of the Chao Phraya and Mekong rivers—as they made use of these waterways to help them move southward.[49] As new powers in the Chao Phraya basin, the Lanna and Sukhothai kingdoms forged a new geopolitical path there.

The kingdom of Lanna emerged in the northern part of Thailand and was founded by Mangrai. It was established formally in 1292 in Chiang Mai, although, according to the Chronicles of Chiang Mai, Mangrai had moved his kingdom from the Yonok region, near the Mekong River, and had changed his capital several times before: to Chiangrai in 1262, Fang in 1272, Haripunchai in 1283, Wiang Kum Kam in 1286, and finally Chiang Mai in 1292. During his sixty-year reign, Mangrai succeeded in founding a powerful kingdom that unified many *muangs* in the northern part of the Chao Phraya basin. This was possible due to the compact administration that Mangrai had created. As his kingdom's bureaucracy operated well, the court could easily control its various regions, and the ruler of Lanna could manage their provision and management of labour for the rice fields as well as their military aspects.[50] The court's involvement in water control seems to have been particularly intense in the Lanna period. The Yonok Historical Records tell that the king of Chiangsaen ordered a large irrigation canal be dug in order to draw water into the rice fields for the benefit of the farmers.[51] The Mengraisat laws, issued by King

47 H.W. Woodward, *Studies in the Art of Central Siam, 950-1350 A.D.* (Dissertation, Graduate School of Yale University, 1975); P. Kanjanajuntorn, et al. "Tracing Post-Dvaravati Culture from Space: Applying Remote Sensing Technique in West-Central Thailand", *Asian Perspectives* 53/1 (2014): 29-52.

48 Higham and R. Thosarat, *Early Thailand*: 253-254.

49 Kasetsiri, *The Rise of Ayudhya*: 36-39.

50 D.K. Wyatt, Thailand. *A Short History* (New Haven and London: Yale University Press, 2003): 33-38, 63-71.

51 Although the date of this record, from 757 AD, is still questioned, it is certain that it came from an ancient period, see: S. Van Beek, *The Chao Phya: River in Transition* (Kuala Lumpur: Oxford University Press, 1995): 16.

Mengrai in 1296, regulated water control and management and were overseen by an official called Khun Nai Fai. His duty was to organize the construction of waterworks, find construction workers, control the water, collect maintenance fees, and repair the waterworks. The waterwork most commonly used in Lanna areas was the *muang fai* system. This sought to divide a stream into two watercourses through the construction of a weir in the stream. This is still used today, albeit with some modifications.[52]

The rivers and streams were also important for the life of the Lanna kingdom because they were used as transportation and communication channels by the people who lived along their banks. The Ping river enabled the movement of people and goods around Lanna lands and assisted people both there and in the other areas of the Chao Phraya basin—in central and southern parts—to communicate with each other. In many cases, the river was also used as a natural defence against outside invasion as it was used to construct moats.[53]

On the other hand, the Ping river also caused natural disasters to strike the Lanna kingdom, of which flooding was the most common. Sometimes the flood was larger than expected, something associated with environmental change such as a large-scale La Nina phenomenon. Flooding would threaten cities, and so efforts were made to prevent or control this by constructing embankments and walls. However, these measures were not always capable of preventing floodwater from inundating cities. The Lanna chronicles record that a palace compound was buried by a flood, an event which made King Mengrai realize the danger from flooding and caused him to move his capital from Wiang Kum Kam to Chiang Mai.[54] Research conducted by Serene Ng, Spencer H. Wood, and Alan D. Ziegler confirms that Wiang Kum Kam was flooded many times. Their research also found that a large flood struck the city of Wiang Kum Kam.[55]

The other kingdom that emerged following the decline of Dvārāvatī was Sukhothai, in the Yom river valley around 300 km south-east of Chiang Mai. The Sukhothai kingdom attempted to take control of the whole of the Chao Phraya basin, or even the entire region of present-day Thailand. It seems that the Sukhothai polity was more centralized than was Dvārāvatī. Theravada Buddhism was declared the state religion in the thirteenth century—although it had actually been adopted by both Mons and Dvārāvatī many centuries earlier—while many other belief systems were also in use, such as local beliefs and Hinduism. Ceramics became an important new trade good, and extraordinary examples of all kinds of arts and handicrafts were produced during the Sukhothai period. Sri Satchanalai, located on the banks of the

52 Van Beek. *The Chao Phya*: 14-17.

53 S. Ng, S.H. Wood and A.D. Ziegler, "Ancient Floods, Modern Hazards: The Ping River, Paleofloods and the 'lost city' of Wiang Kum Kam", *Nat Hazards* 75 (2015): 2248.

54 Van Beek, *The Chao Phya*: 21.

55 Ng, Wood and Ziegler, "Ancient Floods, Modern Hazards": 2258-2260.

Yom river, was one centre of ceramic production, and there were many hundreds of kilns along the right bank of the Yom river. Its famous ceramics were exported, and as such it became a major contributor to the Sukhothai economy.

Another significant cultural development that took place in the Chao Phraya basin in the period of Sukhothai rule was the invention of the Thai script by King Ramkhamhaeng. This script was simply a reworking of those that had been used before, but it has been used by the Thai people ever since.[56] The most famous inscription that uses this script is "Inscription Number One" or the "Ramkhamhaeng Inscription." Thus, since the period of Sukhothai rule, and especially the time of King Ramkhamhaeng, the Thai polity has had a unique political and cultural identity.

The inscription's content demonstrates the prosperity of Sukhothai, although perhaps the substance of the inscription has been given too much emphasis. The land is described in the inscription as such: "There are fish in the water and rice in the fields."[57] From this quotation, we can infer that the Sukhothai was a fertile region that produced these two foodstuffs.

Nikom Musigakama's research on the Sukhothai irrigation system supports the belief that this polity and the surrounding regions were productive areas, enhanced by natural and man-made irrigation.[58] Moreover, Musigakama also details the irrigation system used by the Sukhothai dynasty. The types of hydraulic infrastructure built by the Sukhothai kings included dams, dykes, reservoirs/*baray*s, ponds, city moats, canals, and wells. From the many examples of these various types of hydraulic systems, each of which was a huge structure, he explains that the water infrastructure supported Sukhothai's capital and the surrounding areas by providing irrigation for agriculture, preventing floods, providing drinking water, and offering protection against enemy attacks. He also notes the possibility that there were Khmer influences in the construction of the water control systems, especially in the building of the reservoirs (*baray*s) and wells, which were very common in Khmer regions. The construction of waterworks is also seen in Sukhothai inscriptions. For example, the Ramkamhaeng stone inscriptions record a dam construction that was completed in 1327 by King Ramkamhaeng; Inscription III—dated to 1357—tells how King Maha Thammaracha employed a *muang fai* irrigation system to supply rice fields with water; and Inscription XIII—dating from 1510—describes the restoration of a city and its infrastructure, and that, as part of this, a canal was built.[59]

The Sukhothai kingdom weakened in the first half of the fourteenth century, and

56 B. Gosling, *Sukhothai. Its History, Culture, and Art* (Singapore: Oxford University Press, 1991): 29.

57 This sentence is written on the first side of the stone pillar; see: Rooney, *Ancient Sukhothai*: 28.

58 Musigakama, "Irrigation Development under the Sukhothai Dynasti", *The Journal of Sophia Asian Studies* 18 (2000): 53-63.

59 Van Beek, *The Chao Phya*: 25-27.

the centre of power around Chao Phraya shifted to Ayutthaya, which was established by Uthong in 1351.[60] However, the Sukhothai polity continued to exist alongside that of Ayutthaya—including at times being subjugated to Ayutthaya power—until 1438, when its last king, Maha Thammaracha IV, died, and Sukhothai completely collapsed. After that, Ayutthaya was the most powerful polity in the Chao Phraya basin. Its rise wrought many changes to social and geopolitical life across the entire Chao Phraya basin. Ayutthaya emerged as a powerful centre with a more influential military and a more rigidly structured political system than had been the case with previous political centres.[61] Through its military power, Ayutthaya expanded its dominion to both the northern-most part of the basin and southward, to the upper peninsula. In so doing, the Ayutthaya did not seek to bring other states into a rigidly-controlled political system but instead ruled the territory in a much looser way. Perhaps it is true, as Chris Baker argues, that the goal of Ayutthaya's military expansion was merely to maintain commercial links and glorify its rule.[62]

As well as its political strength, another central aspect of the Ayutthaya state was its water management technology. Inside the capital are numerous building-works related to water management, including a 12km city wall with 20 water gates as well as 56km of canals or waterways with 28 bridges across.[63] The canals were built for three different purposes: to make the waterways easier for ships to navigate; to join the eastern and western parts of the city; and to protect the city from attacks.[64] Because Ayutthaya historical sources related to state involvement in water control are very rare, it is very difficult to reconstruct the Ayutthaya water management. However, on the basis of sources from after the eighteenth century, H.T. Brummelhuis has attempted to trace Ayutthaya involvement in water management. He argues that the Ayutthaya ruler did not involve himself in water control, and especially not in that which involved the management of the water required for rice field irrigation. Indeed, from the eighteenth to the nineteenth centuries, while there is evidence that the rulers of the kingdoms involved

60 Some scholars argue that the Ayutthaya polity in fact existed long before 1351; see: *Kasetsiri, The Rise of Ayudhya*: 51-72. Chris Baker even states that the polity existed two centuries before 1351; see: C. Baker, "Ayutthaya Rising: From Land or Sea?", *Journal of Southeast Asian Studies* 34/1 (2003): 41 – 62.

61 Kasetsiri, *The Rise of Ayudhya*: 114. Kasetsiri also calls the beginning of Ayutthaya polity in Chao Phraya basin "the beginning of a new chapter in Siamese history"; see: C. Kasetsiri, "Ayudhya: Capital-Port of Siam and Its 'Chinese Connection' in the Fourteenth and Fifteenth Centuries", Presented at a seminar on "*Harbour Cities Along the Silk Roods*," 10-11 January 1991, Surabaya, East Java, Indonesia, Centre for Social and Cultural Studies, Indonesia Institute of Sciences.

62 Baker, "Ayutthaya Rising": 56.

63 V. Rojpojchanarat, "Ayutthayya: Influences of Water on Settlements and Ways of Life", *The Journal of Sophia Asian Studies* 18 (2000): 303.

64 H.T. Brummelhuis, *King of the Waters. Homan van der Heide and the Origin of Modern Irrigation in Siam* (Leiden: KITLV Press, 2005): 17-18.

themselves in water control matters in order to protect the rice crop, this was in fact more to maintain both rice tax revenues and the regime's legitimacy.[65] In addition, the construction of canals by the ruler was not directly related to supplying water for agriculture. As such, it is clear then that the task of maintaining water for agriculture was in the hands of individual households or groups of farmers.[66] In other words, local farmers were independent as regards water control in order to irrigate their rice fields.

Compared with the centres of the earlier Chao Phraya basin polities, Ayutthaya was located both further south and nearer to the sea. The city of Ayutthaya was located near the Chao Phraya river, on the southern part of its floodplain, giving it easy access to the sea despite being in the hinterland. Consequently, Ayutthaya was ideally located as a commercial port and it succeeded in exploiting this. From the middle of the fifteenth century, it developed as a trading port, especially after King Trailok's reforms of the Ayutthaya administration and bureaucracy (from 1448 to 1488 CE) had placed control of trade in the hands of the court. Ayutthaya was the first hinterland political centre to also act as a commercial port within the Chao Phraya basin.[67] The main achievement of the Ayutthaya polity, however, was to combine the best aspects of a hinterland polity with the commerciality of a trading port; in the words of Chris Baker, Ayutthaya was "the powerful coastal-hinterland hybrid of the high Ayutthaya period."[68]

In sum, after examining the development of the Dvārāvatī, Lanna, Sukhothai, and Ayutthaya kingdoms we recognize that there were three distinctive geographical zones that generated three different water management systems. They are the northern zone, the central zone, and the southern zone, and each was represented by the Lanna, Sukhothai, and Ayutthaya kingdom, respectively. Dvārāvatī had a very different role. In the development of the Chao Phraya basin, Dvārāvatī was never a centralized political power; instead, it represented both a culture and a conglomeration of city-states. However, it also provided a foundation for further development in the Chao Phraya river basin, which each region then cultivated in accordance with its own specific geographical and political characteristics.

The three zones trace a gradual shift in water management from north to south, particularly in the involvement of the central power or the court. The northern zone saw the firm and direct involvement of the ruler in almost everything related to water, from the management of the rice-field water supply to the prevention of flooding; this occurred less in the central zone and the least of all in the southern. It seems that the more dependent on rice as a source of revenue the kingdom was,

65 Brummelhuis, *King of the Waters*: 23-31.

66 Yoshikaru Takaya described the relation between the power center and farmers as "the two communities lived independently of one another", see: Y. Takaya, "An Ecological Interpretation of Thai History", *Journal of Southeast Asian Studies* 6/2 (1975): 194.

67 Kasetsiri, "Ayudhya": 78.

68 Baker, "Ayutthaya Rising": 62.

the greater the involvement of the central power in water management. Northern kingdoms, like Lanna, depended greatly on rice production, while the middle and southern parts had various other means of generating income, particularly because the southern part is nearer to the sea and so its maritime trade could be more intensive.

2.3. THE MEKONG BASIN: ANGKOR

Angkor is situated near the Tonle Sap river, not far from the Tonle Sap lake, in Cambodia. Although it is quite far from the Mekong, about 230 km west of it, it is still part of the Mekong river basin. The Mekong itself is the largest river in Southeast Asia, being 4,909 km in length and having an 813,000 km^2 catchment area. The river originates in the Tibetan Plateau in western China and discharges into the South China Sea. The Tonle Sap connects the Mekong with the Tonle Sap lake, where Angkor is located on the former's alluvial plains.[69]

Śrī Yaśodharapura ("Glory-Bearing City") or Angkor was made the capital of the Khmer Empire in the ninth century CE and lasted until the fourteenth century. The city was one of the largest preindustrial urban complexes in mainland Southeast Asia. Many scholars view it as a "hydraulic city", an urban complex marked by sophisticated water management infrastructure.[70] The city had many impressive features, including highly-developed water management systems, demonstrated in its network of reservoirs, channels, moats, and embankments, across a region of around 1,000 km^2.[71] Recent research has uncovered an even more extensive hydraulic network.[72] One of Damian Evans' research conclusions—part of an attempt to create an archaeological map of Angkor—has revealed that "Angkor as an extensive settlement landscape [was] inextricably linked to the water resources that it increasingly exploited over the first half of its existence."[73]

The development of Angkor was started by Jayavarman II (802-835 CE), when

69 D. Penny, "The Mekong River system and the End of the Angkor Civilization. A Water Historical Perspective", in: *Rivers and Society: From Early Civilisations to Modern Times. A History of Water, Series II Volume II*, ed. T. Tvedt and R. Coopey (London: I.B. Taurus, 2010): 128-129.

70 One of the scholars is Groslier, see: B. Groslier, "La Cité Hydraulique Angkorienne: Exploitation ou Surexploitation du Sol? BEFEO 66 (1979): 161-201.

71 M.B. Day et al., "Paleoenvironmental History of the West Baray, Angkor (Cambodia)", *PNAS* 109/4 (2012): 1046–1051.

72 R. Fletcher et al., "The Greater Angkor Project 2005–2009: issues and program" in: *Uncovering Southeast Asia's Past: Selected Papers from the 10th International Conference of the European Association of Southeast Asian Archaeologists*, ed. E.A. Bacus, I.C. Glover, and V.C. Pigott (Singapore: NUS Press, 2006): 347–354.

73 D. Evans et al., "A Comprehensive Archaeological Map of the World's Largest Preindustrial Settlement Complex at Angkor, Cambodia", *PNAS* 104/36 (2007): 14277–14282.

he founded a capital at Roluos or Hariharālaya. However, his successor, Indravarman I (877-889) built many temples and irrigation works in the city. His most impressive construction was the Indratataka ("Sea of Indra") reservoir, which covered 650 acres and could hold as much as 7.5 million cubic metres of water. He also constructed two temples: Preah Ko, a six-tower temple complex dedicated to his ancestors and to his wife; and Bakong, a pyramid-shaped temple. The city of Angkor itself was begun by Yaśovarman (889-900), Indravarman I's son, in the ninth century after he moved the capital of the Khmer kingdom from Roluos to Angkor, a new settlement near the Tonle Sap lake. The shift of the capital happened for two reasons. The first was religious in nature: that the new place had better characteristics and was, according to Hindu concepts, the ideal place for a capital, especially due to the existence of both water and a hill.[74] The second reason was more practical: the Indratataka, the *baray* in the old capital, was beginning to silt up.[75] Moreover, the Yaśodharapura had much higher subsurface water than did Hariharālaya, meaning that the former was agriculturally more productive than the latter.[76] After the capital was moved to Angkor, more and larger water infrastructure features were built there than had been the case before.

The water management at Angkor is very impressive and reveals how the Khmer rulers and community managed the water. Matti Kummu, one of the most important scholars on the subject, describes water management at Angkor as being primarily based on four water sources: natural rivers, groundwater, precipitation, and the Tonle Sap lake.[77] There are three rivers in the area: the Puok, Siem Reap, and Roluos, all of which originate in the Kulen hill before flowing down to the Tonle Sap lake. The groundwater is easily accessible, as its depth varies from 11 to 40 metres. Tonle Sap lake is the largest freshwater lake in Southeast Asia, although its size, length, and volume of water vary considerably over the year. Furthermore, Kummu explains that water management at Angkor can be viewed from two different perspectives: water management levels and water management zones. He defines the two classifications as follows:

> The water management levels are based on the water management structures while the zones are derived from the ways the water was managed through the landscape at a larger scale. The levels highlight the diversion of water management at different scales, and also within each of the zones.[78]

74 W.J. van Liere, "Traditional Water Management in the Lower Mekong Basin", *World Archaeology* 11 (1980): 265–280.

75 J. DiBiasio, *The Story of Angkor* (Chiang Mai: Silkworm Books, 2013): 21-22.

76 B. Acher, "Mysteries of Angkor Revealed: Hydrology and the Siting of Angkor", in: *Old Myths and New Approaches: Interpreting Ancient Religious Sites in Southeast Asia*, ed. Alexandra Haendel (Clayton: Monash University Publishing, 2012): 38.

77 M. Kummu, "Water Management in Angkor: Human Impacts on Hydrology and Sediment Transportation", *Journal of Environmental Management* 90 (2009): 1413–1414.

78 Kummu, "Water Management in Angkor": 1416.

There were three levels of water management: household, village, and city. At the household level, water was provided by a well that was dug in the water table. At the village level, the *trapeang*—a pond—supplied water for the village, as well as being related to a temple, around which was also a moat. At the highest level, the city, there were *baray*s (enormous reservoirs) and channels. The water in the *baray*s originated in the rivers and was siphoned off through channels. At the city of Angkor there were four major *baray*s: Indratataka (Baray of Lolei), Yaśodharatataka (East Baray), West Baray, and Jayatataka (North Baray).[79]

As regards the water management zones, the other perspective used by Kummu in his article, there were also three: the collector zone, the aggregator and holding zone, and the drainage and dispersal zone. These water management zones were defined according to the elevation of their major features and how water was used.[80] As he concludes:[81]

> The location of Angkor was, from a water management point of view, very convenient for many reasons. Firstly, groundwater was close to the surface throughout the year. Secondly, Tonle Sap Lake offered an excellent transport link to the riparian provinces and the Mekong River and, at the same time, secured part of the food supply and maintained a fertile floodplain to cultivate rice. Thirdly, natural rivers originating in the Kulen Hills meandered across the plain. A drawback was the long dry season for which water needed to be stored. Therefore the Angkorian engineers built an extensive water management network of channels and baray around and within the main temple area covering an area of approximately 1200 km^2.

The development of the Angkor water management system has been reconstructed by Fletcher *et al*.[82] They analysed the development of this system on the basis of a new map of the Angkor water management network prepared by the EFEO (École Française d'Extrême-Orient) and the Greater Angkor Project, an international research programme involving Australian, Cambodian, and French scholars. The result is a history of the water management networks in the area, presenting the successive major water constructions within it. Early construction began in the southeast, later spreading to the north and west, before being concluded with major constructions along the central axis of Angkor in the early twelfth century. These final constructions included two channels—the Angkor Wat canal and Siem Reap

79 Kummu, "Water Management in Angkor": 1416. See also: R. Fletcher, D. Evans, and M. Kummu, *The Dynamics of Water Management of Angkor, Cambodia, 9th to 16th Century*. Paper presented in 3rd Conference of IWHA in Alexandria, Egypt (2003): 8-9.

80 Kummu, "Water Management in Angkor": 1416-1418. See also: Fletcher, Evans, and Kummu, *The Dynamics of Water Management of Angkor, Cambodia, 9th to 16th Century*: 9-10.

81 Kummu, "Water Management in Angkor": 1419.

82 R. Fletcher et al., "The Development of the Water Management System of Angkor: A Provisional Model", *IPPA Bulletin* 28 (2008): 57-66.

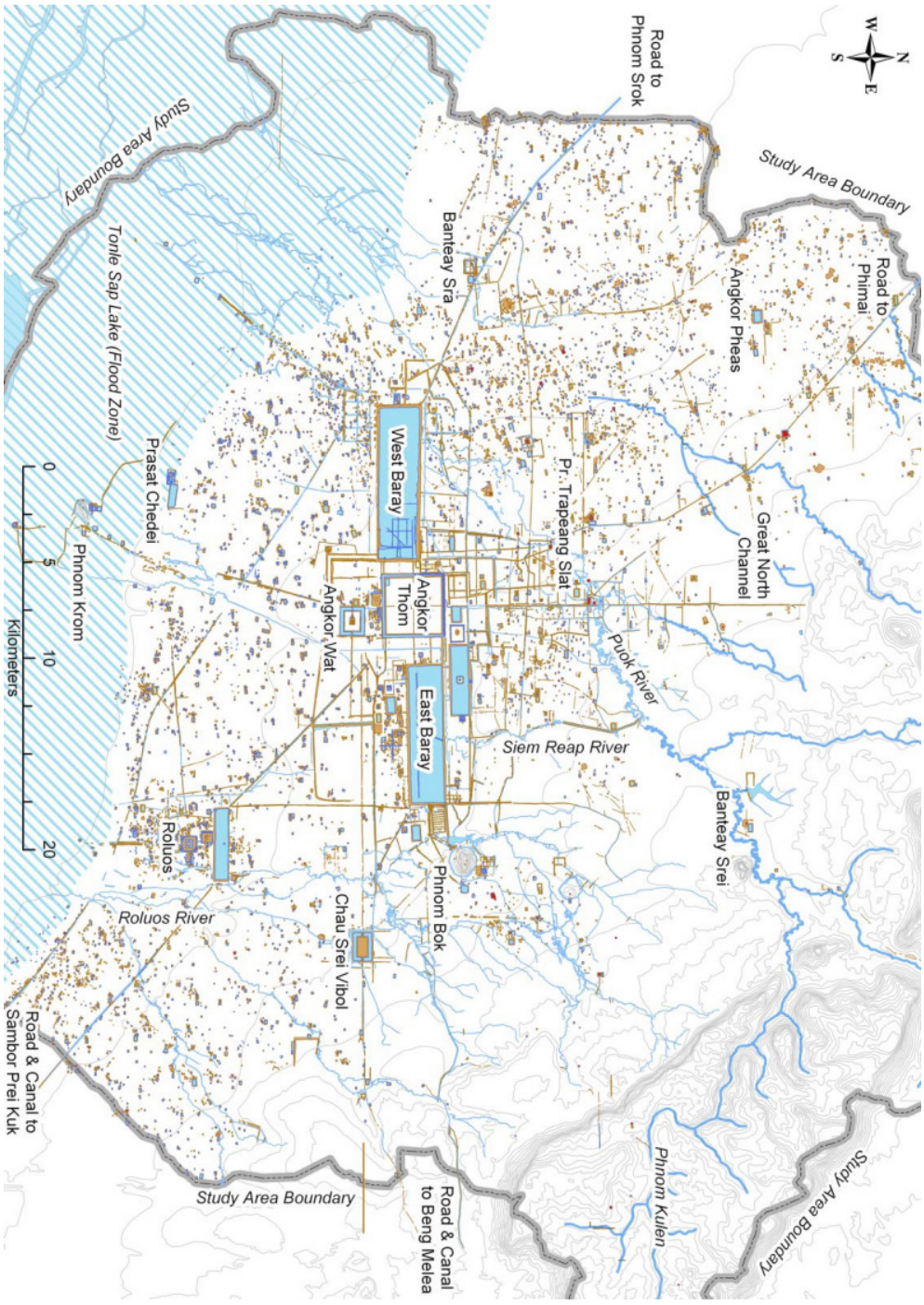

Fig. 2.5. Archaeological Map of Angkor. (Source: Evans *et al.*, 2007)

canal—which discharged water into the lake. The development pattern of water management in Angkor affirms that the main function of the water network was related to flood control and irrigation.[83]

The irrigation role of the water networks was related to rice agriculture in Angkor, which was the state's main source of food and had been one of the founding pillars of Angkor. Although no source details the role of rice production—apart from the *Zhou Daguan*,[84] which only describes the rice production system in the Angkor region, i.e. flood-retreat farming—many scholars believe that Angkor was a rice-based agrarian state.[85] Recent research, using a new approach, has resulted in a very interesting theory regarding the centralization and decentralization of rice production. This research, conducted by Scott Hawken, used a topographic classification of the landscape based on extensive mapping from remote sensing imagery and fieldwork carried out from 2007–10. It found that there were two rice field systems: the cardinal system and the coaxial system. Each was characterised by a different system of rice production; the cardinal system saw the Angkorian elites involved in the establishment of its infrastructure, while the coaxial system was related to the local communities and the state was not directly involved.[86]

The Angkor complex's water management system was developed in response to the region's monsoon climate. The Tonle Sap is greatly affected by annual floodwaters that are the result of the monsoon rain. The Mekong adds 45 km^3 of floodwater to the Tonle Sap, causing an area of 15,000 km^2 around the lake to be covered by floodwater, bringing productive silt to the floodplain and fish to the lake.[87] On the other hand, the monsoon climate caused great destruction to Angkor in the fourteenth and fifteenth centuries, when there was a period of extreme rainfall variation caused by global climate change. Intense droughts in Southeast Asia occurred during the period from the Medieval Climate Anomaly (MCA) to the Little Ice Age (LIA), which reduced average rainfall by 30%.[88] The changing hydrological

83 The previous researchers tended to interpret that the baray had a cosmological function than as for agricultural water work, see: Van Liere. "Traditional Water Management in the Lower Mekong Basin"; E. Moore, "Water Management in Early Cambodia", *The Geographical Journal* 155 (1989): 204-214; P. Stott, "Angkor: Shifting the Hydraulic Paradigm", in: *The Gift of Water, ed. Jonathan Rigg* (London: School of Oriental and African Studies, University of London, 1992): 47-58.

84 Zhou Daguan was a Chinese envoy who visited Angkor in 1296-97 and wrote *A Record of Cambodia: The Land and Its People* after his return to China.

85 No Khmer inscriptions describe rice production in detail, instead detailing rice offerings made to God. See: J.M. Scott, "The Ecology of Angkor: Evidence from the Khmer Inscriptions", in: *Nature and Man in Southeast Asia*, ed. P.A. Stott (London: School of Oriental and African Studies, 1978): 110-111.

86 S. Hawken, "Designs of Kings and Farmers: Landscape Systems of the Greater Angkor Urban Complex", *Asian Perspectives* 52/2 (2013): 347-367.

87 Kummu, "Water Management in Angkor": 1415.

88 Penny, "The Mekong River System and the End of the Angkor Civilization": 135. See also:

conditions could not have been predicted by the existing hydraulic network; as such, the water network was not able to adapt to such changes.[89] It was a combination of increasing aridity and incidental flooding that may have been a cause of the decline of the Khmer kingdom.

2.4 CONCLUSION

To sum up, the development of the three river basins—the Irrawady, the Chao Phraya, and the Mekong—from *c.* the tenth to the sixteenth centuries displays both similarities and dissimilarities. First, topographically speaking, each basin forms a relatively low area of land stretching from north to south and bound by mountains and highlands. These mountains and highlands create three geographically separate regions: the Tanasserim Hills separate the Irrawaddy from the Chao Phraya valley while the Khorat Plateau separates the Chao Phraya from the Mekong valley. The only connecting pass, the Three Pagodas Pass, is a narrow lowland area south of the Khorat Plateau that creates a pass between the Chao Phraya basin and the Mekong basin. The north-south shape of each basin makes the movement of people and goods in that direction much easier than is possible across the mountains, between east and west.

Second, most of the main polities were located near perennial rivers or streams that were themselves both not far from the main river and within its basin. Angkor was situated close to the Siem Riep, a tributary of the Mekong; and Lanna and Sukhothai were near tributaries of the Chao Phraya.

Third, and related to these two conclusions, there was a trend towards interaction between downstream and upstream communities along the main river, for which they used the river as a means of transportation. To a large extent, they employed it as a means of distribution for political power and to trade goods. However, there is less evidence of this in the case of Angkor.

Fourth, the climates of the three basins are fairly similar. The centres of political power grew up in relatively dry areas with comparatively low rainfall, and the political centres of Burma were even situated in the driest area of Southeast Asia. Lanna, Sukhothai, Ayutthaya, and Angkor were located in good positions, being in

Day et al., "Paleoenvironmental History of the West Baray, Angkor (Cambodia)": 1050.

89 See: R. Fletcher and D. Evans. "The Dynamics of Angkor and its Landscape", in: *Old Myths and New Approaches: Interpreting Ancient Religious Sites in Southeast Asia*, ed. Alexandra Haendel (Clayton: Monash University Publishing, 2012): 60-61.
The Medieval Climate Anomaly, also called The Medieval Warm Period, was a time of warm climate from about 900–1300 CE in which relatively warm conditions are said to have prevailed in various parts of the world, though predominantly in the Northern Hemisphere from Greenland eastward through Europe and parts of Asia, but, at the same time, raifall rised in others such as the tropical Pacific. The period was followed by The Little Ice Age, from about 1300 to 1850 CE, some parts of the world were, on average, slightly but significantly colder.

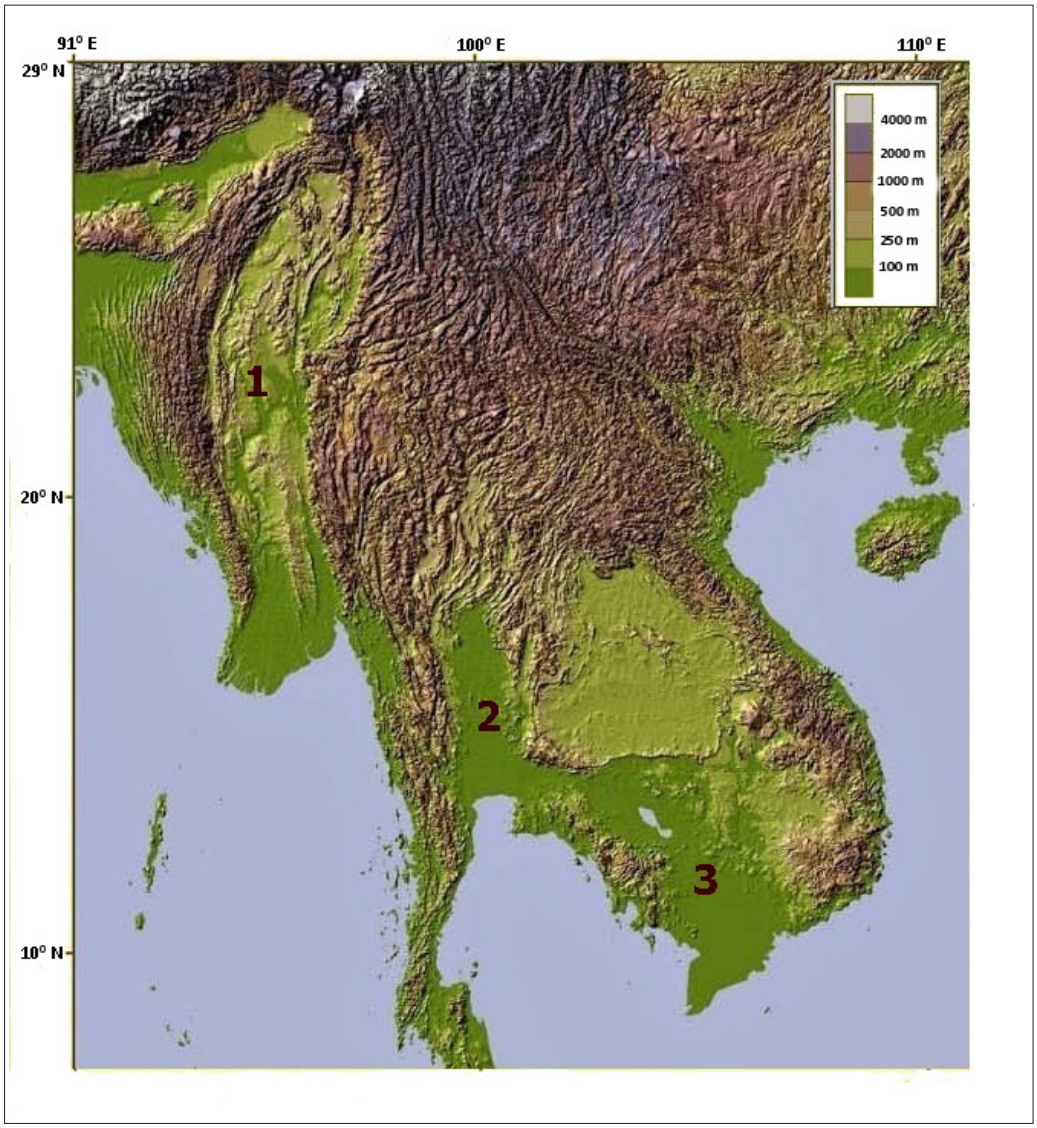

Fig. 2.6. Topographic map of three river basins: The Irrawaddy basin, (2) The Chao Phraya basin, and (3) The Mekong basin. (Souces: www.treehouse-maps.com with modification)

semi-dry areas but still able to take advantage of the frequent inundations of the areas around them.

Fifth, global climate change seems to have influenced the cultural, economic, and social development of the societies in each basin. A wetter climate—a consequence of climate change that occurred *c.* 900/1000-1300—supported kingdoms in the three basins by increasing their agricultural productivity. Moreover, increased

rainfall also led to an expansion of waterworks and water management programmes. When the climate change occurred after 1300 CE in which several droughts existed, the kingdom such as Angkor probable was unsuccessful to cope it caused in declining of the kingdom.

Sixth, it seems that the river-polities adjusted to their environments by creating and/or employing suitable water technologies: Angkor with its canals, moats, and lake; Upper Burmese polities with canals, moats, small tanks, and weirs; and the Thai ones with dams, dykes, reservoirs, ponds, city moats, canals, and wells. At first glance, it seems that these three basins show similar waterwork constructions. However, if we look at them more closely, differences are revealed. For example, the Thais—especially those of Lanna—and the Burmese built and utilized weirs because they needed to distribute water in order to enlarge the area of irrigated land in their hilly region.

Seventh, there is a difference between polities in the Southeast Asian mainland as regards the authorities' role in managing the water. According to Victor Lieberman the mainland states of Southeast Asia generally tended towards increasing administrative centralization.[90] It remains to be seen, though, to what extent such centralization is also reflected in the state's involvement in water management. Indeed, the Burmese, Thai, and Khmer rulers paid increasing attention to the construction of water infrastructure, yet they differed in how involved they were in maintaining the irrigation waterworks. The Burmese rulers, especially those of Bagan, directly supervised the *kharuin* irrigation system while Ayutthaya left the management of rice field irrigation to local communities or even households. The Khmer rulers held tightly the water management in their hands.

These water managements in the three river basins of mainland Southeast Asia will be compared with East Javanese water management in the period of the tenth to the sixteenth centuries CE. The act of comparing both regions (mainland Southeast Asia and East Java) is guided by aspects related to the geographical conditions and development of the polities and is aided by the amount of written evidence and artefactual sources from both. Comparing the water management of the two regions will not only contribute to understanding the trajectories of water management development in both, it will also sharpen my analysis of East Javanese water management, which focuses on the relationship and division of power between the East Javanese authorities and the local population. It is also significant that the explanation of water management in the three regions of mainland Southeast Asia helps create the following premise for the development of water management in ancient East Java: that the relationship between political power and water management correlates with geographical characteristics, the state's economic base as an agrarian state, climate change, and the socio-political structure of the region.

90 V. Lieberman, "South East Asia and Eurasia during a Thousand Years", *South East Asia Research*, 19, 1 (2011): 11. See also: Lieberman, Strange Parallels: 459.

Chapter 3

Environment and Landscape of the Brantas River Basin

The chapter consists of three sections. The first explores the Javanese natural and cultural landscape, and therein I attempt to highlight the geographical conditions relating to Javanese agricultural practices in ancient times. I also provide a brief comparison with the geographical features of mainland Southeast Asia. In the second part of the chapter, I attempt to show the important role climate played in shaping both the natural and the human environment through an explanation of the climate change that occurred in ancient Java. The last section contains a description of the Brantas river basin and its role in the geopolitical development of the East Javanese states.

3.1. THE NATURAL AND CULTURAL LANDSCAPE OF JAVA

The island of Java is situated between latitude 5°15' and 8°30' south and between longitude 105° and 115°15' east, stretches roughly 1,000 km from west to east, and has a total area of around 132,107 km^2. Java shares with the rest of the Indonesian archipelago a position between the Indian and the Pacific oceans and between the Asian and Australian land masses. The majority of Java consists of material from the Tertiary and Quarternary periods, although some very recent geological areas have been formed by folds, volcanic deposits, and sediments. Java is formed of two distinct parts, the northern and the southern part. The first is a geosynclinal lowland that stretches across the north of Java and is composed primarily of Tertiary

developments modified by very young folds. The latter is a southern mountain range, an area of Quaternary volcanoes. This volcanic range stands on a Tertiary rock base and is interrupted by valleys and river basins that were formed by rivers cutting through the range or flowing down the mountainsides.[1]

The geographical conditions of Java are distinct from those of its neighbours in Southeast Asia, and especially those of the Southeast Asian mainland. Three main distinctive features are the causes of this difference: the existence of volcanoes, the river system, and the soil.

Volcanoes

Java has a larger number of volcanoes than the southeast Asian mainland. There are about 90 active volcanoes in Southeast Asia, 19 of which are in the Philippines and the rest—71 volcanoes—are in Indonesia. Of these 71 volcanoes, 34 are currently active.[2] Java has the largest number of active volcanoes, with around 25.[3] These volcanoes have made a significant contribution to the geographical conditions of the island, either through changing its physical geomorphology or by shaping its anthropogeography. The Javanese volcanoes are one of the main factors that created the island's cultural landscape.

The history of volcanicity in Java has often been explored through the prism of catastrophe, but it has also benefitted the islands; for example, the soil of Java is extremely fertile. Volcanic activity has not only formed the distinctive Javanese landscape, it has also provided an enormous and widely-deposited volume of sediment for the majority of the island. When volcanoes explode, they produce material—in the form of both ash and pyroclastic flows—that create very fertile black soils with a high water-retention capacity. Such soils are very fertile and so are extensively cultivated.[4]

Soil

The soils of Java and of the Southeast Asian mainland are very different, and that has led to distinctive geomorphological features in both areas. Most of the soil of

1 W. Donner, *Land Use and Environment in Indonesia* (London: The Institute of Asian Affairs, 1987). The detailed zones of Java can be seen in: H. Th. Verstappen, *Outline of the Geomorphology of Indonesia* (Enschede: International Institute for Aerospace Survey and Earth Sciences, 2000): 26-30.

2 H.Th. Verstappen, "Volcanic Islands", in: *The Physical Geography of Southeast Asia*, ed Avajit Gupta (Oxford: Oxford University Press, 2005): 143.

3 N. van Padang, *Catalogue of the Active Volcanoes of Indonesia* (Napoli: International Volcanological Association, 1951): 62.

4 A. Gupta, *Tropical Geomorphology* (New York: Cambridge University Press, 2011): 268; T. Whitten, Roehayat Emon and Suraya A. Afiff, *The Ecology of Java and Bali* (Hongkong: Periplus Editions, 1996): 95; Verstappen, "Volcanic Islands": 148; Donner, *Land Use and Environment in Indonesia*: 7-10.

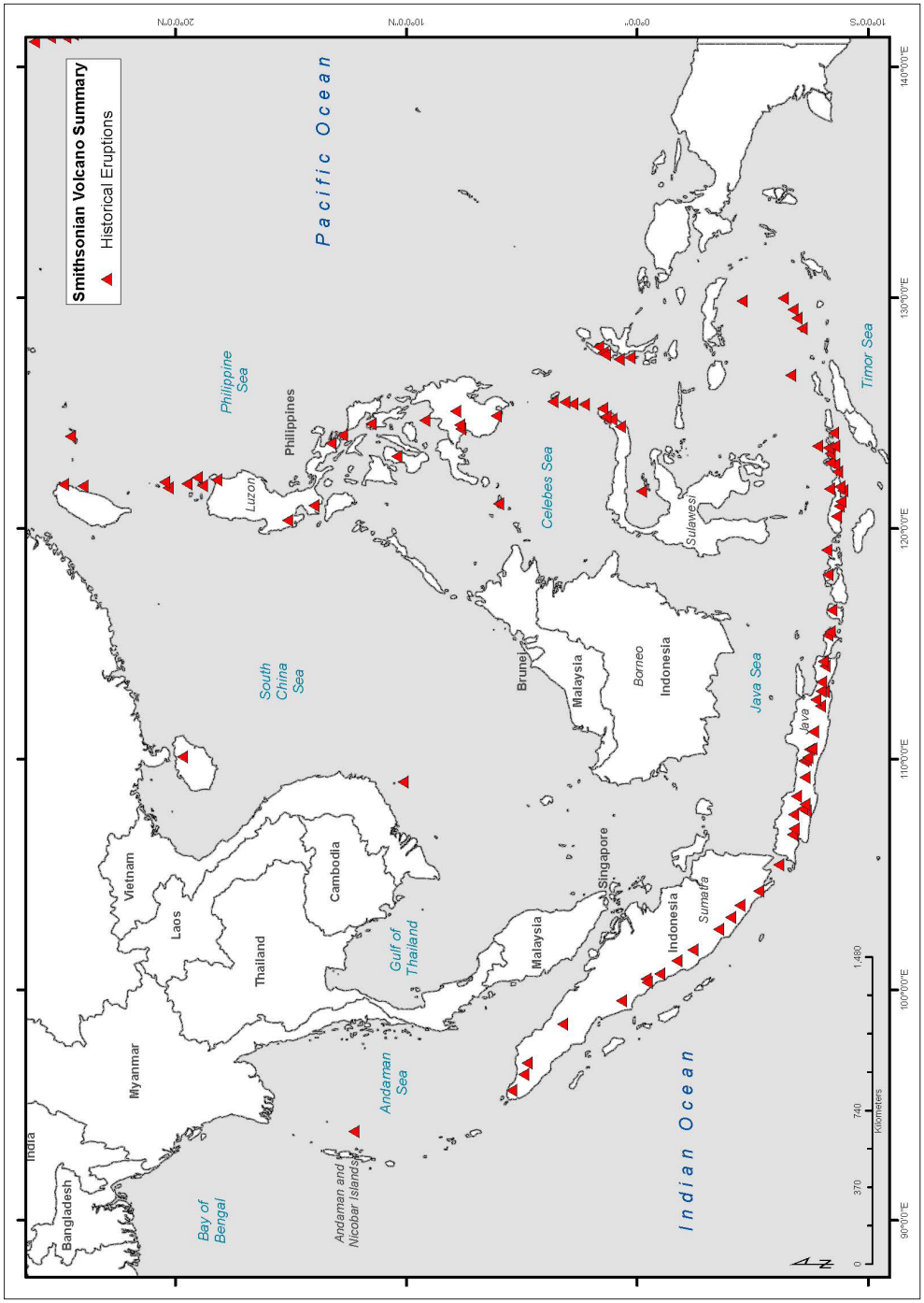

Fig. 3.1. Volcanoes in Southeast Asia. (Source: https://www.earthobservatory.sg/files/resources/files/Southeast%20Asia-Volcanoes%20map.pdf)

the Southeast Asian mainland is *acrisols* while Java is dominated by *andosols*.[5] The *andosols* consist of material produced by volcanic eruptions. They spread far around the area of the volcano and are then weathered by the humid tropics until, after several decades, the land is extremely fertile. The *andosols* form the dominant soil group in Java (as well as in West Sumatra and the Philippines) and have higher agricultural potential than *acrisols*. As such, it is more productive when cultivated than is the soil of the Southeast Asian mainland, especially if it is also irrigated. This means that Java is more productive as regards agricultural cultivation than anywhere on the Southeast Asian mainland. S. van Valkenberg[6] described the fertile land of Java in the following way:

> Notwithstanding the disastrous eruptions, the volcanoes must be considered a veritable gift of the gods. Their fertile ashes have, to a large extent, covered the Tertiary laterite and made of Java a real garden of the East.

Although, in general, Java is a very fertile land, sometimes there may be a short period of agricultural difficulties, usually caused by natural disasters such as dry climate, heavy rain, or earthquakes.

As in most tropical zones, though, the Javanese littoral was far from conducive for massive agricultural investment. In fact, as we have seen already, it was easiest to start agriculture in the semi-arid interiors and not on the coast, mainly because of its unhealthy conditions (e.g. malaria) as well as water management problems. In tropical areas high, year-round rainfall produces poor soils due to nutrient leaching, so that it is precisely those areas with a pronounced dry season, such as Central and East Java, that are the most fertile, although irrigation may be necessary in order to realize their full potential.

Rivers

In addition to volcanoes and soils, the fertility of Java is also influenced by the Javanese river system. In their relationship with the material ejected by the volcanoes, rivers function as a means of transportation, as they carry the volcanic matter a large distance. They carry and deposit this sediment to places including valley floors, alluvial fans, along alluvial valleys, and at deltas.[7] The rivers of Java, such as the Bengawan Solo and the Brantas, carry volcanic sediment over a wide area, widening the area of extremely fertile land. In contrast, while the Southeast Asian mainland contains larger and longer rivers they do not disperse volcanic sediment as happens on Java.

5 R. Dudal, "Soils of Southeast Asia", in: *The Physical Geography of Southeast Asia, ed Avijit Gupta* (New York, Oxford University Press, 2005): 102.

6 S. van Valkenberg, "Java: The Economic Geography of a Tropical Island", *Geographical Review* 15/4 (1925): 569-570.

7 Gupta, *Tropical Geomorphology*: 129

Although there are a number of differences between the physical environments of Southeast Asia and Java, both regions share the importance of rice, the production of which has influenced political, economic, social, and cultural life both in the past and present. The history of agriculture in Southeast Asia has been dominated by the management of rice cultivation.

Regarding the history of agriculture over the whole of Southeast Asia, there is not sufficient historical and archaeological evidence to explain its development in the region, including within Java.[8] The origin of rice cultivation has been particularly subject to debate. There are many theories regarding where rice (*Oryza sativa*) originated and how it spread across Southeast Asia. However, on the basis of archaeobotanical data, many scholars now believe that rice spread across mainland Southeast Asia from southern China before the third millennium BC. Archaeological research in Sarawak and Sulawesi reveals that the introduction of rice cultivation into the islands of Southeast Asia occurred around 2,000 BC.[9] Yet, in the case of Java, a date for the beginning of rice cultivation has not been established. Bellwood assumes that rice was domesticated in Java in the first century CE.[10] So far, however, there is no archaeological or palaeobotanical evidence for this assumption. The earliest evidence comes from palynological evidence, inscriptions, temple reliefs, and the existence of rice chaff in bricks that dates back at least to the eighth century CE.[11]

However, many scholars discuss the development of rice only and ignore the importance of other staples in the development of agriculture in early Java, such as foxtail millet, Job's tears, taro, yams, and sago. Indeed, in some areas the inhabitants focus on a certain food staple, such as on the Ok mountain of central New Guinea, where taro is the staple (although they also cultivate other varieties of plant for food).[12] In mainland Southeast Asia, too, certain areas focus on specific types of agriculture; for example, the Mon, Khmer, and Cham prefer house-gardening, while the Burmese, Thai, and Vietnamese cultivate rice.[13] In the case of Java, rice cultivation

8 I.G. Glover, "The Late Prehistoric Period in Indonesia", in: *Early South East Asia. Essays in Archaeology, History and Historical Geography*, ed. R.B. Smith and W. Watson (New York: Oxford University Press, 1979): 167-184.

9 C. Doherty, Paul Beavitt, and Edmund Kumi, "Recent Observations of Rice Temper in Pottery from Niah and other Sites in Sarawak", *Bulletin of the Indo-Pacific Research Association* 150 (2000): 150; I. C. Glover, "Prehistoric Plant Remains from Southeast Asia, with Special Reference to Rice", *South Asian Archaeology* 1 (1977): 7-37.

10 P. Bellwood, *Prehistory of the Indo-Malaysian Archipelago* (Honolulu: University of Hawaii Press, 1977): 117.

11 J.W. Christie, "The Agricultural Economies of Early Java and Bali", in: *Smallholders and Stockbreeders. History of Foodcrop and Livestock Farming in Southeast Asia*, ed. Peter Boomgaard and David Henley (Leiden: KITLV Press, 2004): 47-48.

12 G.E.B. Morren Jr and David C. Hyndman, "The Taro Monoculture in Central New Guinea", *Human Ecology* 15/3 (1987): 301-315.

13 The Khmer developed wet-field rice agriculture extensively, especially, and gradually, in the Mekong Basin, yet most parts of Cambodia kept house-gardening. See: R. A.

and house-gardening probably existed side-by-side. Another example of a cultivated grain is foxtail millet, which was also farmed in ancient Java. A famous relief from the Borobudur temple shows sheaves of grain on a shoulder pole, which suggests that foxtail millet was a cultivated grain and a food staple for the Javanese.[14]

Regarding ancient Javanese cultivation systems, Jan Wisseman Christie assumed that swidden (slash-and-burn) agriculture was practiced by the Javanese.[15] Her assumption was based on the Srokodan inscription—a Balinese inscription from the ninth century CE—although the inscription itself does not specifically mention swidden agriculture happening in ancient Bali. She bases her assumption on her translation of *lmah sukĕt* as a fallow swidden land, but it is a mistranslation.[16] It is not relevant to discuss here the shifting cultivation types of Java. The land area of Java is not as large as is the case on the other main islands of Indonesia, such as Borneo, for example, neither is the forest denser. Despite having limited space to shift cultivation, Javanese cultivators do not have to move from one area to another because the lands are fertile enough to be used all the time; the volcanic ash and sediment mean it is permanently fertile. In addition, Pujoarinto and Cushing—who conducted research on pollen stratigraphic evidence of human activities at Dieng, in Central Java—found no evidence of the use of fire to clear the land because there were not significant levels of carbon within the sediment.[17]

The development of agriculture in ancient Java enters the historical record after the ninth century CE, as further archaeological and textual data suggest. According to Christie, wet rice cultivation was the main agricultural production method in Java, followed by various other farming systems based on the following productive types of land:

> dry or hill rice fields *(gagā, gagān);* dry or swidden fields *(tĕgal/parlak);* fallowed swidden land *(lmah sukĕt);* orchards or perennial gardens *(kbuan/ ngmal, mmal);* houseland with gardens *(pomahan); sirih* gardens *(pasĕrĕhan);* taro fields *(patalĕsan);* cotton fields *(pakapasan);* meadow or grass land *(dukut/ padang);* treeless, uncultivated land *(harahara);* forest *(alas);* marsh *(rĕnĕk);*

O'Connor, "Agricultural Change and Ethnic Succession in Southeast Asian States: A Case for Regional Anthropology", *The Journal of Asian Studies*, 54/4 (1995): 969-970, 972-973. See also: G.J.A. Terra, "Some Sociological Aspects of Agriculture in S. E. Asia", *Indonesië* 6/4 and 6/5 (1953): 297-316, 439-63.

14 Although there is debate regarding this relief (I b 41), and particularly whether it is rice or foxtail millet. See: D. Henley, "Rizification Revisited: Re-examining the Rise of Rice in Indonesia with Special Reference to Sulawesi", in: *Smallholders and Stockbreeders. History of Foodcrop and Livestock Farming in Southeast Asia*, ed. Peter Boomgaard and David Henley (Leiden: KITLV Press, 2004): 121-122.

15 Christie, "The Agricultural Economies of Early Java and Bali": 50-51.

16 See: R. Goris, *Inscripties voor Anak Wungçu* (Bandung: Masa Baru, 1954): 129-130.

17 Agus Pudjoarinto and Edward J Cushing, "Pollen-stratigraphic evidence of human activity at Dieng, Central Java", *Palaeogeography, Palaeoclimatology, Palaeoecology* 171/3 (2001): 329-340.

river banks/margins *(tpitpi);* rivers *(luah, kali, bangawan);* lakes, ponds *(ranu/danu);* salterns *(lmah asinan* or *pawuyahan).*[18]

I have different interpretations for some of those Old Javanese words than does Christie. For instance, I prefer to interpret *gagā* as meaning a dry rice field, not always on a hill; *tĕgal* as a dry cultivated field, not a type of swidden cultivation; and *lmah sukĕt* as an uncultivated field. Despite these differences of interpretation regarding field types, for the period after the ninth century CE I agree with Christie that different types of agriculture were practised in ancient Java and that rice cultivation was one of the types of agriculture. The Javanese cultivated a wide variety of plants on different types of agricultural lands.[19] These included dry fields, irrigated lands, gardens, and even ponds and riverbanks.

Of all these different cultivation systems in ancient Java, the *sawah* was the most important agricultural activity, both for individuals and states. The development of wet-field rice cultivation in that region is believed to have been related to subsistence farming, to increased tax revenue, and to trade. In other words, some of the rice produced in Java was consumed by the Javanese households who grew it while the remainder was traded, thereby contributing to the state's income through taxes. As such, it was sensible for the Javanese rulers to support the people's attempts to create more wet rice fields. The increase in cultivated land resulted in many forests across Central Java being converted into agricultural land. For example, forests of teak, which had been introduced to Java around 200 CE and had become widespread across the island, were cleared for agriculture in the sixth century CE.[20] Moreover, from the ninth century CE, ancient Javanese inscriptions detail many more examples of the conversion of dry fields to wet rice fields, encouraged by the state.[21]

One consequence of the expansion of the wet rice fields and of the increased demand for rice as a commodity was that the state had to find a new strategy to accomplish it.[22] It seems likely that the relocation of the Javanese kingdom from

18 Christie, "The Agricultural Economies of Early Java and Bali": 50.

19 See for the various types of agricultural lands in Majapahit period: Ph. Soebroto, "Sektor Pertanian sebagai Penyangga Kehidupan Perekonomian Majapahit", in: *700 Tahun Majapahit. Suatu Bunga Rampai*, eds. Sartono Kartodirjo, et al. (Surabaya: Dinas Pariwisata Daerah Propinsi Tingkat I Jawa Timur, 1993): 152-176.

20 Franck Lavigne and Yanni Gunnell, "Land Cover Change and Abrupt Environmental Impacts on Javan Volcanoes, Indonesia: A Long-Term Perspective on Recent Events", *Reg Environ Change* 6 (2006): 94.

21 Christie, "The Agricultural Economies of Early Java and Bali": 55.

22 For paddy farming in ancient Java based on the relief evidences, see: Siswanto, "Potret-Potret Kearifan Lingkungan Masa Lalu dalam Relief dan Sastra Tertulis". In: *Majapahit. Batas Kota dan Jejak Kejayaan di Luar Kota*, ed. Inajati Adrisijanti (Yogyakarta: Penerbit Kepel Press, 2014): 60-67.

Central to East Java in the tenth century CE[23] was one of the strategies by which rice production and commerce were increased. By relocating the centre of the kingdom to East Java, close to the Brantas river and its tributaries, there were two benefits. First, water for irrigating the rice fields became more easily accessible than it had been in Central Java, which had no large river and tributaries comparable in size to the Brantas. Consequently, it was easy to create irrigation infrastructures for rice fields in East Java. Archaeological data from this region provides us with further evidence of irrigation infrastructure features—dams, canals, and tunnels—as do epigraphic records, which provide more indications than do the archaeological data and epigraphic records of Central Java. Secondly, as a commercial river, the Brantas connected the inland rice production centres with coastal trading centres.[24] As the East Javanese coastal trading posts became more prominent in Southeast Asia after the tenth or eleventh century CE, more and more rice was transported through the Brantas river routes from its hinterlands.

In conclusion, a comparison of the farming practices of the Southeast Asian mainland with those of Java demonstrates that differences in the natural environment caused people to create specific agricultural practices appropriate for their area. For example, the fertility of Javanese soil is more sustainable for agriculture than is that of mainland Southeast Asia due to the existence of volcanoes and of *andosols* in the former.

The growth of agriculture in Java does not follow Boserup's theory of population pressure, which states that increased population growth results in starvation which then motivates people to invent agricultural technologies and cultivation methods in order to increase food production.[25] The evidence from Java shows that Javanese agricultural growth was the result of the natural fertility of the land, increased economic factors (rice trading), and improved irrigation technology, especially as regards rice cultivation. As a result of both the benefits of its cultivation and encouragement from the Javanese rulers, rice became a favorite plant for cultivation in Java. Economic considerations also caused the rulers to shift the centre of the kingdom from Central to East Java—to the Brantas river basin—in order to produce more rice and have easier access to coastal ports, eventually enhancing their capability in irrigation technology, but the direct cause of the eastern shift were quite different and more dramatic.

23 The problem of the movement of the Javanese Kingdom has been explored by Boechari; see: Boechari, "Some Considerations of the Problem of the shift of Mataram's Center of Government from Central to East Java in the 10th century A.D." (Jakarta: Proyek Pelita, Pembinaan Kepurbakalaan dan Peninggalan Nasional, Departemen P. & K. 1976).

24 Some ports in delta Brantas river were mentioned by Christie, in: J.W. Christie, "Javanese Markets and the Asian Sea Trade Boom of the Tenth to Thirteenth Centuries A.D.", *JESHO* (1998): 344-381.

25 See: E. Boserup, *The Condition of Agricultural Growth* (Chicago: Aldine, 1965).

3.2. CLIMATE CHANGE

While the previous section discussed the environment and agriculture of Java, in this part I will discuss the region's climate and how climate change influenced the socio-political development of the Javanese states. In other words, I want to explain to what extent climate change in the tenth to the sixteenth centuries impacted the development of the Javanese states. My assumption is that, to a certain degree, people who live in the changing environment will adapt to the climate or at least to climate conditions. At the state level, the changing environment and the inhabitants' adaptation to it help contribute to the growth of the state itself.

Lieberman is one scholar who has explored the relationship between climate change and the growth of states. His hypothesis is that the early development of Pagan, Angkor, and Dai Viet in mainland Southeast Asia was the result of stronger monsoons at the time of the medieval climate anomaly (*circa* 900/950-1250/1300 CE).[26] Unfortunately, he does not go into detail about the influence this had on the Javanese states, simply concluding that the increase in East Javanese agriculture was driven by the monsoons and weak El Niño during the period c. 820-1270 CE.[27]

Lieberman's statement raises a very interesting question when we look more closely at the Javanese states of that period. As noted above, in 929 the centre of the Javanese kingdom was moved from Central to East Java, from a relatively wet and fertile region to a drier area with less rain. Different theories regarding the reasons for this move to East Java have been proposed by various scholars, and many explanations have been advanced; these include religious reasons, warfare, economic considerations, natural disasters, and environmental factors, and these have been summarized by both Boechari[28] and Voûte.[29] Caesar Voûte, as well as giving a summary of the reasons for the shift, also put forward a hypothesis of his own: that it was triggered by continuous sedimentation along the north coast which resulted in the silting up of the Central Javanese trading ports. This resulted in an

26 V. Lieberman and Brendan Buckley, "The Impact of Climate on Southeast Asia, circa 950–1820: New Findings", *Modern Asian Studies* 46/5 (2012): 1049-1096. See also: V. Lieberman, *Strange Parallels: Southeast Asia in Global Context, c. 800-1830. Vol. 2: Mainland Mirrors: Europe, Japan, China, South Asia, and the Islands* (Cambridge: Cambridge University Press, 2009). Another scholar who also relates climate to the development of Southeast Asian states is Anthony Reid; see: Anthony Reid, *Southeast Asia in the Age of Commerce, 1450-1680. Volume 2. Expansion and Crisis* (New Haven: Yale University Press, 1993).

27 Lieberman, *Strange Parallels: Southeast Asia in Global Context, c. 800-1830. Vol. 2*: 792.

28 Boechari, "Some Considerations".

29 C. Voûte, "Religious, Cultural and Political Developments during the Hindu-Buddhist Period in Central and East Java-Relations with India and Srilangka- Human Actors and Geological Processes and Events", in: *Society and Culture of Southeast Asia Continues and Changes, ed. Lokesh Chandra* (New Delhi: International Academy of Indian Culture and Aditya Prakashan, 2000): 329-334.

economic disaster for the Central Javanese polity so it moved to East Java, where the harbors were still suitable for trading.[30] However, none of these theories considers the change in climate that occurred at that time as being a factor.

The question remains as to what the relationship was between the movement of Javanese states, on the one hand, and the climate, monsoon rains, and weak El Niño on the other. To answer this question, we must explore the connection between the climate, monsoons, and El Niño in Java at that time.

Regarding the difference in climate between Central and East Java, the map below shows the classification of climates on Java. The Köppen climate classification divides Java into three zones: Am (tropical monsoon), Aw (tropical wet and dry/tropical savanna), and Cfa (humid subtropical). Most of East Java has an Aw climate, meaning it is drier than the rest of Java.[31] It has a pronounced dry season, with the driest period seeing less than 60 mm of precipitation over more than two months. As such, under normal conditions Central Java is more suited to growing agricultural crops, especially rice, than is East Java. Most of the Central Java region with its Am climate has an amount of rainfall in the wet months which can compensate for the lack of rainfall in the dry months. If there is too much rainfall, though, the quality of agricultural soil may degrade caused by nutrients leaching as in the case of Java's coastal areas.[32]

Java's climate correlates with the monsoon rains and with the El Niño Southern Oscillation (ENSO),[33] and both these factors determine whether rain will be abundant or scarce in any given period. On the basis of proxy evidence such as tree-ring records and coral evidence,[34] it seems that there was a high frequency of

30 *Ibid*.

31 Sutikno, "Kondisi Geografis Kraton Majapahit", in: *700 Tahun Majapahit. Suatu Bunga Rampai*, eds. Sartono Kartodirdjo, et al. (Surabaya: Dinas Pariwisata Daerah Propinsi Tingkat I Jawa Timur, 1993): 16-18.

32 The effect of too much rainfall on the soil quality can be seen in D. Henley, "Population, Economy and Environment in Island Southeast Asia: An Historical View with Special Reference to Northern Sulawesi", *Singapore Journal of Tropical Geography*, 23, 2, (2002): 171-174. See also: E.C.J. Mohr, "Climate and soil in the Netherlands Indies", *Bulletin of the Colonial Institute of Amsterdam*, 1 (1923): 245; E. C. J. Mohr and R. L. Pendleton, The soils of Equatorial Regions with Special Reference to the Netherlands East Indies (Michigan: J. W. Edwards, 1944): 114-117.

33 Grove and Chappell define it in the following way: "The phenomenon itself is a see-saw of atmospheric mass involving exchanges of air between eastern and western hemispheres centerd in tropical and subtropical latitudes, with centers of action over Indonesia and the tropical Pacific Ocean"; John Chappell and Richard H. Grove, "ENSO: A Brief Overview", in: *El Niño. History and Crisis*, ed. Richard H. Grove and John Chappell (Cambridge: The White House Press, 2000): 5.

34 D. Khider, *Paleoceanofraphy of the Indonesian Seas over the Past 25,000 Years* (Dissertation University of Southern California, 2011): 140-143; K. M. Cobb, et al., "El Niño/Southern Oscillation and Tropical Pacific Climate during the Last Millennium", Nature 424 (2003): 271-276.

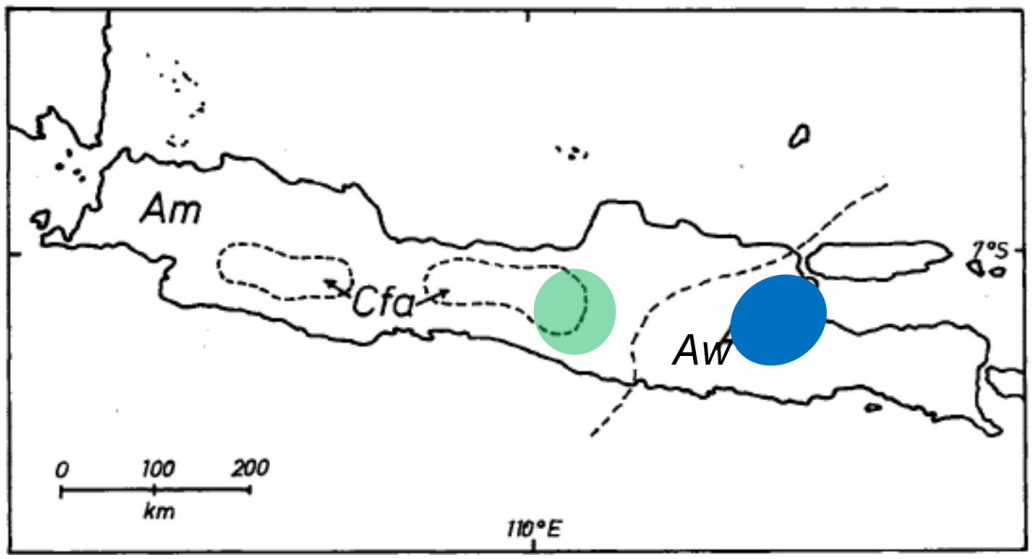

Fig. 3.2. Climate of Java and the centres of Javanese states

Am = Tropical climate, rainforest climate despite a short dry season (monsoon type)

Aw = Tropical climate, tropical savanna climate with a pronounced dry season

Cfa = Temperate rainy climate, wet in all seasons, with hot summers

= Centre of Central Javanese state

= Centre of East Javanese state

Basemap: Meyers Grosser Weltatlas, 1979, pp. 246-7.

Source: Wolf Doner. Land Use and Environment in Indonesia: 88, with a modification.

La Niña and relatively cool conditions in the years *c.* 900-1300 CE (the "Medieval Warm Period" or "Medieval Climate Anomaly"). Consequently, Java had higher than average rainfall during the Medieval Climate Anomaly. J.R. Rodysill agrees with this hypothesis and, based on her research on lake sediment deposits in East Java, states that there was more frequent flooding in East Java from 850 to 1350 CE as a consequence of high activity levels of both El Niño and La Niña during the Medieval Climate Anomaly.[35] Another study by B.L. Konecky *et al*. conducted on precipitation proxy reconstruction from Lake Lading, Java, from 850 CE to present, proves that rainfall has continually increased in Java over the past millennium. Indeed, there were drier periods occurred during 960–1090 CE, 1260–1300 CE, 1380–1450 CE, 1600–1690 CE, 1790–1800 CE, and 1840–1900 CE, but wetter conditions happened

35 J.R. Rodysill, et al., "ENSO-driven Flooding Events in East Java, Indonesia during the Past Millennium", *American Geophysical Union, Fall Meeting 2013*, see: http://adsabs.harvard.edu/abs/2013AGUFMOS34A.06R

in between.[36] It is interesting that at least from 850 to 960 CE a wetter climate occurred in Java just before the political power in the Central Java moved to the East Java.

I suggest that climate was a primary factor behind the shift of the Javanese kingdoms towards the eastern part of the Island. To support my hypothesis, I will explore both historical and archaeological records. First, archaeological evidence from Central Java contains indications of natural disasters caused by severe rainfall. This, in turn, caused pyroclastic sediments from mountain tops to cascade down the surrounding valleys in the form of rain-triggered volcanic mudflows (lahar flows[37]), events which are almost always caused by heavy rainfall. When the lahar flows occur soon after an eruption, they are hot lahar flows; if not—if they happen some time after an eruption—they are cold lahar flows. However, cold lahars are more hazardous than are hot lahars because they occur more frequently. F. Lavigne declares that the frequency of cold lahars depends on the characteristics of the rainfall and on the volume and grain size of the fresh pyroclastic deposits on the mountain.[38] In the case of the Merapi volcano, around the tenth century there were pyroclastic deposits that were the result of a 765-911 CE eruption[39] and which had become cold lahars in subsequent years. These cold lahars were transported down the valleys via rivers—there are at least 13 rivers on the slopes of the Merapi volcano—and many of the lahars travelled a long distance from the banks when the rivers overflowed as a result of a period of extreme rainfall.

During the Medieval Climate Anomaly, when there was increased rainfall in Java, more lahars would flow from the tops of the mountains down the mountainsides to the river basins, via valleys and rivers whose headwaters were in the mountains. As a result, many temples that lay in the regions around the volcanoes were buried by volcanic ash and sediments. Most of those in the vicinity of Merapi, for example, were struck by a volcanic mudflow at some point that buried or destroyed them;

36 B.L. Konecky et al., "Intensification of Southwestern Indonesian Rainfall over the Past Millennium", *Geophysical Research Letters*, 40 (2013): 386–391.

37 A lahar is defined by Lavigne as "a mixture of debris and water, other than streamflow, that flows from a volcano at relatively high speed. A lahar is usually an event, not as a deposit, which may be originated in several ways, from debris avalanches, through lake outburst or breaching, snowmelt by pyroclastic flows, which transform to aqueous flows, and through removal of pyroclastic debris by subsequent heavy rainstorms during an eruption." See: F. Lavigne and Jean-Claude Thouret, "Sediment transportation and deposition by rain-triggered lahars at Merapi Volcano, Central Java, Indonesia", *Geomorphology* 49 (2002): 45–69.

38 F. Lavigne, et al., "Lahars at Merapi Volcano, Central Java: An Overview", *Journal of Volcanology and Geothermal Research* 100 (2000): 423–456.

39 According to Andreastuti, this date is nearest to the time when the Central Javanese polity moved to East Java in the 10th century CE. See: S.D. Andreastuti, Chris Newhall, and Joko Dwiyanto, "Menelusuri Kebenaran Letusan Gunung Merapi 1006", *Jurnal Geologi Indonesia* 1/4 (2006): 204 and 207.

Fig. 3.3. Liyangan site, Temanggung, Central Java, an archaeological site which is buried by volcanic mudflow of Sindoro mountain. (Source: Left Photo from http://sains.kompas.com/read/2014/11/23/21135401/Situs.Liyangan.Sudah.Dihuni.Sejak.Abad.ke-6 and right photo by Dwi Pradnyawan)

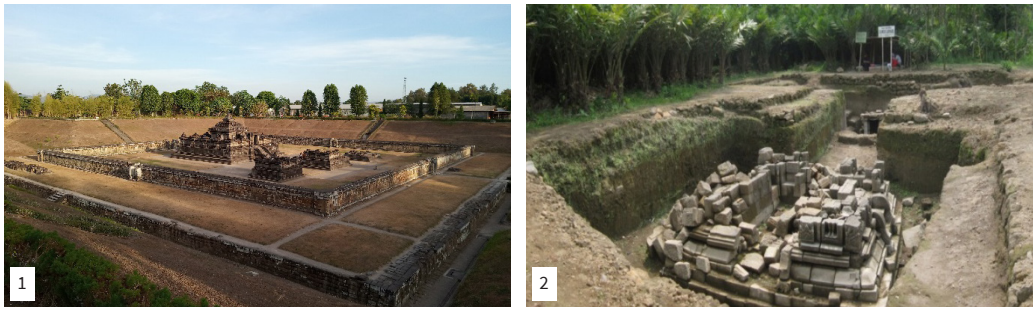

Fig.3.4. Sambisari (1) and Losari (2) temples, which are other examples of temples buried by alluvial sediments. Sambisari was found six metres below the surface. (Photos by Tjahjono Prasodjo)

Sambisari and Kedulan temples are two such examples. And Merapi was not the only volcano in Central Java that caused temples to be buried. Mt. Sindoro,[40] situated not far from Temanggung, also did so to Liyangan, which is a large archaeological compound dating from around the ninth century CE that was discovered in 2009 and contains evidence of a disaster caused by lahars, primarily from the Sindoro volcano. The site was covered by four to seven metres of volcanic deposits.

Secondly, another record—an Old Javanese epigraphic text dating from 907 CE, the Rukam inscription, found in 1975 in Petarangan village (Temanggung) on the

40 Mount Sindoro (Sundoro or Sendoro) is a statovolcano with a long history of large eruptions from prehistoric time; See: N.J.M. Taverne, "Vulkaanstudiën op Java", *Vulkanalogische Mededelingen No. 7*. ('s Gravenhage: Algemeene Landsdrukkerij, 1926): 40-45.

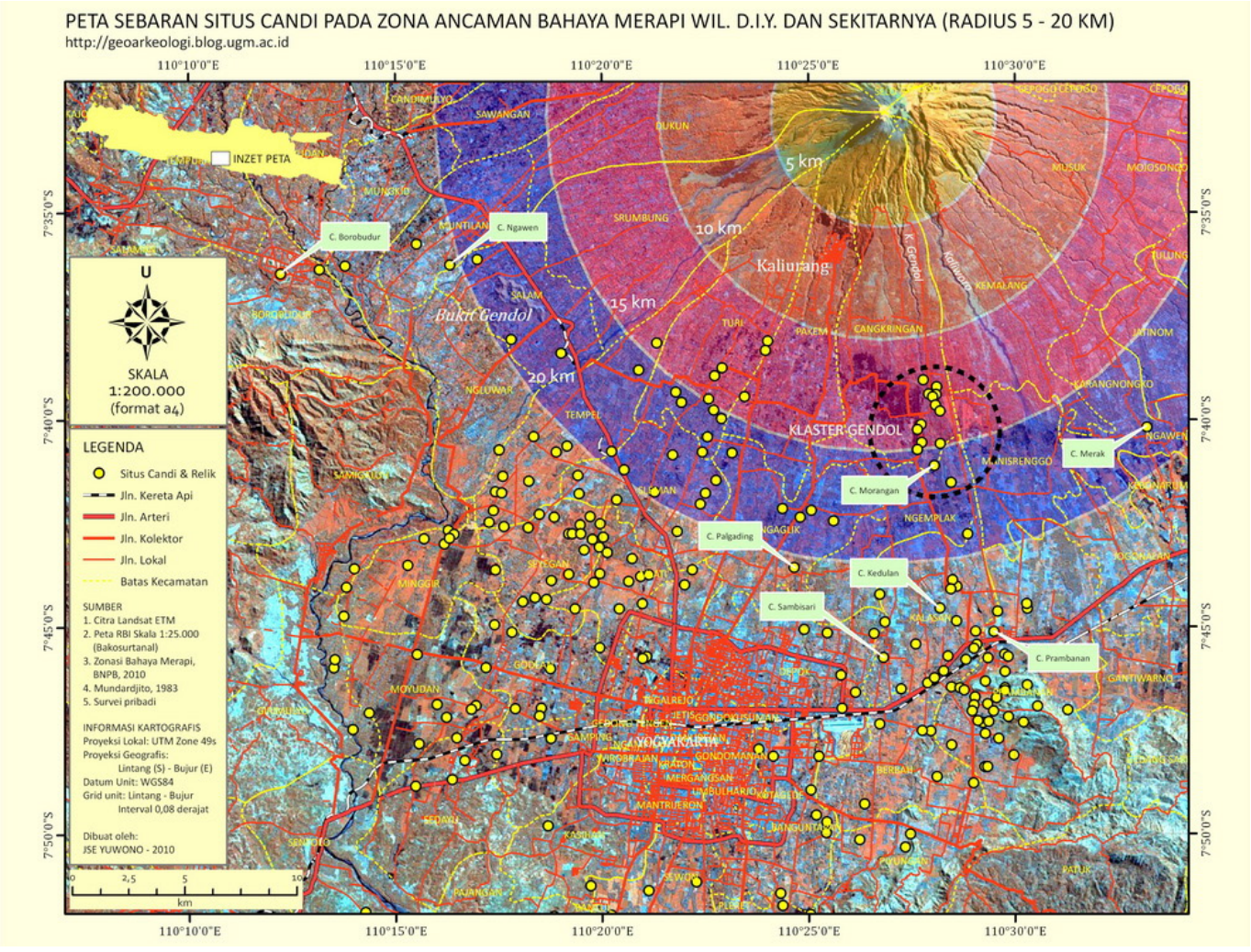

Fig. 3.5. Map of the distribution of archaeological sites, temples, and *in situ* artefacts on the western and southern slopes of Merapi volcano within the Merapi hazard zones. Yellow dots indicate the locations of archaeological sites, temples, and artefacts. Source: http://geoarkeologi.blog.ugm.ac.id/tag/jogja/

slopes of Mount Sumbing—contains information relating how Śrī Mahārāja Rake Watukura Dyaḥ Balituṅ, the king of the Central Javanese kingdom, gave the order to designate the village of Rukam as a *sīma* because it had been destroyed by *"guntur"*. I translate the term *guntur* as lahar flows, so the phrase "*saṅkā yan hilaṅ de niṅ guntur*" in the inscription means "because of the fact that it had been destroyed by lahar flows".[41] This differs from Titi Surti Nastiti's translation as "because it was destroyed by a volcanic eruption".[42] Her citation of the whole sentence is

1. *....tatkāla ājñā śrī mahārāja rake watukura dyaḥ balituṅ śrī dharmmodaya mahāśambhu miṅ*
2. *sor i mahāmantri śrī dakṣottama bāhubajra pratipakṣakṣaya kumonnakan ikanaṅ wanua i rukam wanua i dro saṅkā yan hilaṅ de niṅ guntur sīmān rakryān sañjīwana nini haji maṅaseˇa i dharmma nira i limwuṅ muaṅ pagawa*
3. *yana kamulān*[43]

I translate it as:

1. ...at the time when the order of Śrī Mahārāja Rake Watukura Dyaḥ Balituṅ Śrī Dharmmodaya Mahāśambhu
2. was sent down to Mahāmantri Śrī Dakṣottama Bāhubajra Pratipakṣakṣaya to give an order regarding Rukam village, which is a village in the inner part of the palace; because of the fact that it had been destroyed by lahar flows, it should be converted into a *sīma* of Rakryān Sañjīwana, the grandmother of the king, as a tribute to the holy temple in Limwuṅ and should
3. be made a *kamulān* (a shrine for ancestor worship)

In addition, three inscriptions found near the Kedulan temple—the Panaṅgaran, Sumuṇḍul, and Tluron inscriptions—also relate a flood disaster. They state that a dam and a canal should have been built to prevent water flooding a dry-field and that construction was delayed for years as a result of various disasters. As the temples in which the inscriptions were found were buried by 8 metres of volcanic sediment, it is very possible that the inscriptions refer to a lahar flood, not just flooding by water. These four inscriptions together demonstrate that lahars occurred at that time, and

41 Lahar is an Indonesian term that internationally accepted as a geologigal term describes a rapidly flowing mixture of volcanic mud flows and water from a volcano. F. Lavigne et al.: "Lahars at Merapi Volcano, Central Java: An Overview", *Journal of Volcanology and Geothermal Research* 100 (2000): 423–424.

42 T.S. Nastiti, Dyah Wijaya Dewi, and Richadiana Kartakusuma, *Tiga Prasasti dari Masa Balitung* (Jakarta: Pusat Penelitian Arkeologi Nasional, 1982): 23. According to Zoetmulder, "*guntur*" also means "flood (with rocks and lava from a volcanic eruption)" instead of simply "volcanic eruption". See: P.J. Zoetmulder, *Old Javanese-English Dictionary. Part 1: A-O* ('s-Gravenhage: Nijhoff, 1982): 556.

43 Nastiti, Dyah Wijaya Dewi, and Richadiana Kartakusuma, *Tiga Prasasti dari Masa Balitung*: 23.

it is very likely that they were caused by heavy rainfall.

Thirdly, East Java's climate and environment is unlike that of Central Java. East Java does have some active volcanoes but not as many as Central Java, where the urban centres were surrounded by active volcanoes. In East Java, Kelud, Semeru, and Raung are the most active volcanoes, while Central Java has Slamet, Dieng, Sindoro, Sumbing, Merbabu, and Merapi.[44] Another characteristic of the volcanoes of Central Java is that they are found in a relatively small area; this is especially the case with Merapi and Merbabu, which are on two adjacent mountains, as are Sindoro and Sumbing. It is also possible to compare the volcanic eruptions on mountains in Central Java and East Java; for instance, Merapi and Kelud are both famous for their violent and often deadly eruptions, yet Merapi has almost always had repeated eruptions over a relatively long period of time whereas Kelud's eruptions are usually comparatively brief. Kelud produced less lava, bombs, and ash than Merapi which makes Merapi steeper than Kelud.[45] When a lengthy eruption, such as those of Merapi, occurs at a time of heavy rainfall, it often leads to a very dangerous long-term lahar disaster in the surrounding areas.[46] Unstable geological conditions caused by volcanic activity on Central Java around the ninth and tenth centuries have been highlighted by Christie, who has shown that epigraphic records support the notion of geological turbulence in that period.[47]

Although East Java is located in an Aw climate zone—meaning that the centre of the Javanese kingdom moved to a drier region when it relocated there—it moved into the Brantas river basin, meaning that the increased dryness was offset by the water that flowed into the basin, which could be accessed easily. Moreover, it survived in this new, drier area partly as a result of the increased rainfall that was a result of Medieval Climate Anomaly; however, even if there had only been average rainfall—or even a period of drought[48]—it was still more secure compared to the Central Java region.

After the periods of heavy rainfall of the Medieval Climate Anomaly, some

44 For each description of these mountains, see: van Padang, *Catalogue of the Active Volcanoes of Indonesia*: xiii, 102-104, 107-115, 118-128, 132-137, 141-145, 153-156.

45 E.C.J. Mohr, *The Soils of Equatorial Regions with Special Reference to the Netherlands East Indies* (Michigan: J. W. Edwards, 1944): 647.

46 Thouret and Lavigne show how the same hazards and risks are still faced by those living around Mount Merapi in Central Java today: J. Thouret and Franck Lavigne, "Hazards and Risks at Gunung Merapi, Central Java: A Case of Study", in: *The Physical Geography of Southeast Asia, ed Avajit Gupta* (Oxford: Oxford University Press, 2005): 275-299.

47 J.W. Christie, "Under the Volcano: Stabilizing the Early Javanese State in an Unstable Environment", in: *Environment, Trade and Society in Southeast Asia: A Longue Durée Perspective*, ed. David Henley and Henk Schulte Nordholt (Leiden: Brill, 2015): 46-61.

48 Based on paleolimnological records, Jessica R. Rodysill et al. find that there was a drought period in East Java in the period 930-1130. See: J.R. Rodysill, et al., "A Paleolimnological Record of Rainfall and Drought from East Java, Indonesia during the last 1,400 year" *J Paleolimnol* 47 (2012): 125–139.

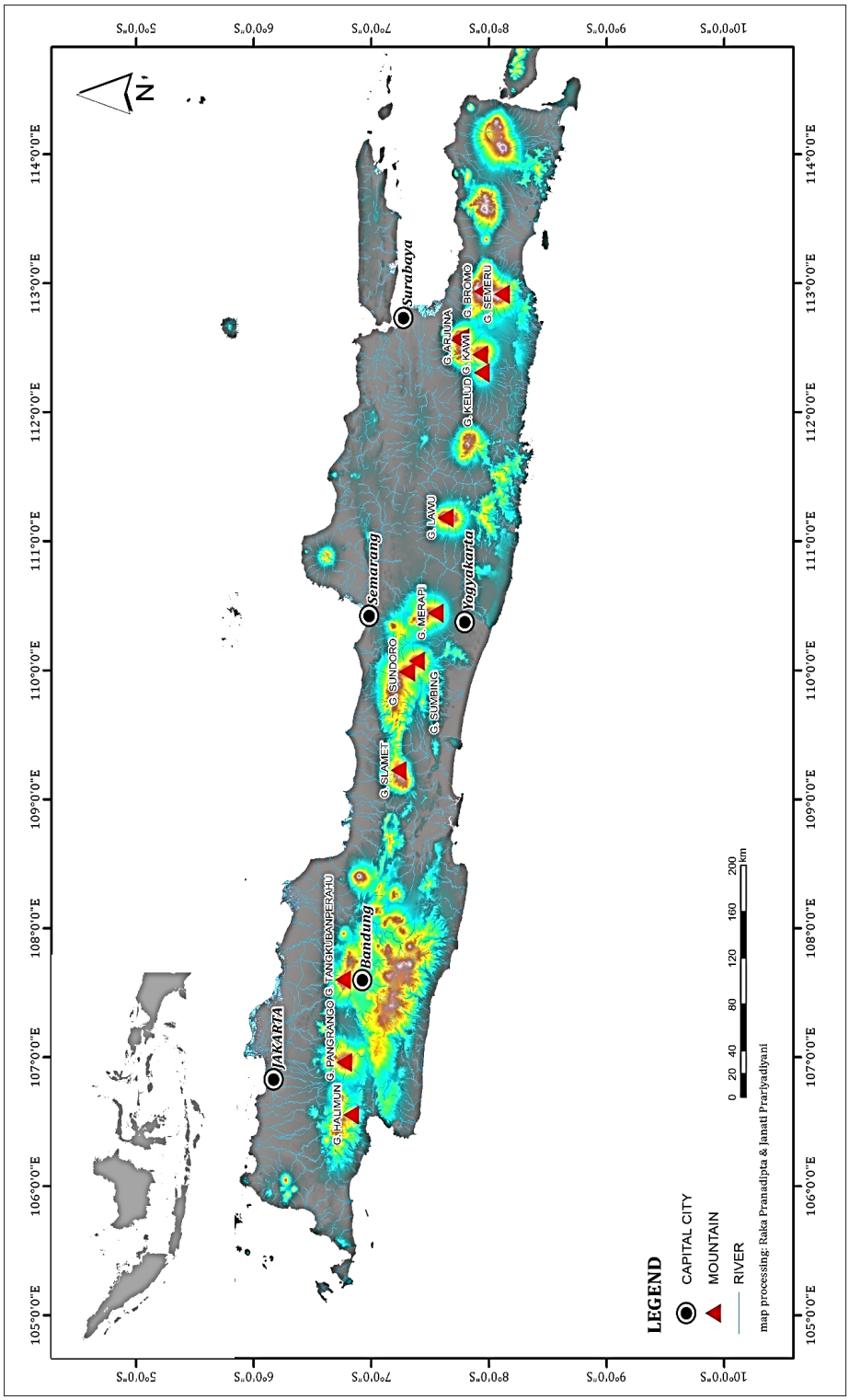

Fig. 3.6. The distribution of volcanoes on Java. (Map by Tjahjono Prasodjo)

parts of the world, including Southeast Asia, entered a much drier period, as the Southeast Asian climate was impacted by the Little Ice Age. This occurred from the early fourteenth to the mid-nineteenth century, after the Medieval Climate Anomaly. Whereas the Medieval Climate Anomaly had produced more rainfall, the Little Ice Age was marked by droughts, although their duration and intensity varied from place to place. That lengthy and recurring droughts occurred during the Little Ice Age in mainland Southeast Asia have been highlighted by various scholars, as have their influence on the region's states.[49] Even the period of transition from the Medieval Climate Anomaly to the Little Ice Age contributed to the crises faced by various Southeast Asia states. In the field of paleoclimatology, research into the relationship between climate and the development of states in Southeast Asia before the nineteenth century is still in its infancy. There is limited data and that which does exist is not always consistent.

Recently, some research has been conducted into the East Javanese paleoclimate, particularly on the basis of the paleolimnological records from three lakes in East Java.[50] The most important finding is that there were periods of drought at various points in East Javanese history. One of these pieces of research has discovered evidence of four droughts over the past 1,400 years, occurring in 930-1130, 1460–1640, 1790–1860, and 1985–2008 CE.[51] Another record, from Ranu Lamongan, shows two multi-decadal periods of drought: *c.* 1275–1325 CE and *c.* 1450–1650 CE.[52] Further research, by Rodysill *et al.*, demonstrates that the most severe drought happened around 1790 CE, ± 20 years.[53] On the basis of their research into the sediments of Lake Kalimpaa in central Sulawesi, Michael Wündsch *et al*. have explained that the periods of drought in East Java coincided with those in Sulawesi, although there are parts of their study that also highlight dissimilarities.[54] On the basis of an isotopic analysis of stalagmites from the Ciawitali cave, in West Java, Watanabe *et al*. have suggested that there were episodes of drier conditions

49 Lieberman and Brendan Buckley, "The Impact of Climate on Southeast Asia, circa 950–1820": 1073-1074.

50 Rodysill, et al., "A Paleolimnological Record of Rainfall and Drought from East Java, Indonesia During the Last 1,400 year": 125-139; Jessica R. Rodysill, et al., "A Severe Drought During the Last Millennium in East Java, Indonesia", *Quaternary Science Reviews* 80 (2013): 102-111.

51 Rodysill, et al., "A Paleolimnological Record of Rainfall and Drought from East Java, Indonesia During the Last 1,400 year": 137.

52 Shelley D. Crausbay, "A ca. 800-year Lithologic Record of Drought from Sub-Annually Laminated Lake Sediment, East Java", *Journal of Paleolimnology* 35 (2006): 641–659.

53 Rodysill, et al., "A Severe Drought during the Last Millennium in East Java, Indonesia": 109-110.

54 Michael Wündsch, et al., "ENSO and Monsoon Variability During the Past 1.5 kyr as reflected in sediments from Lake Kalimpaa, Central Sulawesi (Indonesia)", *The Holocene* (2014): 10-11.

around the years 1600, 1800, and 1990 CE, a hypothesis that agrees with lake sediment analysis.[55] However, the records are inconsistent, especially those which show there was a period of drought in 930-1130 CE in Java;[56] I assume this to be a "false" record, or at least one that should be critically reconsidered, because other research findings have suggested that it was, in fact, wetter in Java at that time.[57] Hence, periods of drought in either Java or East Java took place *c.* 1300 CE, *c.* 1450-1650 CE, *c.* 1790-1860 CE, and 1985-2008 CE. These were interspersed with wetter periods.

The Javanese droughts that occurred during the transition between the Medieval Climate Anomaly and the Little Ice Age correlated with similar events in mainland Southeast Asia. Buckley *et al.* have sought to explain the relationship between climate—especially long droughts combined with intense monsoons in Cambodia—and the eventual demise of the Khmer empire. Based on climatic evidence from a 750-year hydroclimate reconstruction on the basis of tropical southern Vietnamese tree rings, they argue that a decades-long drought would have decreased Khmer agricultural productivity while large-scale monsoons would have destroyed the water control infrastructure.[58] Lieberman and Buckley added further similar examples from Pagan and Dai Viet to confirm this idea.[59] Their conclusion highlights a correlation between a drought-driven climate and socio-economic vulnerabilities that could eventually create a situation in which the kingdoms in question could collapse.

The drier climate of East Java was both expected and planned for by farmers and by the state through the provision of irrigation infrastructure; in other words, the solution put forward for the drier climate was the construction of more waterworks. Evidence found in Old Javanese inscriptions regarding water infrastructure or water management is rare and most are from East Java rather than Central Java.[60] This pattern suggests that problems regarding water control were greater in East Java.

55 Y. Watanabe, et al., "Hydroclimate Reconstruction in Indonesia over the Last Centuries by Stalagmite Isotopic Analyses". *PAGES News*, Vol 20, No 2, December (2012): 74-75.

56 See: Rodysill, et al., "A Paleolimnological Record of Rainfall and Drought from East Java, Indonesia During the Last 1,400 year": 135.

57 Khider, Paleoceanofraphy of the Indonesian Seas over the Past 25,000 Years: 140-143; Cobb, et al., "El Niño/Southern Oscillation and Tropical Pacific Climate during the Last Millennium": 271-276. Also see: Rodysill, et al., "ENSO-driven Flooding Events in East Java, Indonesia during the Past Millennium".

58 B.M. Buckley, et al., "Climate as a Contributing Factor in the Demise of Angkor, Cambodia". *PNAS*, vol. 107, no. 15, April 13 (2010): 6749-6750.

59 Lieberman and Brendan Buckley, "The Impact of Climate on Southeast Asia, circa 950–1820": 1049-1096.

60 J.W. Christie, "Water from the Ancestors: Irrigation from Early Java and Bali", in: *The Gift of Water: Water Management, Cosmology and the States in Southeast Asia*, ed. Jonathan Rigg (London: School of Oriental and African Studies University of London, 1992): 17.

Archaeological features and artifacts from East Java relating to water management can be found all along the Brantas river valley, and include dams, water-tunnels, ponds, and river channels. As a result of facing larger water-management issues, it seems that the role of the East Javanese court was greater, if not in the water management system as a whole, at least in specific instances such as collecting agricultural taxes.

To sum up, both the physical environment itself and other environmental factors in Java played important roles in how ancient Javanese political authorities and societies responded and adapted to the environmental conditions. I also consider that the climate and climate change in ancient Java, and especially ancient East Java, had a profound influence on the socio-political dynamics of the states. Climate records, combined with historical and archaeological data, support the various explanations put forward by scholars about how these states and their inhabitants adapted to the changing environment and climate by simply improving water control technology and management or, as an extreme measure, by moving the state's centre.

3.3. THE BRANTAS RIVER BASIN

The basin is surrounded by Mount Bromo and Mount Semeru to the east, a series of low ridges to the south, Mount Wilis and its ridges to the west, and the Kedung low ridges and Madura Strait to the north. In the middle of the basin is the Arjuno mountain complex, which consists of Mount Arjuno, Mount Butak, and Mount Kelud. The Brantas river is 320 km in length, and its source is located in a village called Sumberbrantas, on the southern flank of Mount Arjuno. The basin covers nine regencies—Tulungagung, Trenggalek, Kediri, Nganjuk, Blitar, Malang, Mojokerto, Jombang, Sidoarjo—and five municipalities—Malang, Kediri, Blitar, Mojokerto, and Surabaya.[61]

The river flows in a clockwise, spiralling course from its source to the Madura Strait. The main branch of the river can be divided into three parts, or reaches. The first part, also known as the upper reach, starts at the spring, runs southward through the Malang Plateau, and, after about 20 kilometres, turns west. After this, the Brantas river is joined by a large number of tributaries which stream down from the southern slope of Mount Kelud. The slopes of this first reach are generally steeper than those of the second stretch, or the middle reach. The middle reach begins near Tulungagung, when the Brantas river turns northward, and it then flows north to north-west of Jombang, before flowing eastwards to Mojokerto. The lower reach of the Brantas river begins at Mojokerto, where it divides into two branches,

61 Anjali Bhat, Kikkeri Ramu, and Karin Kemper, "Institutional and Policy Analysis of River Basin Management. The Brantas River Basin, East Java, Indonesia". *World Bank Policy Research Working Paper* 3611 (May 2005): 8.

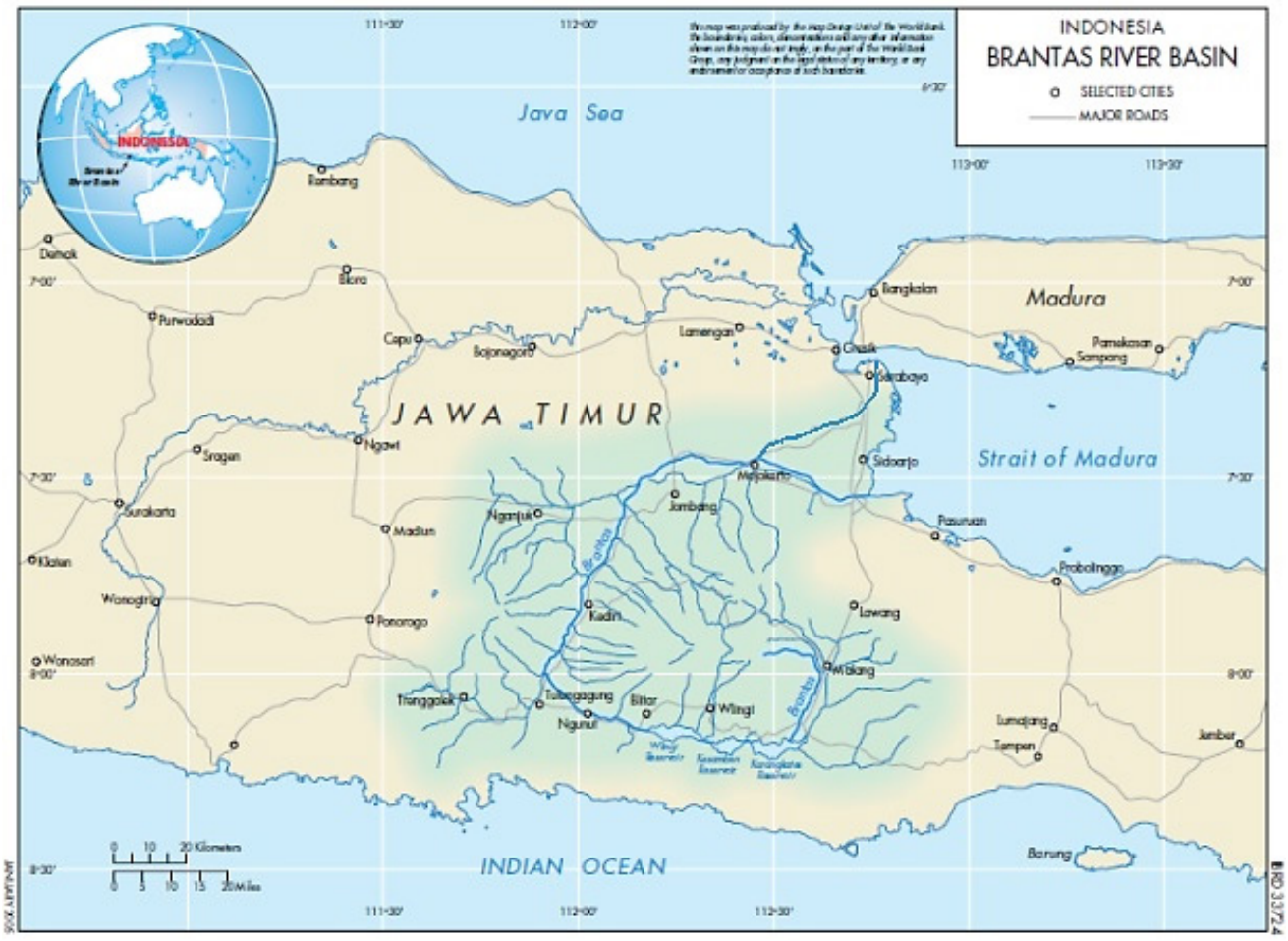

Fig. 3.7. Map of the Brantas river basin. (Source: Anjali Bhat, Kikkeri Ramu, and Karin Kemper, "Institutional and Policy Analysis of River Basin Management The Brantas River Basin, East Java, Indonesia". *World Bank Policy Research Working Paper* 3611, May 2005)

Kali Mas and Porong. Both branches discharge into the Madura Strait, the Kali Mas river to the northeast of Surabaya, at Surabaya Strait, and the Porong river at Porong bay, south of Sidoarjo.[62]

As the geomorphology of the river basin is, to a large extent, characterised by volcanoes, the basin and the river itself are impacted by their existence. At the very least, the volcanoes both contribute to the fertility of the basin and play a role in silting up the river, riverbed aggravation, and reservoir sedimentation through their eruptions. The two active volcanoes in the basin are Mount Semeru and Mount Kelud, which at times produce volcanic ash and other material. The volcanic debris that is deposited on the mountain slopes is regularly taken, via rainwater runoff, into the Brantas river. Analysis of the Brantas river sediment shows that it mainly consists of tuffaceous sandstones, agglomerates, or volcanic conglomerates.[63]

The sedimentation that is a product of the volcanic material also plays a role in shaping the Brantas delta, which is the area between the Kali Mas and the Porong rivers. The delta was formed in the Mid-Pleistocene era, demonstrated by marine deposits being found as much as dozens of metres below the present-day sea level.[64] The ancient delta certainly did not have the same form as it does now, because the delta was almost entirely shaped during the last century, as is evident from old maps.[65] The question is, however, how far the delta has altered and developed between then and the present. Van Bemmelen estimates that, in the tenth century, the Brantas estuary was still fairly wide and formed a natural harbor, but now the Porong estuary is more than 40 km from the very end of the Brantas river.[66] On the basis of a list of ferry harbors along the Brantas river that was inscribed on a Trowulan inscription from 1358 CE and an old map of Residentie Soerabaia, Van Stein Callenfels and Van Vuuren suggest that the mouth of the Brantas or Porong was in Tulangan or Pamotan,[67] 30-20 km from the coastline today. On the other hand, Verbeek believes that, a thousand years ago, the coastline was essentially the same

62 R.D. Moetariyono, *Sediment Budget and Estuarine Circulation on The Brantas River Estuary East-Java, Indonesia* (Masters Thesis, Faculty of Engineering and Applied Science, Memorial University of Newfoundland, Canada, 1992): 5-17.

63 P. Hoekstra and Tiktanata, "Coastal Hydrodynamics, Geomorphology and Sedimentary Environments of Two Major Javanese River Deltas. Program and Preliminary Results from The Snellius-II Expedition (Indonesia)", *Journal of Southeast Asian Earth Sciences* 2/2 (1988): 102.

64 Sunarto, *Rekonstruksi Sejarah Geomorfologis Delta Brantas dalam Hubungannya dengan Situs Arkeologi Medowo Jawa Timur* (Yogyakarta: Fakultas Geografi UGM, 1990): 24.

65 Hoekstra and Tiktanata, "Coastal Hydrodynamics, Geomorphology and Sedimentary Environments of Two Major Javanese River Deltas": 104-105.

66 R.W. van Bemmelen, *The Geology of Indonesia---General Geology of lndonesia and Adjacent Archipelagoes*, Vol. 1A. (The Hague: Martinus Nijhoff, 1949): 30.

67 P.V. van Stein Callenfels and L. van Vuuren, "Bijdrage tot de Topographie van de Residentie Soerabaia in de 14de Eeuw", *Tijdschrift van het Koninklijk Nederlandsch Aardrijkskundig Genootschap* 41/1 (1924): 67-81.

as it is today, an assumption he makes on the basis of an archaeological survey of the Brantas river delta in which he found archaeological artifacts in both Kalang Anyar and Tulungan, only 3 km from the present coastline.[68] Most researchers believe that the delta is constantly evolving and that these morphological changes suggest a dynamic development along the whole river basin over time.

Like the majority of Indonesia, the Brantas basin has a tropical monsoon climate which is divided into two seasons: the rainy season, from November to April, and the dry season, from May to October. The changing of the seasons is influenced by the Southeast Asian monsoon wind pattern. In the rainy season, the wind blows from the South China Sea, bringing moist air with high levels of humidity, while the reverse is the case in the dry season, when the wind brings dry air from the Australian continent. Peak rainfall is from December to February, while June to August is the peak of the dry season, when rainfall drops to a minimum. As such, 80% of rainfall occurs in the rainy season and there is an average of 2,000 mm per year. Nevertheless, there is variability between the level of rainfall in the mountains and in the lowlands, as the latter sees less. The mountainous areas have significant rainfall, occasionally even having some in the dry season; the average rainfall in these mountainous areas is between 3,000 and 4,000 mm. The annual mean temperature in the Brantas river basin is between 24.2^0 and 26.6^0 celsius and the annual relative humidity ranges from 75% to 82%.[69]

The origins of the name of the river—which is the second largest and longest river in Java—is unknown. Although many authors wrote descriptions of the river in Old Javanese or Sundanese texts, they did not call it "the Brantas." In Old East Javanese inscriptions the river was named *Bangawan*, such as in the Kamalagyan inscription of 1037 CE;[70] today, this term is used to describe any river. Bujangga Manik, who wrote an account of his journey from Sunda to East Java in the fifteenth century, may have named the river Ci Ronabaya. He wrote about the Ronabaya river when he crossed it after passing through Blitar, on his return journey to Sunda, and Noorduyn[71] has suggested that "Ronabaya" refers to the Brantas. Babad Tanah Jawi, an Old Javanese source from the eighteenth century, calls the river Banawi Palabuhan or the Palabuhan river.[72] Hence, at least up to the that time the river

68 R.D.M. Verbeek, *Oudheden van Java: Lijst der Voornaamste Overblijfselen uit den Hindoetijd op Java, met Eene Oudheidkundige Kaart* ('s Hage: Nijhoff, 1891): 207.

69 E. Aldriana and Yudha Setiawan Djamila, "Spatio-Temporal Climatic Change of Rainfall in East Java Indonesia", *International Journal of Climatology* 28 (2008): 437.

70 See the transcription of the inscription in: J.L.A. Brandes, "Oud-Javaansche Oorkonden", Negalaten Transcripties van Wijlen Dr. J.L.A. Brandes, uitgegeven door Dr. N.J. Krom, *VBG* 60 (1913): 134-136.

71 J. Noorduyn, "Bujangga Maniks Journeys through Java: Topographical Data from an Old Sundanese Source", *BKI* 138/4 (1982): 425-426.

72 See: J. Noorduyn, "Further Topographical Notes on the Ferry Charter of 1358, with Appendices on Djipang and Bodjanegara", *TBG* 124/4 (1968): 469.

was not called the Brantas. It may be that the old sources referred to above call the river by a local name or that the river had many names given to it by the different peoples who lived near it. If that is the case then it may be that one reach of the river was called Brantas; this is likely to have been the first part of the river as the river's spring is at Sumber Brantas (Source of the Brantas) village in the sub-district of Bumiaji, in Batu, East Java. Perhaps, in the past, during the initial mapping of Java or East Java the cartographer took "Brantas" as a label to name the whole reach of the river.

The Brantas river was closely linked to the growth of East Javanese polities in the tenth to the sixteenth centuries. It is possible to see very clearly here the political role of the river, especially when the capitals of the East Javanese polities shifted from one location to another. This was the case as early as the time Pu Siṇḍok Śrī Īsānawikramma Dharmmotuṅgadewa (929-949 CE), the king of Java, moved his capital to East Java and proclaimed himself the founder of a new dynasty, the Īsāna,[73] while his kingdom used the name Matarām.[74] He built his new capital at Tamwlang,[75] now a village in Tambelang, but then moved it to Watugaluh, near the Brantas river in Jombang. In the year 1019 CE, a new king of Java ascended the throne. This was Airlaṅga (r. 1019-1045 CE), one of the most famous kings of early Java. During his reign, he subjugated many local polities and thereby unified the kingdoms in the area. However, at the end of it, he had to divide his kingdom into two—thereby creating the Jaṅgala and the Pañjalu kingdoms—one for each of his two sons.[76] After around 60 years, the Kaḍiri kingdom emerged. The capital of this kingdom was centreed on Kediri, also in the Brantas basin, although it was in the upper part of the middle reach.[77]

After the fall of the Kaḍiri kingdom (*c.* 1222 CE) there emerged a new dynasty. This dynasty was that of Rājasa, also called Girīndra, and its kingdom was called the Siṅhasāri. This is very important because its capital was moved towards the upper reach of the Brantas river. The founder and first king of this dynasty was Ken Arok (1222-1227 CE), who unified Java by conquering neighbouring polities. According to the Nāgarakṛtāgama, he conquered both the Kaḍiri and the Jaṅgala kingdoms and once again unified East Java.[78] The most famous of the kings of Siṅhasāri was

73 The name of this dynasty is recorded in the Pucangan inscription, which was issued by Airlangga, see: H. Kern, "De Steen van den berg Penanggungan (Surabaya), thans in 't Indian Museum te Calcutta", *VG* 7 (1917): 83-114.

74 See the Paradah inscription and the Añjukladang inscription: Brandes, *Oud-Javaansche Oorkonden: Nagelaten Transcripties*: XLVIII and XLVI.

75 Poesponegoro and Nugroho Notosusanto, *Sejarah Nasional Indonesia III*: 158.

76 On this division, see: H. Kern, "De Sanskrit-inscriptie van het Mahākṣobhya-beeld te Simpang (stad Surabaya, 1211 çaka)", *VG* 7 (1917): 187-197; S. Robson, Deśawarṇana (Leiden: KITLV Press, 1995): LXVIII.

77 Poesponegoro and Nugroho Nootosusanto, *Sejarah Nasional Indonesia III*: 265.

78 S. Robson, *Deśawarṇana* XL: 1-5.

Kṛtanagara (1254-1292 CE), who was the first Javanese king to attempt to expand his power outside Java. In 1275 CE, he sent an expedition to Mālayu (western Sumatra) to make an alliance with the Mālayu in an attempt to counter Chinese supremacy in the Malacca Strait.[79] Besides Mālayu, other polities that were his imperium included Pahang (Malaysia), Gurun, Bakulapura, Sunda, and Madura and the rest of Java, while he also had a good political relationship with Campa. The Siṅhasāri polity declined in 1292 CE because of a rebellion by Jayakatwaṅ who was from Kaḍiri, and this was followed by large-scale political upheavals involving Jayakatwaṅ, Wirarāja, Wijaya (a son-in-law of Kṛtanagara), and the Mongols.[80] Wijaya succeeded in usurping power, becoming the first king of a new kingdom—Majapahit—which became extremely powerful until its eventual collapse in the first quarter of the sixteenth century. It is likely that the Majapahit capital moved several times, although the largest of them is believed to have been at Trowulan, a site located close to the Brantas river. From its beginnings until the last quarter of the fourteenth century, Majapahit rule saw great economic, political, and cultural achievements. However, the rest of the Majapahit period after king Hayam Wuruk was declining, especially as a result of the internal political struggles between various members of the ruling family.

Besides increased political developments, in this period East Java was characterised by increased development along the Bengawan Solo and the Brantas river basins. Following the movement of the Javanese kingdom's centre of power to East Java, water management greatly increased, and East Javanese inscriptions[81] provide more records related to the building of water control infrastructure. These inscriptions demonstrate that many dams and other irrigation works were built in the Brantas river basin at this time. These inscriptions highlight the double-edged nature of the river: it provides water for irrigation and for shipping but remains a constant threat due to the risk of flooding.[82]

As such, the hydrological infrastructure projects of ancient East Java included

79 J.G. de Casparis, "Sriwijaya and Malayu", *SPAFA Final Report: SEAMEO Project in Archaeology and Fine Arts, Consultative Workshop on Archaeological and Environmental Studies on Sriwijaya* (Jakarta, Padang, Prapat and Medan: Southeast Asian Ministers of Education Organization, 1985): 247-249.

80 On the Mongol invasion of Java, see: D.W. Bade, *Of Palm Wine, Women, and War: The Mongolian Naval Expedition to Java in the 13th Century* (Singapore: Institute of Southeast Asian Studies, 2013). See also: J. Gommans, "Java's Mongol Demon. Inscribing the Horse Archer into the Epic History of Majapahit", in: *HerStory. Historical Scholarship between South Asia and Europe. Festschrift in Honour of Gita Dharampal-Frick*, ed. Rafael Klöber and Manju Ludwig (Heidelberg: CrossAsia-eBooks, Heidelberg University Library, 2018): 243-252.

81 N.C. van Setten van der Meer, *Sawah Cultivation in Ancient Java: Aspects of Development during the Indo-Javanese Period, Fifth to fifteenth Century* (Canberra: Australian National Univesity Press, 1979).

82 F.H. van Naerssen, "De Brantas en Haar waterwerken in den Hindu Javaanschen tijd", *De Ingenieur* 35/7 (1938): A65.

damming rivers and building canals both to prevent flooding and to provide water for agriculture. As early as 804 CE, a canal was built in the upper reaches of the Brantas river by the elders and villagers of Culaṅgi; an inscription records that the canal was called the Hariñjing canal. Today, it is known as the Srinjing canal.[83] Another water control feature of the ancient Brantas river basin is mentioned in the Kamalagyan inscription, from 1037 CE.[84] This records a dam built upon the orders of King Airlaṅga both to prevent flooding of the surrounding areas where, in the past, the river had burst its banks and to help trading vessels reach Caṅgu, the hinterland royal-port.[85]

Indeed, hydrological infrastructure played a very important role in supporting economic life within East Java, and consequently the East Javanese polities would sometimes intervene when local problems could not be solved by the community itself. The scale and richness of irrigation features constructed during this period is demonstrated by the archaeological records of the Majapahit kingdom, as there are more than ten dams from the Majapahit period in the Brantas river basin,[86] while archaeological features in the ancient city of Trowulan demonstrate that there was an ancient East Javanese urban population near the Brantas river.[87] This city, located at the confluence of the Brantas river and some of its tributaries, has a large number of hydrological structures—including canals, reservoirs, and bathing places—which were part of the water control network system of the Brantas river basin. This will be explored further in Chapter 5.

Furthermore, in the past, the Brantas river played an important role as a means of transporting goods and people from the coast to the hinterlands and vice versa. The Trowulan inscription from 1358 CE describes places or villages along the river as being harbors, showing that it was possible to navigate the river as far as the vicinity of Kertosono from the Kali Mas and the Porong rivers. The ancient Nagarakṛtāgama text mentions Bubat, a village located on the Brantas river, as being a large commercial centre with many sizeable buildings that was populated

83 Sukabumi or Hariñjing inscription, see: P.V. van Stein Callenfels, "De Inscriptie van Soekaboemi", *MKAW-L*, B 78 (1934). See also: F.H. van Naerssen and R.C. de Iongh, The Economic and Administrative History of Early Indonesia. Leiden: E.J. Brill, 1977): 57.

84 Brandes, *Oud-Javaansche Oorkonden*: 134-136.

85 Tjahjono Prasodjo, "Kemajuan Teknologi Masa Airlangga: Contoh Kasus Pembangunan Tambak atau Ḍawuhan dalam Prasasti Kamalagyan 1037 M.", paper presented in a discussion "Airlangga sebagai Tokoh" in Jombang (2004): 5.

86 H. Maclaine Pont, "Eenige Oudheidkundige Gegevens Omtrent den Middeleeuwschen Bevloeiïngstoestand van de Zoogenaamde 'Woeste Gronden van de Lieden van Trik' voor Zoover Zij Wellicht van Belang zullen kunnen zijn voor eene Herziening van den Tegenwoordigen Toestand". *OV* 1926, Bijlage G (1926): 100-129.

87 J.N. Miksic, "Water, Urbanization, and Disease in Early Indonesia", in: *Complex Polities in the Ancient Tropical World. Archaeological Papers of the American Anthropological Association*, No. 9, eds. Elizabeth A. Bacus and, Lisa J. Lucero (Arlington: American Anthropological Association, 1999): 175-180.

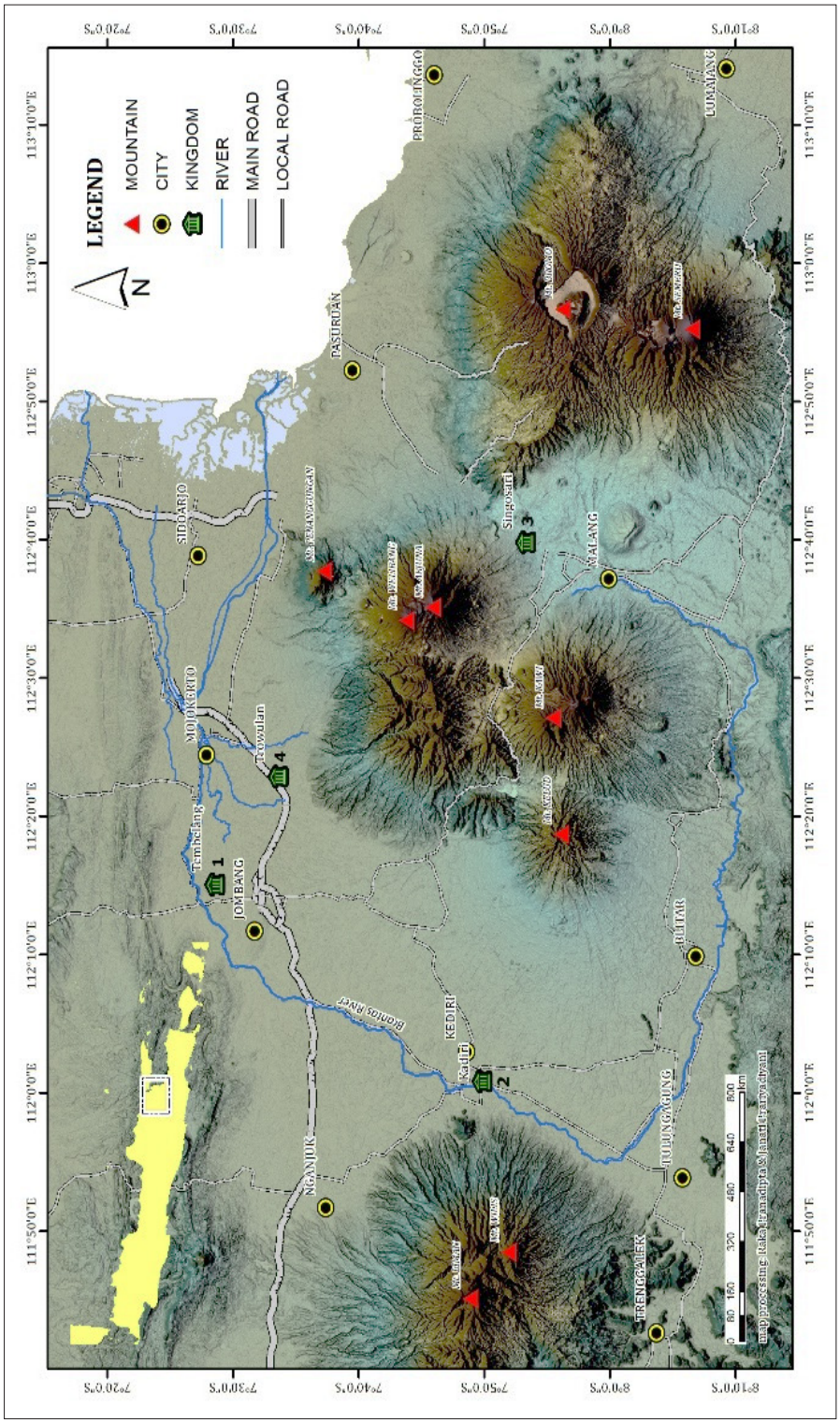

Fig. 3.8. Centers of East Javanese polities. 1.East-Java Mataram kingdom (929-1006 CE), 2. Kaḍiri kingdom (1117-1222 CE), 3. Singhasari kingdom (1222-1292 CE), 4. Majapahit kingdom (1293-1521 CE). (Map by Tjahjono Prasodjo)

by both local and foreign inhabitants. Due to the fact that the Brantas river was navigable, it facilitated communication between the people who lived along it, from the hinterland to the coast.

3.4. CONCLUSION

Comparing the situation of Central Java before the tenth century with that afterwards in East Java, the latter also faced environment problems but there was less instability than in Central Java. The largest disasters experienced were floods, the result of overflowing rivers caused by heavy rain or lahars. For instance, the capital of the Majapahit kingdom, Trowulan, was located in an area that is greatly influenced by various geological systems—including the volcanic system (Anjasmoro-Welirang-Penanggungan-Kelud) and the river system (Brangkal-Landean-Pikatan)—which led to flooding several times a year. On the other hand, the area was extremely fertile.

To sum up, the Brantas river basin has been a dynamic region since prehistoric times both in geographical terms and in how the inhabitants have dealt and coped with climate changes through water control infrastructure. The hydromorphology of the river has changed over time and is dependent on many aspects, from the structure and evolution of the surface of the basin to how humans have interacted with and sought to control the river. The hydrological systems of the Brantas river basin have evolved due to a variety of natural and anthropogenic influences, including changes in land and water use caused by human inhabitation, agriculture, climate change, modifications to water infrastructure, and water use. As such, this kind of hydromorphological response must be considered important when researching water management in the Brantas river basin.

Chapter 4

Textual Records of Ancient East Javanese Water Management

This chapter discusses the reconstruction of water management in East Java on the basis of inscription records. The first part contains an explanation of East Javanese inscriptions, in which I discuss the nature of Javanese inscriptions in general before making some more specific comments about the inscriptions I have used in the thesis. The second part analyses those inscription records that deal with water management in East Java, and in which I explain the water management approaches employed by the East Javanese. In the final part of this chapter, I note the important role of the Brantas river as a commercial space, after which there is the conclusion.

4.1. THE NATURE OF THE EAST JAVANESE INSCRIPTIONS

Hundreds of inscriptions have been found in Indonesia, especially from the Hindu-Buddhist period. They have been found in Sumatra, Kalimantan, Java, and Bali, and date from the end of the fourth century (the oldest inscriptions, namely the Kutai Inscriptions) to the latest dated inscriptions, Trailokyapuri I and II inscriptions, from 1408 Śaka (1486 CE). Most of them have been published and some have also been translated (into Indonesian, Dutch or English), with notes and commentaries. Some essential corpuses of Old Javanese inscriptions have been published. In 1913, J.L.A. Brandes published transcriptions of 125 inscriptions, both dated and undated.[1]

1 J.L.A. Brandes, "Oud-Javaansche Oorkonden", *Verhandelingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen, Deel LX* (Batavia-'s Hage: Albrecht & Co.-M.

Others were published by J.G. De Casparis, H.B. Sarkar, and Boechari.[2] In 1952, L.Ch. Damais published a list of 290 dated inscriptions, while 251 dated long inscriptions and 352 dated short inscriptions were listed by Kōzō Nakada in 1982.[3] There are also small collections that cover less than 30 inscriptions, for instance those published by A.B. Cohen Stuart, Machi Suhadi and Richardiana K., Soekarto Karto Atmojo *et al*., and Machi Suhadi and M.M. Soekarto, and also A. Griffiths.[4]

These inscriptions were carved into stone or metal. Some of the stone inscriptions are very large and were even inscribed onto huge monolithic stones, such as the Ciaruteun inscription near Bogor, West Java. At the same time, there are also large inscriptions chiseled into a block shape, such as the Sangguran inscription, which is around two metres high and 35 cm thick. Smaller stone inscriptions have been shaped from blocks of stone less than one metre in size. Metal inscriptions were produced on copper, silver or gold. The copper plate inscriptions are of various sizes, from around 20 to 50 cm in length and 10 to 25 cm wide, but an inscription on silver or gold is usually very thin — less than 0.2 cm thick — and with small dimensions.[5] More perishable materials such as *lontar* or palm leaf are assumed to have also been used at that time.[6]

Most of the inscriptions are legal documents concerning the establishment of *sīmas*. It is not currently possible to give an exact number, but some scholars assume

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Nijhoff, 1913).

2 J.G. de Casparis, *Prasasti Indonesia 1: Inscripties uit de Çailendra-tijd* (Bandung: Nix, 1950); J.G. de Casparis, *Prasasti Indonesia 2: Selected Inscriptions from the Seventh to the Ninth Century A.D.* (Bandung: Nix, 1956); H.B. Sarkar, *Corpus of the Inscriptions of Java Vol. I* (Calcutta: Firma K.L. Mukhopadhyay, 1972); H.B. Sarkar, *Corpus of the Inscriptions of Java Vol. II* (Calcutta: Firma K.L. Mukhopadhyay, 1972); Boechari, *Prasasti Koleksi Museum Nasional Jilid I* (Jakarta: Proyek Pengembangan Museum Nasional, 1985-1986).

3 L.Ch. Damais, "Etudes d'Epigraphie Indonésienne: Liste des Principales Inscriptions Datées de l'Indonésie, *BEFEO* 46 (1952): 1-105. K. Nakada, *An Inventory of the Dated Inscriptions in Java* (Tokyo: Toyo Bunko, 1982).

4 A.B. Cohen Stuart, *Kawi Oorkonden in Facsimile: met inleiding en transcriptie* (Leiden: E.J. Brill, 1875); M. Suhadi and K. Richardiana, *Berita Penelitian Arkeologi No. 47: Laporan Penelitian Epigrafi di Wilayah Provinsi Jawa Timur* (Jakarta: Proyek Penelitian Arkeologi Jakarta, Pusat Penelitian Arkeologi Nasional, Departemen Pendidikan dan Kebudayaan, 1996); M. Suhadi and M.M. Soekarto, *Berita Penelitian Arkeologi No. 37. Laporan Penelitian Epigrafi Jawa Tengah* (Jakarta: Proyek Penelitian Purbakala, Departemen Pendidikan dan Kebudayaan, 1986); A. Griffiths, "The Epigraphical Collection of Museum Ranggawarsita in Semarang (Central Java, Indonesia)", *BKI* 168, 4 (2012): 472-496.

5 See for the example of the inscriptions in: A. Griffiths, "Written traces of the Buddhist past: Mantras and Dhāraṇīs in Indonesian Inscriptions", *Bulletin of SOAS*, 77, 1 (2014): 137–194.

6 See: J.G. de Casparis, *Indonesian Palaeography: A History of Writing in Indonesia from the Beginnings to c. A.D. 1500* (Leiden: Brill, 1975).

that more than 90 per cent of the total are such *sīma* inscriptions.[7] A *sīma* grant inscription attests that a village or part of a village has had its taxes reduced or that the beneficiary has a tax exemption; in most cases, this was a religious foundation. The *sīma* land seemingly benefitted from this financial reward, but after receiving it seems that the *sīma* land had to finance the operating costs of the religious foundation located on that land. It seems likely that the *sīma* owner had to change how tax was paid; instead of paying it to the state, the owner had to give it to a new beneficiary, usually a religious foundation or something to which the *sīma* was dedicated.[8]

The text of an inscription is usually divided into a number of sections, and each section contains different information. Scholars have attempted to identify a general structure to these texts, but as the various sections are not the same in each inscription they have only been able to describe the structure of such texts in very broad terms.[9] For *sīma* inscriptions this consists of (1) the *maṅgala*, (2) the date, (3) the promulgation of the decree by the king or royal functionaries who established the *sīma*, (4) the motivation or reason for the establishment of the *sīma*, (5) information regarding the status of the *sīma*, (6) the list of functionaries and names of guests to whom gifts were given, (7) the description of the *sīma* ritual ceremony, (8) the description of the feast that was given as part of the process, and (9) the name of the person who produced the inscription.

The first section of the *sīma* inscription is the *maṅgala,* which is an invocation of a deity or a salutation, for instance *nama śiwāya* (a salutation to Śiwa), *om* (or *oṅ*, the sacred syllable), *awighnam astu* ("may there be no hindrance"), or just *swasti* ("hail"). Some inscriptions lack a *maṅgala* element. Most of the dates are in the Śaka era and they are commonly given with various expressions, such as

7 One of the scholars who stated this was Jan Wisseman Christie, in: J.W. Christie, *Patterns of Trade in Western Indonesia: Ninth through Thirteenth Centuries A.D.* (Ph.D. Thesis, School of Oriental and African Studies, University of London, 1982).

8 Comparing them with Indian inscriptions from around the same period, Timothy Lubin argues that although the Javanese borrowed the word from India, the concept of *sīma* had a different meaning in Java: "*sīma* (sometimes *dharma sīma)* denotes a distinctive Javanese variant of the South Asian land grant", see: T. Lubin, "Writing and the Recognition of Customary Law in Premodern India and Java", *Journal of the American Oriental Society* 135/2 (2015): 252. For the definition of *sīma,* compare to A.M.B. Jones, *Early Tenth Century Java from the Inscriptions. A Study of Economic, Social and Administrative Conditions in the First Quarter of the century* (Dordrecht: Foris Publications, 1984): 59-61 and also Christie, *Patterns of Trade in Western Indonesia:* 84.

9 Among them are: Buchari, "Epigraphy and Indonesian Historiography", in: *An Introduction to Indonesian Historiography*, ed. Soedjatmoko *et al*. (Ithaca, New York: Cornell University Press, 1965): 47-73; Jones, *Early Tenth Century Java from the Inscriptions:* 11-12; J. van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band I* (Ph.D Dissertation, Leiden University, 1996).

"Śrī Śakawarṣātīta", "Śakawarṣātīta", or just "*iṅ Śaka*". This is then followed by the digits of the year. Another era used in Old Javanese inscriptions is the *Sañjayawarṣa*, but this is found in only four inscriptions, namely those of Taji Gunuṅ, Timbaṅan Wuṅkal, Tihaṅ, and Tulaṅ Er. After the year, other dating elements follow, such as the month, the day, and various astronomical dating elements.[10] The inscription then mentions the *ājñā* (command) handed down by the ruler to the lower functionaries that would establish the *sīma*. This part of the inscription contains very useful data that help us identify the bureaucratic system of the state. Then the reason for the *sīma*'s establishment is described, usually preceded by the word *sambandhanya* (the reason was the following). The *sambandhanya* passages provide important historical data, such as that the tax of the cultivated land was transferred to a religious institution. The next part of the inscription mentions the rights and privileges of the grants that the beneficiary received, such as tax exemptions. It then records the various gifts or donations (*pasĕkpasĕk*) that were given to the officials and the witnesses who came from neighbouring villages (the status and positions of the officials determined the total gifts they would receive). Then comes a description of the ritual ceremony, which was led by a religious functionary called the *saṅ makudur*, and which sometimes began with a list of offerings provided for the ceremony followed by the ceremony itself and the curses that were uttered by the *saṅ makudur*. In many inscriptions, it is recorded that a feast was held after the ceremony, the description of which contains information on the food, drinks, and entertainment (e.g. dancing, singing, comedy, and even gambling) involved. The final part of the inscription records the name of the scribe (*citralekha*) who produced it.

The other type of inscription is the non-*sīma* inscription, and includes inscriptions dealing with judicial decisions, religious mantras, disputes over land, disputes over debt payments, donations to religious foundations, names, and those inscriptions which contain only a date. These non-*sīma* inscriptions may be either short or long; the name and date inscriptions are always short; names — whether official or personal — consist of less than five words while dates have only three or four digits. Mantra inscriptions often have longer texts, sometimes consisting of more than one row and being inscribed on a stone or a precious metal, such as gold or silver plate. The longest non-*sīma* inscriptions contain judicial opinions that resolve legal disputes and political decisions. One such example is the Wurudu Kidul

10 For further details on dating elements, see: J.G. de Casparis, *Indonesian Chronology* (Leiden: Brill, 1978); van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band I:* 59-69; and A. Gomperts, "Sanskrit *jyostiṣa* Terms and Indian Astronomy in Old Javanese Inscriptions", in: *Fruits of Inspiration. Studies in Honour of Prof. J.G. de Casparis*, ed. Marijke J. Klokke and Karel R. van Kooij (Groningen: Egbert Forsten, 2001): 93-134; and J.C. Eade and Lars Gislén, *Early Javanese Inscriptions. A New Dating Method* (Leiden: Brill, 2000).

inscription (dated 922 CE), which concerns a dispute about citizenship status.[11] The inscription records how the dispute arose, the subsequent judicial process, and the judgement that was promulgated by the law court.

It is important to highlight F.H. van Naerssen's explanation of the nature of Old Javanese inscriptions. He states that, because the inscriptions were related to "deeds of land grants or records of economic transactions," they were "not state documents dealing with general administration but dealt rather with specific local affairs".[12] Moreover, he concludes that Old Javanese inscriptions can be considered "the most authentic documents for historians". His conclusion was drawn on the basis of his observation that the content of the inscriptions really did record events of the past and that these were faithfully detailed in the inscriptions with authentic dates given;[13] as such, historians generally agree that the inscriptions do contain historically useable records. They can, however, be used as historical sources only if they are treated carefully and attempts are made to discover precisely what information contained within each may be used to reconstruct ancient Javanese history.

The main point to note is that it is necessary to understand both the contexts in which the inscriptions were produced and their limitations as records of past events. The context of an inscription refers to the target audience and the aim or mission of the inscription (or of the author or individual who tasked the author with producing the text). As such, the context of a *sīma* inscription is not the same as, for instance, the context of a mantra inscription; an inscription with a mantra or spell had to produce the spell precisely in order to fulfill its extra-textual function, to produce a magic effect, usually to a single owner. A *sīma* inscription was meant to be read aloud publicly because its content was legal documentation related to the status of a piece of land.

Even though Van Naerssen called them the most authentic documents for historians, it should be noted that Old Javanese inscriptions were in general not intended to record historical events and as such have limited value as historical sources. In the first place, because most inscriptions deal only with *sīma* grants, the overall information available is limited because we lack other kinds of data that could help us reconstruct a more comprehensive image of the ancient Javanese past. As such, it would be useful to compare the inscriptions with other sources, such as archaeological and literary ones. Secondly, by their very nature all Old Javanese inscriptions come from the past and use a very different language from Javanese

11 W.F. Stutterheim, "Transcriptie van Twee Jayapattra's", *OV 1925* (1925): 59; W.F. Stutterheim, "Een Javaansche Acte van Uitspraak uit het Jaar 922 A.D.", *TBG* 75 (1935): 444-456.

12 F.H. van Naerssen, "Ancient Javanese Recording of the Past", *Arts. The Journal of the Sydney University Arts Association* 5 (1968): 32.

13 Van Naerssen, "Ancient Javanese Recording of the Past": 33.

today. Old Javanese, with its many Sanskrit loan words, is not yet fully understood and still presents us with various problems of interpretation. Without a doubt, Zoetmulder's Old Javanese-English dictionary — which was based on literary texts — has contributed greatly to understanding the meaning of Old Javanese words, but comprehensive linguistic research on the Old Javanese used in the inscriptions remains a desideratum.[14] Thirdly, those editions of Old Javanese inscriptions that have been published contain many misreadings, incorrect transcriptions, mistranslations, and debatable interpretations.[15] Hence, each edition that will be used must be checked carefully. Fourthly, there is the possibility that some inscriptions may have been copied at a later time. In ancient Java, there were many inscriptions that were duplicated from older, original ones, while other inscriptions contain orthographic errors that cast doubt on their originality. In a dubious inscription errors can be found in the palaeography, linguistics, and dating, as well as historical anachronisms. For instance, the Gulunggulung inscription from 851 Śaka (929 CE) has many incorrect aspects; for example, Old Javanese words such as *pamṛṣi*, *tan pa wuah*, *duhilaten*, and *parahu* are written as *pamṛsi*, *tan mawuah*, *duhilatan*, and *barahu* respectively.[16] In this case, it is necessary to question the cause of these errors: were they caused by a sloppy carver or by someone who did not have good ability in Old Javanese?[17] The best way to detect this sort of errors is to compare the inscription in question to validated inscriptions from the period in question, comparing their paleographic style and linguistic characteristics.

4.2. THE EAST JAVANESE INSCRIPTIONS ON WATER MANAGEMENT

According to Nakada's list, 128 dated long inscriptions and 352 dated short inscriptions have been found in East Java, in 18 regencies (*kabupatens*).[18] Nakada

14 J.A.L.B. van den Veerdonk has argued that linguistic research has been undertaken only partially, and has called for more wide-ranging research involving the overall corpus of extant inscriptions; see: J.A.L.B. van den Veerdonk, "Old Javanese Inscriptions and Linguistic Research", in: *Studies in South and Southeast Asian Archaeology.* ed. H.I.R. Hinzler (Leiden, Brill: 1986): 5-12.

15 J.G. de Casparis puts forward these issues: J.G. de Casparis, "Reading Old Javanese Inscriptions", *BKI* 143/4 (1987): 545-547.

16 Trigangga, *Tiga Prasasti Batu Jaman Raja Sindok* (Jakarta: Museum Nasional, 2003): 10-16.

17 This is also seen in Indian epigraphy; for example, Richard Salomon wrote that in South Indian epigraphy are occasionally found spurious copperplate inscriptions. See: R. Salomon, *Indian Epigraphy. A Guide to the Study of Inscriptions in Sanskrit, Prakrit, and the other Indo-Aryan Languages* (New York-Oxford: Oxford University Press, 1998): 165-168.

18 Nakada, *An Inventory of the Dated Inscriptions in Java*: 100-171.

did not include undated inscriptions. His list was published in 1982, and the total number of inscriptions will be higher now because both more inscriptions have since been found and the many undated inscriptions must be included. On the basis of Nakada's list, the regency with the highest number of inscriptions is the Mojokerto regency, which has 148 inscriptions in total, followed by the Blitar regency with 61, the Kediri regency with 54, the Malang regency with 38, and the Tulungagung regency with 34.[19] It seems that the quantitative distribution of the inscriptions within East Java directly correlates with the regencies in which the centres of the East Javanese kingdoms were located.[20]

It is also interesting to note that around 38 inscriptions found in East Java are from the Central Javanese period, when the centre of power was Central Java (before 929 CE). The below table gives the names of these inscriptions, where they were discovered, and their dates.

Table 4.1. Inscriptions from East Java pre-929 CE.

No.	Name of Inscription	Place of discovery	Date	
			Śaka	CE
1	Kañjuruhan (Dinoyo)	Dinoyo and Merjosari, Malang	682	760
2	Pu Taṅgal	Not known[1)]	717	795
3	Hariñjiṅ A[2)]	Siman, Pare, Kediri	726	804
4	Pu Bali,	Gundik, Ponorogo		mid-9th c.
5	Pu Kayutarā	Gundik, Ponorogo		mid-9th c.
6	Pu Balārāma	Gundik, Ponorogo		mid-9th c.
7	Abhaya	East Java (?)		mid-9th c.
8	Abhayamukha	East Java (?)		mid-9th c.
9	Kuṭi (Joho)[3)]	Joho, Sidoarjo	762	840
10	Dang Hyaṅ Guru Candik	Dinoyo, Malang	772	850
11	Kañcana (Buṅur A/Gedaṅan I)[4)]	Gedangan, Sidoarjo	782	860
12	Waharu I (Keboan Pasar)	Keboan Pasar, Sidoarjo	795	873
13	Baliṅawan (Singosari I)	Singosari, Malang	813	891
14	Pĕnampihan I[5)]	Tulungagung	820	898/9
15	Taji (Ponorogo II)	Ponorogo	823	901
16	Baṇigrama (Watukura I A)	East Java (?)	824	902
17	Ketanen I	Ketanen, Mojokerto	826	904
18	Kubukubu (Malang I)	Singosari (?), Malang	827	905

19 Nakada, *An Inventory of the Dated Inscriptions in Java*: 184-190.

20 A more detailed explanation of the centers of the Javanese kingdoms can be found in the next sub-chapter.

19	Kinĕwu (Blitar I)	Blitar	829	907
20	Barsahan	East Java (?)		ca. 908
21	Parĕ Gaṇeśa	Pare, Kediri	83[?]	908-17
22	Kaladi (Penangungan)	Gunung Penangungan	831	909
23	Tulaṅan (Jedong I)	Jedung, Mojosari Lor, Mojokerto	832	910
24	Sugiḥ Manek	Singosari, Malang	837	915
25	Piliṅpiliṅ	Dinoyo, Malang	840	918
26	Hariñjiṅ B (Sukabuni B)	Siman, Pare, Kediri	843	921
27	Wurudu Kidul A (Singasari III)	Malang	844	922
28	Wurudu Kidul B (singasari IV	Malang	844	922
29	Kambang Śrī A (Jedong II)	Jedung, Mojosari Lor, Mojokerto	848	927
30	Hariñjiṅ C (Sukabumi C)	Siman, Pare, Kediri	849	927
31	Palĕbuhan (Gorang gareng)	Gorang gareng, Madiun	849	927
32	Kambaṅ Śrī B (Jedong III)	Jedung, Mojosari Lor, Mojokerto		927-928 (?)
33	Kinawĕ (Tanjung Kalang)	Kediri	849	928
34	Saṅguran (Minto Stone)	Malang/Surabaya	850	928
35	Paṅgumulan III (Blota)	Blota, Mojokerto	850	928
36	Kampak (Pangurumbigyan)	Surabaya		pre-929[6]
37	Karaṅ Tengah	Blitar		10th c.[7]
38	Wijaksara	Banyuwangi		10th c.[8]

Note:

1) Now kept in the Laboratory of Universitas Negeri Surabaya, Ketintang, Surabaya.
2) This inscription was reissued in the early tenth century.
3) A copied inscription from Majapahit period
4) A copied inscription from Majapahit period
5) A majapahit copy of a Balitung inscription (?)
6) Undated; according to Brandes, the inscriptions dates to before 850 Śaka. See: Brandes, "Oud-Javaansche Oorkonden": 110-111.
7) Undated, but probably at least from the early tenth century based on the character style; see: Machi Suhadi and K. Richardiana, Berita Penelitian Arkeologi No. 47: Laporan Penelitian Epigrafi di Wilayah Provinsi Jawa Timur (Jakarta: Proyek Penelitian Arkeologi Jakarta, *Pusat Penelitian Arkeologi Nasional, Departemen Pendidikan dan Kebudayaan, 1996): 1-2, 25-16.*
8) Undated; it has the same case as the Karang Tengah inscription above; see: Suhadi and Richardiana, Berita Pene*litian Arkeologi No. 47: 1-2, 7-8.*

The presence of so many inscriptions from the Central Javanese period within East Java demonstrates that polities did exist in these regions despite the fact that power was focused in Central Java. J.G. de Casparis has even claimed that, from

the time of Balituṅ, the Central Javanese polity had a second capital, in East Java.[21] However, I think there is little evidence for this because there is no single extant textual source that proves this. I suggest that some smaller polities flourished in East Java from the middle of the eighth century CE, some of which were under the power of the Central Javanese polity. At the very least, the inscriptions in the list above—with the exception of the Kañjuruhan inscription, the oldest inscription, which suggests an autonomous polity in the earliest period—contain the names of rulers who were probably petty local sovereigns related to the Central Javanese kings. The Waharu I inscription, for instance, mentions that a local ruler who established a *sīma* was the nephew of Rakryan Tuloḍoṅ.[22] Hariñjiṅ B, found in Pare and dating from 921 CE, has the title "*saṅ dewata lumaḥ i Kwak*", which seems to be referring to a local ruler. [23] Moreover, from a broader perspective, the presence of these inscriptions issued in East Java by the Central Javanese kings demonstrates how the Central Javanese polity consolidated its authority over East Java.

Some of the Central Javanese inscriptions found in East Java also refer to matters related to water management in the latter region when political power was still centreed in Central Java.[24] Thus, at least from the early ninth century CE water management was a significant issue for the villages and inhabitants of East Java. In this thesis, I will make use of the inscriptions relevant to my topic, while these and other inscriptions from the East Javanese period used as sources within this thesis are listed in Table 4.2, below.

Table 4.2. Inscriptions from East Java from 929 to ca. 16th century CE

No.	Inscription	Dates		Place of Discovery
		Śaka	CE	
1	Poh Rintiṅ	851	929	Glagahan, Jombang.
2	Saraṅan	851	929	Mojokerto
3	Guluṅ guluṅ	851	929	Singosari, Malang.

21 J.G. de Casparis, "Some Notes on Transfer of Capitals in Ancient Sri Lanka and Southeast Asia", *Pertemuan Ilmiah Arkeologi VI* (Jakarta: Pusat Penelitian Arkeologi Nasional, 1993/1994): 378.

22 Boechari, *Prasasti Koleksi Museum Nasional I*: 22-27.

23 P.V. van Stein Callenfels, "De inscriptie van Soekaboemi", *MKAWL 78* (1934): 115-130. In this article, van Stein Callenfels reads "*sang dewata lumah i Twak*", while Sukarto K. Atmodjo reads "*sang dewata lumah i Kwak*". The term *Kwak* is the name of a village in Kediri, called Kuwak, which has the spring Umbul Kuwak nearby. See: S.K. Atmodjo, "Bhagawanta Bārī, Bapak Pembangunan Daerah Kediri Tahun 804 Masehi", in *Jawa: Majalah Berkala Kebudayaan Vol. 1* (1997): 61.

24 See also Table 5.2; water officials mentioned in Old Javanese inscriptions from the eighth to the fifteenth century in this chapter.

4	Liṅgasuntan	851	929	Lawajati, Malang.
5	Waharu II	851	929	Jenggala, Surabaya
6	Turyan	851	929	Watugodeg, Turen, Malang.
7	Cuṅgraṅ I	851	929	Suci, Bangil, Pasuruhan.
8	Cuṅgraṅ II	851	929	Mount Kawi, East Java.
9	Jru jru	852	930	Banyubiru, Singosari, Malang.
10	Wulig	856	934	Bakalan, Gondang, Mojokerto.
11	Añjukladaṅ	857	935	Candi Lor, Berbek, Nganjuk.
12	Hriṅ	859	937	Kujon Manis, Berbek, Nganjuk.
13	Paraḍaḥ	865	943	Siman, Kediri.
14	Kanuruhan	865	943	Bunul, Blimbing, Malang
15	Muñcaṅ	866	944	Malang
16	Kamban	893	971	Pělěm, Trowulan, Mojokerto.
17	Cane	943	1021	Surabaya (Cane, Sambeng, Lamongan?)
18	Terep I dan II	954	1032	Penanggungan, East Java.
19	Baru	956	1034	Simpang, Surabaya
20	Kamalagyan	959	1037	Kelagen, Sidoarjo
21	Gandhakuti	964	1042	Keboan Pasar, Sidoarjo
22	Sumĕṅka	981	1059	Surabaya
23	Padlĕgan	1038	1116	Pikatan, Blitar
24	Patakan	n.d.	11th century	Surabaya (Patakan, Lamongan?)
25	Manañjuṅ	n.d.	11th century	Malang
26	Hantaṅ	1057	1135	Ngantang, Malang
27	Panumbaṅan	1062	1140	Plumbangan, Blitar
28	Talan	1058/ 1068	1136/1146	Gurit, Babadan, Wlingi, Blitar
29	Jaring	1103	1181	Jaring, Kembang Arum, Blitar.
30	Pĕnampihan/ Sarwadharma	1191	1269	Pĕnampihan, Tulungagung
31	Kudadu	1216	1294	Gunung Butak, Blitar/Malang.
32	Dhimaṇāśrama	n.d.	13th /14th century	Brantas Delta, near Sidoarjo
33	Sukamĕrta	1218	1296	Penanggungan slope, between Gajah Mungkur and Bekel.
34	Balawi	1227	1305	Trowulan, Mojokerto
35	Balambangan/ Jayanagara/ Lamongan	n.d.	early 14th century	Lamongan

36	Kambaṅ Putih	n.d.	early 14th century	Tuban
37	Tuhañaru/ Sidatĕka	1245	1323	Sidateka (?), Mojokerto
38	Kuśmala	1272	1350	Kandangan, Kediri
39	Pĕlĕm	n.d.	1350-1389	Pĕlĕm, Mojokerto.
40	Jenggring	1276	1354	Jenggring (Jabung), Mojokerto
41	Keputran	1277	1355	Keputran, Kutorejo, Mojokerto
42	Caṅgu/Trowulan I	1280	1358	Temon, Trowulan, Mojokerto
43	Seloliman	1280	1358	Seloliman, Trawas, Mojokerto
44	Biluluk I	1288	1366	Bluluk, Lamongan
45	Buṅur B	12(89)	1(367)	River Gedangan, Sidoarjo
46	Karaṅ Bogĕm/ Tirah/ Trowulan V	1308	1386	Trowulan, Mojokerto
47	Biluluk V (Karaṅ Bogĕm)	n.d.	1387	Bluluk, Lamongan.
48	Biluluk II	1313	1391	Bluluk, Lamongan
49	Śelamaṇḍi I	1316	1394	Surabaya ?
50	Lumpang/ Katiden II	1317	1395	Malang
51	Biluluk III	1317	1395	Bluluk, Lamongan
52	Śelamaṇḍi II	1317	1395	Surabaya (?)
53	Wariṅin Pitu/ Surodakan	1369	1447	Soradakan, Trenggalek
54	Pamintihan	1395	1473	Sendang Sedati, Bojonegoro
55	Trailokyapuri I	1408	1486	Jiyu, Mojokerto
56	Trailokyapuri IV	n.d.	late 15th century	Jiyu, Mojokerto
57	Saṇḍuṅan	n.d.		Berbek, Nganjuk.
58	Kalimusan	n.d.		Malang, East Java

The inscription record supplies much information related to aspects of East Javanese water management, as the information provided shows the relationship(s) between water, infrastructure, various political and economic aspects of the kingdoms, and the local community.

4.3. WATER BUREAUCRACIES IN ANCIENT JAVA FROM INSCRIPTIONS

Based on inscription data, we can conclude that the administrative structure of the ancient Javanese polity had a lengthy developmental history. Two distinctive

administrative structures can be identified: one that existed before the tenth century and one that existed after that time. The most significant development that occurred after the centre of the Javanese polity had moved to East Java was the alignment of the growth of settlement patterns, population structure, and trading activities.[25] The latter was the most significant aspect for transforming the administrative and bureaucratic structure of the East Javanese polity. Moreover, as Christie argues, the centre of the East Javanese polity began to place more importance on commerce—especially in the Brantas river basin—as the inscriptions mention more traders than administrative officials, while agricultural and commercial taxes began to be recorded more quantitatively than they had been before.[26]

Furthermore, the East Javanese administrative and bureaucratic power structure continued to be based on the three-level hierarchical order of court-village-hamlet. The terms employed to refer to a village or hamlet community and administration were probably altered, but the administrative structure did not change significantly.[27] These hierarchical institutions reflected in the three groups of officials: royal officials, village officials, and hamlet "officials". Royal officials were a group of officers under the direct command of the king. The officials within this group are referred to as, among other things, *rakryan*s or *rakarayān*s; for example, *rakryan mahāmantrī i hino*, *rakryan mahāmantrī i halu*, and *rakryan mahāmantrī i sirikan*. During the Majapahit period, the highest officer was called *rakryan mahāmapatih*, and he had a role similar to that of a prime minister or grand vizier. At the next level down, village officials were tasked with dealing with the administrative affairs of the village. Officers within this group occasionally had a title such as *tuha* (head or superintendent of a group), *hulu* (head of), or *rāma* (village elder).[28] At the hamlet level, it seems that there were more direct

25 J.W. Christie, "States without Cities: Demographic Trends in Early Java", *Indonesia* 52 (1991): 27.

26 J.W. Christie, "Wanua, Thani, and Paraduwan: The 'Disintegrating' of Village in Early Java?", in: *Texts from the Islands: Oral and Written Traditions of Indonesia and the Malay World*, ed. Wolfgang Marschall (Bern: Institute of Ethnology, University of Bern, 1994): 36.

27 Jan Wisseman Christie discusses the changing meanings of these terms in detail. For instance, the term *wanua*—the name of an intermediary institution between a village community and the royal court, which had been used since the early Central Javanese period—was changed to *thāni* in the late tenth century, and the term *wanua* began to disappear. In some inscriptions the *dūwān*—a sub-unit of *thāni*—set up a group of *dūwān* called *paradūwān*. Later, in the fifteen century, another term, *deśa*, appears in the inscriptions. See: Christie, "Wanua, Thani, and Paraduwan": 37-38.

28 According to De Casparis, these officials were royal officers who resided in the villages, but there is not sufficient evidence to support this assertion. For De Casparis' opinion see: J.G. de Casparis, "Some Notes on Relations between Central and Local Government in Ancient Java", in: *Southeast Asia in the 9th to 14th Centuries*, ed. David G. Marr and A.C. Milner (Singapore-Canberra: Institute of Southeast Asian Studies ISEAS-Research School of Pacific Studies, Australian National University, 1986): 49-63.

functionaries, and hamlet affairs may have been handled directly by the elders, who did not have specific titles.

The lists of officials recorded in the inscriptions also refer to irrigation officials who had to deal with the water management of the village. There are at least nine officials who are frequently mentioned in the inscriptions:

1) *Hulair/Hulu air/Huler*
   W.F. Stutterheim identified the *hulair* as an official who maintained the irrigation system and who is nowadays known as the *ulu-ulu.*[29] Using the same definition, De Casparis explained that this person was "in charge of the maintenance of the irrigation system including the distribution of the irrigation water supply to the *sawahs*".[30] In some inscriptions, *hulair karamān* is also mentioned, a term that may refer to a group or board of *hulairs* from a number of villages.[31] The *hulu air* is often mentioned in the lists of officials in inscriptions from the ninth and tenth centuries, although it occurs less frequently in later ones before disappearing completely. It may be that the term *hulu air* was changed into something different during that period. The *hulu air* was a local official at the village level who had a similar role to that of other village officials whose names included the term "*hulu*": *hulu wras* (the official in charge of rice), *hulu buru* (the official in charge of hunting), and *hulu alas* (the official in charge of the forest). Moreover, since the *hulu air* was a local official, he was most likely chosen from among the villagers themselves.[32]
2) *Matamwak/patih tambak/mpu tambak/matamwak mula*
   This official is defined by De Casparis as a "surveyor of the dams", which aligns with Zoetmulder's description.[33] Christie and Van Setten van der Meer give a more elaborate meaning; they suggest that the *matamwak* was a village official in charge of the installation and construction of water works.[34] Whichever is the case, this official was definitely in charge of dykes and dams.
3) *Air Haji*
   The term *air haji* appears in a number of Old Javanese inscriptions, including

29 W.F. Stutterheim, "Inscriptie op een zuiltje van Papringan" *TBG 73* (1933): 100.

30 De Casparis, *Prasasti Indonesia 2*: 230.

31 Cf. N.C. van Setten van der Meer, *Sawah Cultivation in Ancient Java. Aspects of Development during the Indo-Javanese Period, 5th to 15th century* (Canberra: Australian National University Press, 1979): 63.

32 For a description of *hulu air* see also: J.W. Christie, "Water from the Ancestors: Irrigation in Early Java and Bali", in: *The Gift of Water: Water Management, Cosmology and The State in South East Asia*, ed. Jonathan Rigg (London: School of Oriental and African Studies, University of London, 1992): 14.

33 De Casparis, *Prasasti Indonesia II:* 241; P.J. Zoetmulder, *Old Javanese-English Dictionary* (Leiden: KITLV, 1982): 1916.

34 Van Setten van der Meer, *Sawah Cultivation in Ancient Java:* 61; Christie, "Water from the Ancestors": 14.

Er Hangat (885 CE), Waharu I (873 CE), Watukura (902 CE), and Panggumulan A (902 CE). In these inscriptions, the *air haji* is mentioned as one of the *saṅ maṅilala dṛwya haji* officials (royal tax collectors). The precise role of the *air haji* is unclear; perhaps they were the head of the royal holy water officials so, in contrast to those officials who were in charge of water for irrigation purposes, they were in charge of the holy water and the royal *pathirtan* temple, and they collected the (holy) water revenues from the villagers.[35]

4) *Lĕblĕb*
This concept has various forms in Old Javanese inscriptions, including *lĕbĕlĕb, lablab, labalab, ḷbḷb,* and *löbĕlöb*. In modern Javanese, the word has become "*ngĕlĕb*", which refers to the activity of watering a rice field or plants so that the lower part of the plants is submerged for a specific time. Edhie Wurjantoro interprets it as an officer who arranged *sawah* irrigation.[36] Basing himself on a number of inscriptions, Zoetmulder described the *lĕblĕb* as a member of the *maṅilala dṛwya haji*, one of the groups of royal tax collectors.[37] I therefore propose that this functionary was responsible for collecting royal taxes from irrigation.
5) *Hulu wuatan*
The *hulu wuatan*—sometimes spelt *hulu wwatan*—was an officer in charge of supervising bridges and causeways.[38] This official's role was not directly connected to water management but because his work included the building of bridges over rivers it did, therefore, contribute significantly to riverine affairs.
6) *Manambaṅi/Anambaṅi*
This term refers to a person who managed a village's harbor and all the activities related to crossing rivers by boat. Boechari has questioned whether the person was an official who managed and took care of all the crossing places or someone who helped people to cross the river by boat.[39] However, from the Caṅgu

35 This official was also assigned caretaker of Ṛṣis communities, at least in Majapahit period as is stated in canto 75: 2 line 4: "*mantrī her haji taṅ karṣyan iniwönyān/rakṣeka saṅ tapaswi*" ("the mantri Her Haji cares for the communities of Ṛṣis, being the protector of the ascetics"); see the Old Javanese excerpt in: Th. Pigeaud, *Java in the 14th Century: A Study in Cultural History. The Nāgara-Kĕrtāgama by Rakawi, Prapañca of Majapahit, 1365 A.D.* I: *Javanese Text in Transcription* (The Hague: Nijhoff, 1960): 58, and the English translation in: S. Robson, *Deśawarṇana (Nāgarakṛtāgama)* (Leiden: KITLV Press, 1995): 79.

36 E. Wurjantoro, *Anugerah Sri Maharaja. Kumpulan Alihaksara dan Alihbahasa Prasasti-prasasti Jawa Kuna Abad VIII-XI* (Depok: Departemen Arkeologi Fakultas Ilmu Pengetahuan Budaya Universitas Indonesia, 2018): 698).

37 P.J. Zoetmulder, *Old Javanese-English Dictionary I* ('s Gravenhage: Nijhoff, 1982): 949.

38 Van Setten van der Meer, *Sawah Cultivation in Ancient Java:* 62; Stutterheim, "Inscriptie op een zuiltje van Papringan": 96-101.

39 Boechari, "Manfaat Studi Bahasa dan Sastra Jawa Kuna": 38-39.

inscription it is clear that the official was responsible for managing the harbor and serving people crossing the river(s) in boats.[40] This method of crossing rivers is still used today in parts of East Java. The term is found in at least six inscriptions: Wahuta Kuti 762 Śaka (840 CE), Cane 943 Śaka (1021 CE), Caṅgu 1280 Śaka (1358 CE), Garamān 975 Śaka (1053 CE), Sukun 1083 Śaka (1161 CE), and Balambaṅan (undated).[41] Even though the Wahuta Kuti inscription was originally from the Central Javanese period before being rewritten in the Majapahit era, while the other inscriptions are from the East Javanese period, each of these inscriptions was found in East Java, and especially in the delta region of the Brantas river and its surroundings where there are many rivers, both large and small. Something particularly noteworthy is that none of the inscriptions found in Central Java mention this term.[42] Consequently, it can be assumed that the *Manambaṅi* officials and their *tambaṅ* activities were more developed in East Java than they were in Central Java. Geographically, East Java has two large rivers—the Bengawan Solo and the Brantas—and many small rivers within the Brantas delta that required a means of transportation to cross them. Moreover, it seems that the Brantas delta region was an area where there was more intense movement in everyday life and this was probably caused by trade, among various other factors.

7) *Hulu Bañu*

As well as the aforementioned officials, Van Naerssen, De Casparis, and Van Setten van der Meer state that there was another officer who dealt with irrigation system affairs. This officer was known as the *paṅulu bañu*, and has been identified as an irrigation official who had the same task as the *hulair*. Those modern scholars have suggested that this is probably just another, later

40 The Canggu inscription is also called as the Ferry Charter by Pigeaud; see: Th. Pigeaud, *Java in the 14th Century. A Study in Cultural History: The Nāgara-Kĕrtāgama by Rakawi, Prapañca of Majapahit, 1365 A.D. I: Javanese Texts in Transcription* (The Hague: Nijhoff, 1960).

41 The Balambangan inscription has no date, but according to Poerbatjaraka it comes from the period of Jayanagara, while H.M. Yamin assumes that it is from after 1316. See: Poerbatjaraka, "Vier Oorkonden in Koper", *TBG 76* (1936): 388-391 and H.M. Yamin, *Tatanegara Madjapahit Sapta-Parwa II* (Djakarta: Jajasan Prapantja, 1962): 37-40. For a transcription of the inscription, see: van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari–Majapahit, 1255-1486, Band II:* 494-497. For the Wahuta Kuti transcription, see: Boechari, *Prasasti Koleksi Museum Nasional I*: 16-21; and for the Cane inscriptions see: Boechari, *Prasasti Koleksi Museum Nasional I*: 16-21. A transcription of the Canggu inscription is in Th. Pigeaud, *Java in the 14th century, I: 108-112.* Some parts of the transcription were also published in: Boechari, *Prasasti Koleksi Museum Nasional I*: 116-117 and Brandes, *Oud Javaansche Oorkonden*: 255.

42 See the appendix of the table of Water Officials.

term for the *hulair.*[43] However, Pigeaud has a different opinion. He has suggested that the *pańulu bañu* was connected with a type of irrigation-water fee, being the compensation paid by a farmer when he used an irrigation facility owned by someone else.[44] Moreover, Zoetmulder defines *pańhulu bañu* as "a tax for the use of water for irrigation".[45] I tend to agree that it was related to a contribution to or fee paid for using irrigation water, and I will elaborate further on the meaning of *pańhulu bañu* below, in the sub-chapter on water taxes. But my opinion is that the *pańhulu bañu* was a payment given by irrigation water users (farmers) to an official, who was called *hulu bañu*, as compensation for his work. This official had to take charge of irrigation water in the same way as the *hulu air*, and it is most likely that the term *hulu air* morphed into *hulu bañu* during the late East Java period.

8) *Jukuń*

This official's name appears in at least six inscriptions: Kancaña 782 Śaka (860 CE), Talan 1058 or 1068 Śaka (1136 or 1146 CE), Panumbaňan 1062 Śaka (1140 CE), Buńur B 1289 Śaka (1367 CE), Kudadu 1216 Śaka (1294 CE), and Tuhañaru 1245 Śaka (1323 CE). In the Kancaña inscription it is written as "*pajukuń*" while in the others it is recorded as "*jukuń*".[46] The terms *pajukuń* and *jukuń* come from the Old Javanese *jukuń*, which means "a small boat". According to Zoetmulder, it also denotes an official related to a group of *watěk i jro* (*mańilala dṛwya haji*).[47] Therefore, the function of the *jukuń* as a member of the *mańilala dṛwya haji* is related to the meaning of *jukuń* as a small boat; my interpretation of *jukuń* is, therefore, that he was either an official who headed a group of *jukuń* owners or that he was responsible for collecting levies or fees from *jukuń* owners. All six of the inscriptions were found in East Java, and it seems that the *jukuń* official was only known in East Java, from the eighth century. Geographically, as mentioned above, East Java has two large rivers, the Bengawan Solo and the Brantas, along with their tributaries, and consequently the region required much more by means of river transportation than did Central Java. Therefore, the *jukuń* and other kinds of boats were widely used by people in East Java.

43 F.H. van Naerssen, *Oudjavaansche Oorkonden in Duitsche en Deensche Verzamelingen.* Proefschrift Leiden (1941): 50; De Casparis, *Prasasti Indonesia II:* 241; Van Setten van der Meer, *Sawah Cultivation in Ancient Java*: 64.

44 Th. Pigeaud, *Java in the 14th Century. A Study in Cultural History: The Nāgara-Kěrtāgama by Rakawi, Prapañca of Majapahit, 1365 A.D. IV: Commentaries and Recapitulation* (The Hague: Nijhoff, 1962): 383 and 387.

45 Zoetmulder, *Old Javanese-English Dictionary*: 648.

46 See the transcription of this inscription in: H. Kern, "Over eene Oudjavaansche Oorkonde (gevonden te Gĕḍangan, Surabaya)", *Verspreide Geschriften 7* ('s Gravenhage: Martinus Nijhoff, 1917): 32-41.

47 Zoetmulder, *Old Javanese-English Dictionary*: 274. Kern translated *jukuń* as *een schuitenvoerder* (a barge carrier); see: Kern, "Over eene Oudjavaansche Oorkonde": 48.

9) *Mawuai*
This term is found in only two inscriptions, Mantyāsiḥ I (829 Śaka) and Lintakan (841 Śaka). The word *mawuai* comes from the Old Javanese words "*wwe, wwai, wway,* or *way*", which mean "water". In line B.1. of the Mantyāsiḥ I inscription it is written "*mawuai si busū rama ni garagasī muaṅ si rubiḥ kapua winaiḥ pirak mā 2 sowaṅ*", which can be translated as "*Mawuai* si Busū the father of Garagasī and si Rubiḥ were each given 2 *māsa* of silver".[48] From this citation it is very clear that the term "*mawuai*" refers to an official's title and I infer that it was an official who managed and provided water for the people. It is likely that he was only in charge of providing non-irrigation water, because in the Lintakan inscription a *hulair*—an official in charge of irrigation water—is mentioned alongside the *mawuai*.

The table below (Table 4.3) shows how the terms related to water officials that are found in the Central and East Javanese inscriptions are distributed in those areas and demonstrates the development of water officials from Central Java to East Java. Some conclusions may be drawn related to how the officials changed their role in water management; these relate the changing ways in which local rulers and communities dealt with their needs and the environment, especially those aspects related to water management. The East Javanese landscape, with its large rivers and their tributaries, required different strategies compared to Central Java. The emergence of *jukuṅ* and *manambaṅi* officials as part of the East Java bureaucracy shows that the East Javanese communities required transportation services to overcome the physical barriers and to benefit from the existence of the large number of rivers in the region.

However, with the *hulair* officials there is a difference because they were very popular in Central Java, as demonstrated by them being mentioned in many Central Javanese inscriptions. However, after around the middle of tenth century CE they are no longer mentioned in the inscriptions. The last inscription in which the term is recorded is the Paraḍaḥ inscription from 865 Śaka (943 CE). On the other hand, *Lěblěb* officials were mentioned more often in the inscriptions from the first quarter of tenth century CE, which almost exactly corresponds to the time when the Central Javanese powers moved into East Java. It seems that the East Javanese polities saw a general increase in the state income generated from the irrigation taxes collected by the *lěblěb* while, in contrast, the *hulairs* lost their function and then their existence, being replaced by direct self-management by the villagers.

48 See the transcription of this inscription in: W.F. Stutterheim, "Een Belangrijke Oorkonde uit de Kedoe", *TBG* 67 (1927): 205-212 and also in: Sarkar, *Corpus of the Inscriptions of Java II:* 64-81. *M*ā is an "abbreviation of *māsa*, *a* weight (measure) in gold or silver; unit of money", see: Zoetmulder, *Old Javanese-English Dictionary*: 1073.

Table 4.3. Water Officials mentioned in Old Javanese inscriptions from the eighth to the fifteenth centuries CE.

No.	Inscriptions	Dates (Śaka)	Place	Water Official									
				Central Java	East Java	*Air Haji*	*Lĕblĕb*	*Hulair*	*Hulu Wuattan*	Mawuai	Manambaṅi	Jukuṅ	Matamwak
1	Hariñjiṅ A	709	Sukabumi, Pare.		√			+					
2	Waṅwaṅ Baṅen	746	Bagelen.	√		+							
3	Waharu Kuti	762	Joho, Sidoarjo.		√	+	+				+		
4	Tulaṅ Air I	772	Temanggung	√				+					+
5	Kaṅcana	782	Gedangan, Sidoarjo		√		+	+				+	
6	Tunahan/ Polengan I	794	Polengan, Kalasan, Yogyakarta.	√				+					
7	Waharu I	795	Keboan Pasar, Sidoarjo.		√	+	+	+					
8	Humaṇḍiṅ	797	Polengan, Kalasan, Yogyakarta.	√				+					
9	Haliwaṅbaṅ	799	Polengan, Krapyak, Kalasan, Yogyakarta.	√				+					
10	Kwak I	801	Ngabean, Magelang	√				+					
11	Taragal	802	Polengan, Krapyak, Kalasan Yogyakarta.	√				+					
12	Ratawun I	803	Magelang,	√				+					
13	Ratawun II	803	Ngabean, Magelang.	√				+					
14	Salimar I	804	Prambanan, Yogyakarta.	√				+					
15	Salimar II	804	Nanggulan, Yogyakarta	√				+					
16	Salimar III	804	Papringan, Yogyakarta	√					+				
17	Kuruṅan	807	Randusari, Gondang Winagun, Klaten	√				+					
18	Muṅgu Antan	808	Bulus, Balak, Kedu, Magelang	√				+					
19	Baliṅawan	813	Singasari, Malang		√				+				
20	Kembaṅ Arum	824	Yogyakarta	√		+							
21	Watukura I	824	East Java (?)			+	+						
22	Rumwiga I	826	Payak , Piyungan, Yogyakarta	√				+					
23	Poh	827	Central Java	√		+							
24	Kubu	827	Malang (?)		√	+			+				
25	Mantyāsiḥ I	829	Central Java (?)	√		+				+			

Table 4.3. Water Officials mentioned in Old Javanese inscriptions from the eighth to the fifteenth centuries CE.

No.	Inscriptions	Dates (Śaka)	Place	Water Official								
				Central Java	East Java	*Air Haji*	*Lĕblĕb*	*Hulair*	*Hulu Wuatton*	Mawuai	Manambaṅi	Jukuṅ	Matamwak
26	Palepaṅan	829	Borobudur, Magelang.	√				+					
27	Mantyāsiḥ II	829	Matesih, Central Java	√		+							
28	Palepaṅan	829	Borobudur, Magelang	√				+					
29	Wanua Tṅah III	830	Kedunglo, Kaloran, Temanggung	√				+					
30	Kaladi	831	Mount Penanggungan, East Java		√	+	+						
31	Timbaṅan Wuṅkal	835	Gata, Prambanan	√		+							
32	Tihaṅ	836	Prambanan or Magelang (?)	√		+	+						
33	Sugih Manek	837	Singosari, Malang		√	+	+						
34	Lintakan	841	Yogyakarta	√				+		+			
35	Hanriñjiṅ B	843	Siman, Kepung, Kediri		√	+							
36	Saṅguran	850	Ngendat, Malang,		√	+	+						
37	Poh Rintiṅ	851	Glagahan, Jombang.		√	+							
38	Saraṅan	851	Mojokerto		√		+						
39	Guluṅ	851	Singosari, Malang.		√	+	+						
40	Liṅgasuntan	851	Lawajati, Malang.		√	+	+						
41	Waharu II	851	Jenggala, Surabaya		√	+							
42	Turyan	851	Watugedeg, Turen, Malang.		√	+			+				
43	Cuṅgrang I	851	Suci, Bangil, Pasuruhan.		√	+							
44	Cuṅgrang II	851	Mount Kawi, East Java.		√	+							
45	Jru jru	852	Banyubiru, Singosari, Malang.		√	+	+						
46	Añjukladaṅ	857	Candi Lor, Berbek, Nganjuk.		√	+							
47	Hriṅ	859	Kujon Manis, Berbek, Nganjuk.		√		+						
48	Paraḍaḥ	865	Siman, Kediri.		√		+	+					
49	Kanuruhan	865	n.p.										

Table 4.3. Water Officials mentioned in Old Javanese inscriptions from the eighth to the fifteenth centuries CE.

No.	Inscriptions	Dates (Śaka)	Place	Water Official								
				Central Java	East Java	*Air Haji*	*Lĕblĕb*	*Hulair*	*Hulu Wuattan*	Mawuai	Manambaṅi	Jukuṅ	Matamwak
50	Muñcaṅ	866	Malang		√	+	+						
51	Kamban	893	Pĕlĕm, Trowulan, Mojokerto.		√	+	+						
52	Cane	943	Surabaya		√	+	+				+		
53	Baru	956	Surabaya		√	+	+						
54	Bañjaran	975	?			+	+						
55	Sukun	1083	Malang		√	+	+				+		
56	Talan	1058/ 1068	Wlingi, Blitar		√	+	+					+	
57	Pupus	1022	Pojok, Dragung, Semarang.	√		+	+						
58	Padlĕgan	1038	Pikatan, Blitar		√	+	+						
59	Hantaṅ	1057	Ngantang, Malang		√	+	+						
60	Panumbaṅan	1062	Plumbangan, Blitar		√	+	+					+	
61	Jaring	1103	Jaring, Blitar.		√	+							
62	Buṅur B	12(89)	Gedangan, Sidoarjo		√	+	+					+	
63	Kudadu	1216	Gunung Butak, Mojokerto		√							+	
64	Sukamĕrta	1218	Penanggungan Slope.		√	+	+						
65	Balawi	1227	Trowulan (?)		√	+	+						
66	Tuhañaru/ Sidatĕka	1245	Sidateka, Mojokerto		√	+	+					+	
67	Caṅgu	1280	Temon, Trowulan.		√						+		
68	Wariṅin Pitu	1369	Soradakan, Trenggalek		√	+	+						
69	Pamintihan	1395	Sendang Sedati, Bojonegoro		√	+	+						
70	Pĕlĕm	n.d.	Pĕlĕm, Mojokerto.		√						+		
71	Balambaṅan	n.d.	Lamongan, East Java.		√	+	+				+		
72	Erhaṅat	n.d.	Central Java	√		+							
73	Kalimusan	n.d.	Malang, East Java		√		+						

The limited number of royal water officials mentioned in the East Javanese inscriptions highlights the absence of central royal court officials in the management of water. The exception to this was the *lěblěb* and *air haji*, who managed irrigation taxes only. In other words, water management—or at least irrigation management—appears to have been an internal village matter. Exceptions to this may have occurred when issues related to water threatened the safety of a village and its inhabitants; in such circumstances, the central government would intervene and take part in running the village. A Kamalagyan inscription from 1037 CE records the construction of a dam upon the order of King Airlaṅga after the villagers had failed to prevent flooding caused by an overflowing river.[49]

4.4. WATER REDISTRIBUTION AND TAXES

The Old Javanese taxation system is one of the most difficult subjects to investigate because information related to the subject is either opaque or wholly absent. Most of the data are obtained simply from inscriptions, especially those dealing with the establishment of a *sīma*. The element part of the inscription, which gives data on taxes, is within the section that provides the *maṅilala dṛwya haji* list. Etymologically, the term *maṅilala dṛwya haji* has the meaning "collector of the king's due" and can be interpreted as "tax collectors".[50] The *maṅilala dṛwya haji* worked under the supervision of the king and was authorized by him to collect taxes. Therefore, the authority for establishing and changing the taxes was the king, and whenever the stipulation was changed it would be issued in an official decree.

Regarding to the taxes, it is interesting to see a *sīma* as a freehold institution. An inscription regarding a *sīma* is basically a declaration of a freehold grant from the ruler to the land foundation thereby after a land was granted a *sīma* status, the foundation had no obligation to pay taxes. As the land had a status of a tax-free zone, the upkeep of a religious institution such as a temple or a monastery had to finance independently its own operational expenses.[51] Such ancient Javanese religious institutions were essentially non-state funded; money was provided by devotees.

From the lists of the taxes that were collected, it appears that there were many different types of taxes in ancient Java. The taxpayers or individuals who

49 A transcription of this inscription can be found in: Brandes, "Oud-Javaansche Oorkonden": 134-136. See also the Indonesian translation in: Sutjipto Wiryosuparto, "Apa Sebabnja Kediri dan Daerah Sekitarnja Tampil Kemuka dalam Sedjarah", *Kongres Ilmu Pengetahuan Nasional I* (Djakarta: Madjelis Ilmu Pengetahuan Indonesia, 1958): 15-21.

50 For more detailed discussions of this term, see: W.F. Stutterheim, "Een Oorkonde op Koper uit het Singhasarische", *TBG* 65 (1925): 245-267; F.H. van Naerssen, *Oud-Javaansche Oorkonden in Duitsche en Deensche Verzamelingen*: 12-13; Jones, *Early Tenth Century Java from the Inscriptions*: 137-141.

51 Jones, *Early Tenth Century Java from the Inscriptions*: 66-67.

were subject to tax included farmers, artists, fishermen, craftsmen, and traders. Although the inscriptions provide data about the different types of taxes applied in ancient Java, unfortunately these inscriptions only give their names, with no explanation regarding their meanings. Therefore, many modern translations and interpretations of these taxes are still sketchy. Some of them are mentioned only by naming the professions of the taxpayers, like *tuha dagaṅ* (the chief of the traders), *tuha gusali* (the chief of the smiths), *juru judi* (the overseer of gambling), and *uṇḍahagi* (the carpenter), while others are mentioned by name, such as *pabata* (a tax on buildings made with bricks), *pagarĕm* (a tax on salt), *paharĕṅ-harĕṅ* (a tax on making charcoal), *pobaran* (a tax on the dying or the wearing of dyed clothes), *pamĕḍihan* (a tax or contribution in the form of clothes), and *pabaraṅka* (a tax on the making of sheaths).

Taxes and other charges related to water are also recorded in the inscriptions; these include, among others, Sarwadharma 1191 Śaka (1269 CE) and Trailokyapuri IV (undated).[52] The Sarwadharma inscription of 1269 CE depicts the taxes and charges:

IV.b.

4. *…., maryyaweha papiṇḍa pa[ṅ]ti, patiklaṅgas, paṅhulubaña, mareṅ thāni balanya, sowaṅ so*
5. *waṅ, kuněṅ yan panuku baña ikaṅ thāni bala pangaśrayanya, tumatātukwa sapanut sa*
6. *ni sawaḥnya*[53]

Translation:

IV.b.

4. …., should cease to give *papiṇḍah panti* (a contribution for house-moving), *patikĕl aṅgas* (a contribution or fee for *tikĕl aṅgas*[54]), *panghulu bañu* (irrigation water controlling fees) to each village.
5. But in the case of villagers asking to buy [irrigation] water, their purchase of it should be arranged according to
6. [the width of] their irrigated rice-fields.

52 The Trailokyapuri IV inscription is undated, but Hasan Djafar dates it to 1408 Śaka (1486 CE), probably based on the assumption that the date is similar to Trailokyapuri I and II because they are from the same bundle; H. Djafar, *Masa Akhir Majapahit. Girindrawarddhana dan Masalahnya* (Jakarta: Komunitas Bambu, 2009): 9-17.

53 See the transcription and its Dutch translation in: J. van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari – Majapahit, 1255-1486, Band II*: 256. The word *"pa[ng]ti"* should be *"pa[n]ti"*, which means pavilion or house. This translation can also be compared with that of Pigeaud in: Th.G.Th. Pigeaud, *Java in the 14th Century. A Study in Cultural History*, Vol 3 (The Hague: Martinus Nijhoff, 1960): 143-150.

54 Perhaps it is related to the words tikĕl (to break into two) and aṅgas (stick or stake), so it is probably a fee for cutting wooden stakes.

Moreover, another inscription, Trailokyapuri IV (undated) also recorded:

A.

14. *….. deniṅ parimāṇa niṅ deśāmpiha=niṅ trailokyapuri. riṅ talasan=puṅ batu. wuṅgw=iṅ tamraripta. makādi kawĕwnaṅan*
15. *ḍalawan=saṅ hyaṅ dharma. deniṅ paṅulubañu. sakiṅ trailokyapuri, mariṅ jiwu, pisis, 2300, ḍawuhan=wetan=iṅ umaḥ=iṅ jiwu*
16. *miliṅ kali panambaṅan. muwaḥ sawaḥ kumalaśa kahilen=bañu sakiṅ jiwu. margga galĕṅ, kaliṅ siwalan=ḍawuhan=bhumiṅ jiwu, paṅulubañu*
17. *2200, paḍa haśraḥ kaṅkĕn=purṇnamaniṅ kasaṅa. lawan=pari ciṅ. 8. kaṅkĕn=taṅ. 15. ka. 3. makadośa tan=aṅilenana tañu riṅ*
18. *jiwu katĕmpuhana saloṅloṅ=iṅ sawaḥ kaṅ tan=kahilen=bañu, tur katagiha panikĕl= saguṅ=iṅ paṅulubañu.*[55]

Translation:

14. As a number of hamlets in the villages of Trailokyapuri, Talasan, and Puṅ Batu have copper plates (inscriptions), giving the first rights to
15. Saṅ Hyaṅ Dharma to receive the *paṅhulu bañu* (irrigation water controlling fee) of Trailokyapuri to Jiwu [areas], to the amount of 2300 *pisis*,[56] [and of] the dam located south of the house at Jiwu which flows
16. through the Panambaṅan river, and of the rice fields of Kumalaśa which were flowed by water from Jiwu through diking a river at dam Siwalan at Jiwu region. [So, the total amount of] the *paṅhulu bañu* [for the last two areas] is
17. 2200. [Therefore] everyone should hand it over on every full moon in the ninth month and rice worth 8 *ciṅ*[57] every fifteenth (day) of the third month. Guilty are those who do not let the water flow to
18. Jiwu. Someone will be fined [if he makes] the *sawah*s less because [the lands have] have not seen a flow of water; if they do so, people will even be charged double that of the *paṅulu bañu*.

Another passage from the same inscription gives the following information:

55 See the transcription in: Brandes, *Oud-Javaansche Oorkonden*: 94-95. The translation can be compared with: Van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band II*: 484 and 488.

56 *Pisis* is a Javanese currency that emerged after c. 1350. According to Robert S. Wicks, it was based on the Chinese cash coin, and the system was as follows: 1 *kupang* (*sakupang*) = 100 units (*pisis*), 1 *atak* (*sātak*) = 200 units, 1 *māṣa* (*samas*) = 400 units, 2 *māṣa* (*ḍomas*) = 800 units. See: R.S. Wicks, *Money, Markets, and Trade in Early Southeast Asia: The Development of Indigenous Monetary Systems to AD 1400*, (Ithaca, N.Y.: Southeast Asia Program, Cornell University, 1992): 291-292.

57 *Cing* is a unit of measurement, especially for rice.

B.

6. *…… deniṅ deśa sosoran=kaṅ kahilen=bañu sakiṅ trailokya*
7. *puri paḍa haweḥ paṅulu bañu mariṅ trailokyapuri, deśeṅ subaki hasraḥ paṅulu bañu, pisis. 8400. pari. sā. 4. woṅ ka*
8. *tiḍur=asraḥ paṅulu bañu pisis. 8400. pari. sāṅ. 4. haḍawuhan=iṅ ḍoḍogan. riṅ kĕpuḥ. bhumiṅ trailokyapuri sigarada. riṅ aliwu*
9. *wuṅ=hasraḥ paṅulu bañu. 6000. pari ciṅ. 8. riṅ jākuṅ=apaṅulu bañu pisis. 6000. pari. ciṅ. 8. riṅ kaměñjiṅ bañu tutuko*
10. *n. 6000. pari ciṅ. 8. riṅ glĕṅ=atuku bañu. 4000. riṅ garmma. 400. pari ciṅ. 3. riṅ=ĕluk= atuku. 800. kudur paṅulu bañu 100*
11. *0. liṅgirin. 400. pari ciṅ 3. paḍa haśraḥ kaṅkĕn taṅ. 7. ka. 9. yekanaṅ deśa sosoran= hamet paragaḍa tan=aweha paṅulu bañu*
12. *hagagamana handika. rājamudra cĕlĕk=pañĕlĕk=tān=mandiha//* [58]

Translation:

6. ..to the villages located in the lower regions and which are fed by water from Trailokya
7. Puri, [they] pay altogether to Trailokyapuri. The Subaki village should hand over *paṅulu bañu* (irrigation water controlling fees) [to the amount of] 8400 *pisis* and rice 4 sheaves.[59] The residents of
8. Katiḍur should hand over *paṅulu bañu* [to the amount of] 8400 *pisis* and rice 4 sheaves. Whoever uses the dam at Ḍoḍokan and Kĕpuh in the Trailokyapuri region, on the border of
9. Aliwuwuṅ, should hand over *paṅulu bañu* [to the amount of] 6000 [*pisis*] and rice 8 *ciṅ*. In Jākuṅ [they] should pay *paṅulu bañu* 6000 and rice 8 *ciṅ*. In Kaměñjiṅ the payment for buying the water is
10. 6000 and rice 8 *ciṅ*. In Glĕṅ the price of buying the water is 4000 [*pisis*]. In Garmma [the price] is 400 [*pisis*] and rice 3 ciṅ. In Ĕluk [the price is] 800 [*pisis*]. In Kudur the *paṅulu bañu* is 1000 [*pisis*].
11. In Liṅgirin [the price is] 400 [*pisis*] and rice 3 *ciṅ*. They all hand over every seventh day of the ninth month. The villages located in the lower regions which want to try to get *paragaḍa*[60] for not paying the *paṅulu bañu*
12. through use of a royal decree order, it would not be effective.

The above passages demonstrate that there were two different kind of payments

58 *Ibid.*

59 *Sā* or *sāng* is a unit of rice measurement/weight. Van den Veerdonk, based on the Gericke and Roorda's dictionary of *Javaansch-Nederlandsch Handwoordenboek* considers that *sā* = sheaf.

60 The meaning of *paragaḍa* is unclear. From the context of the sentences, it seems that that it is a mechanism to avoid paying taxes.

that were taken from the villagers, *paṅulu bañu* and *atuku bañu.* The first refers to an irrigation water controlling fee while the latter is a payment for buying (*atuku*) water for irrigation. The above inscriptions record that some villages were charged *paṅulu bañu* and that others were required to pay *atuku bañu*, but the passages do not provide sufficient information to explain why a village should give *paṅulu bañu* or *atuku bañu*. I presume that the location of the village determined its water payment. Each irrigated region—composed of a number of villages—had its own irrigation network, and the villages of any one network would only pay the fees (*paṅulu bañu*) while those villages that were located outside the network and which wanted to use water from it had to purchase water by paying *atuku bañu*.

The amount of *paṅulu bañu* and *atuku bañu* that was charged differed, though it is likely that the size of the payment correlated with that of the rice field or the water usage of each village. The water charges were stipulated on the basis of the village, not individual users. Moreover, the payment of both levies was carried out at least once a year on a specific date. It is clear from the inscriptions that the amount of the charge was determined by the royal court and in the case of a *sīma* establishment the stipulation was written down on an official inscription. The rules were supposed to be obeyed and documented in the inscription to make sure that no-one took advantage of the situation.

Since the *sīma*s in Sarwadharma and Trailokyapuri were established to help with the upkeep of the religious foundations located in those villages, the levies and the payments went to these religious foundations directly rather than to the *maṅilala dṛwya haji* or the royal court. In other words, the inhabitants were not freed from paying the levies after their villages had been granted *sīma* status; they still had to pay, but the money was now used for their religious foundations. This is the essence of the *sīma*: it was a contribution to the community finances. The beneficiary of this payment diversion was the religious foundation, perhaps at the hand of the upkeeper of the foundation for operating costs of the foundation.

Other taxes and fees related to water management are mentioned in the Palĕbuhan 849 Śaka (927 CE), Cane 943 Śaka (1021 CE), and Dhimaṇāśrama (undated) inscriptions. These taxes were taken from *parahu/prau* (boat) operators, and the amount of tax depended on the size and equipment of the boats.[61] Similarly, a type of fee might also be applied to small boats or *jukuṅ*.[62] It seems that these taxes were applied to boats used for commercial transport or fishing. The Dhimaṇāśrama inscription provides the interesting piece of information that the taxes could be

61 For a transcription of the Palĕbuhan inscription, see: Stutterheim, W.F., "Epigraphica: I. Een Oorkonde van Koning Wagiçwara Uit 927 A.D.", *TBG* 75 (1935): 420-482. For a transcription of the Cane inscription, see: Brandes, *Oud Javaansche Oorkonden*: 120-125. For a transcription of the Dhimaṇāśrama inscription, see: Christie, *Patterns of Trade in Western Indonesia: Ninth through Thirteenth Centuries A.D.*: 515-516.

62 See the sub-chapter on Water Officials in this chapter.

collected by the *mpuṅku* Muntun, who had purchased land on which to build and endow a religious foundation.[63] As such, the taxes from trade and fishing along the river were given to the religious foundation probably in order to maintain it.

4.5. HYDRAULIC INFRASTRUCTURE

Information on water infrastructure is found in only a few inscriptions, and most of these are from East Java.[64] They are: Hariñjiṅ A 726 Śaka (804 CE), Hariñjiṅ B 843 Śaka (921 CE), Sarañan 851 Śaka (929 CE), Turyan 851 Śaka (929 CE), Wulig 857 Śaka (935 CE), Gaṇeśa Pare (unclear date, probably between 908-1017 CE), Kamalagyan 959 Śaka (1037 CE), Kuśmala 1272 Śaka (1350 CE), Jeṅgring 1276 Śaka (1354 CE), Keputran 1277 Śaka (1355 CE), Seloliman 1280 Śaka (1358 CE), and Trailokyapuri IV (undated, probably the same with Trailokyapuri I and II from 1468 CE), Seloliman . As regards the water infrastructure, these twelve inscriptions refer to dams, dykes, canals, and water pipes.

The inscriptions that refer to dams are Hariñjiṅ, Ganesa Pare, Turyan, Kamalagyan, and Wulig. In the Hariñjiṅ and Ganesa Pare inscriptions, there mention is made of a type of dam, a *mula ḍawuhan*, which has been interpreted by Christie as referring to a dam that had a link with a religious establishment, and she added that it was likely connected to a *patirthan* (a sacred bathing place).[65] In the Hariñjiṅ inscription, *mula ḍawuhan* is mentioned in a passage that refers to "*sīmanira mula ḍawuhan"* (his *sīma* Mula Ḍawuhan), while in the Ganesa Pare inscription the text is unclear so it is not possible to read and therefore understand it, although in some parts of it offerings for *mula ḍawuhan* are recorded.[66] From both these records, we can confirm Christie's interpretation of *mula ḍawuhan*: that it was a type of sacred bathing place that might have had or been near a larger water reservoir, so it could be a *ḍawuhan* (dam).

63 Christie, *Patterns of Trade in Western Indonesia: Ninth through Thirteenth Centuries A.D.*: 514.

64 There are also inscriptions which mention water infrastructure found in West Java and Central Java, namely Tugu inscription (West Java) and Śiwagṛha 866 CE, Rumwiga I 904 CE, Tluron 900 CE (Central Java). See: Poerbatjaraka, *Riwajat Indonesia I* (Djakarta: Jajasan Pembangunan, (1952): 13-14; M. Suhadi, "Prasasti Rumwiga", *Berkala Arkeologi* 4(1) (1983): 37–47; Casparis, *Prasasti Indonesia 1*: 280-330; T. Prasodjo and J.S.E. Yuwono, "Ḍawuhan, Wluran, dan Pañcuran: Penelusuran Aspek Hidrologi terhadap Isi Prasasti Tlu Ron", in: *Menggores Aksara, Mengurai Kata, Menafsir Makna*, ed. Tjahjono Prasodjo and D.S. Nugrahani, (Yogyakarta: Departemen Arkeologi, FIB-UGM, 2019): 8-31.

65 Christie, "Water from the Ancestors": 17.

66 For a transcription of the Hariñjing inscriptions, see: Callenfels, "De inscriptie van Soekaboemi": 115-130; for the Ganesa Pare inscription, see: E. Sedyawati, *Ganesa Statuary of the Kaḍiri and Singhasari Periods: A Study of Art History* (Leiden: KITLV Press, 1994): 323-324.

Other inscriptions provide information on dam construction for the benefit of the villagers. Thus, the Turryan inscription records: "*nikanaṅ Imah kulwan=iṅ lwaḥ ya paṅadaggana saṅ hyaṅ kabhaktyan. mwaṅ makabwatthajya ikeṅ saṅ hyaṅ ḍawuhan tus=niṅ lwaḥ saṅkā ri air=lubaṅ"* ("the land to the west of the river is designated as a location on which to build the Saṅ Hyaṅ Kabhaktyan, and to conduct corvée to build a dam where the spring flows from Airlubaṅ…").[67] The initiative for this dam construction came from Ḍaṅ Atu pu Sāhitya, who appealed to the king to build a religious foundation. The king agreed to do so by giving a decree in favor of the foundation, yet imposed corvée on the villagers to build the dam. The decree also commanded that some lands be converted into part of a *sīma*, to be used in constructing and creating *sawah* that would benefit the religious foundation.

The Wulig inscription records that Rakryan Binihaji Rakryan Maṅibil decreed that three dams be constructed in three villages. The decree also contains regulations regarding taking care of the dams:

Front side:

1. *|| ujar rakryan biniha*
2. *ji rakryan maṅibil umiṅsö*
3. *r) i samgat susuhan umajar(a) ikanaṅ*
4. *rama i wulig mūaṅ i paṅiktan i paḍi*
5. *paḍi i pikattan i paṅhawaran i busuran pa*
6. *rṇnaḥ nikanaṅ ḍawuhan kinonkĕn (?) rakryan binihaji*
7. *gaweyakna samgat susuhan tlas ta ya hinaṛĕp*
8. *de samgat taplan kunaŋ de yanikanaṅ rāma sahananya*
9. *kabaiḥ ṛĕmiṅa ikana an kapratapā rakryan bini*
10. *haji warahĕnnyu aṇaknyu antan ba(r)yyaba(r)yya*
11. *irikana ḍawuhan mūaṅ umajara kamu tepaṅu*
12. *pullakna ḍawuhan telyenu ikana wĕluran*
13. *ri wĕṅi ṅuniwaiḥ umalappa iwaknya i rahina kunaṅ*
14. *yan hana wwaṅ gumawayakĕn ikana senuhuttake*
15. *n kinonnaken anigrahān iṅima katiga*
16. *wĕllas taṅaḥ kunaṅ deyanikanaṅ rama kabaiḥ ka*
17. *yatnaknanyu raṣānike tulis yathanya paḍa la*
18. *pamrinyu iyanakwanūa kabeḥ nahan samgat*

Back side:

1. *taplan kinon rakrya*
2. *n binihaji dumiyyana i*
3. *kana punta pakatuppan deni*

67 For a transciption of this inscription, see: J.G. de Casparis, "Where Was Pu Siṇḍok's Capital Situated?" in: *Studies in Southeast Asian Archaeology No.2. Essays offered to Dr. R. Soekmono*, ed. H.I.R. Hinzler (Leiden: Koentji Press, 1988): 43-44.

4. *kana ḍawuhan kumayatnakna ika*
5. *na saṅ hyaṅ ambrita i rahina i wĕṅi*
6. *|| swasti sakawarṣatīta 856 maghamasa tithi*
7. *pratipāda śuklapakṣa tu ka wṛhaspati wukir wā*
8. *ra irika ḍiwasa rakryan binihaji rakryan maṅibil*
9. *pagĕḥhakĕn ikaṅ ḍawuhan katrini i kahulunan*
10. *i wuatan wulas i wuatan tamya samakaṅkā ku*
11. *eḥ nikaṅ kali tlas mapagĕh……..*[68]

Translation:

Front side:

1. || The command of Rakryan Biniha
2. ji Rakryan Maṅibil [which is] passed down
3. to Samgat Susuhan [as an] order to
4. the head of the village at Wulig and at Paṅiktan, at Padi
5. padi,[69] at Pikattan,[70] at Paṅhawaran, at Busuran
6. [which are decreed] as the location of a dam. [It was] ordered by Rakryan Binihaji [that the dams]
7. to be made by Samgat Susuhan which it is expected
8. to Samgat Taplan [as well]. Now, all the heads of the villages
9. were happy with the authority of Rakryan Bini
10. Haji. Tell your children, your wives
11. about the dam and tell them that there were restrictions
12. regarding destroying the dam, do not flow the water channel in
13. at night and certainly take the fish. But in daytime if
14. there are people who do it there tell them
15. to give to the *sīma* the amount of thirteen
16. and a half. Further, to the entire heads of villages, they should pay attention
17. to the aims of this inscription so that everyone makes a serious effort
18. for all villagers. Then Samgat

Back Side:

1. Taplan was ordered by Rakrya
2. n Binihaji to share part [of the task] with
3. Punta Pakatuppan
4. over the dam, to take serious care of

68 Brandes, *Oud-Javaasche Oorkonden*: 81-82.

69 *Padi-padi* is still the name of a village of Padi, in Kecamatan Gondang, Kabupaten Mojokerto, East Java, near Bakalan village where the inscription was found.

70 *Pikkatan* is now the name of river in the same area where the inscription was found.

5. Saṅ Hyaṅ Ambrita, both night and day.
6. || Hail! The Śaka, has been passed, 856, in the month of Magha
7. on the first of the bright half month of Tuṅlai Kliwon Thursday, Wukir *wuku*
8. when Rakryan Binihaji Rakryan Mañibil
9. inaugurated 3 dams in Kahulunan,
10. in Wuatan Wulas, and in Wuatan Tamya[71]. Thus
11. there many rivers were inaugurated……

The Wulig inscription was found at Bakalan, in Mojokerto, south of the Brantas river and southeast of the Porong river, where there are tributaries of the Brantas. Even today, this area is one of the main irrigated agricultural areas of East Java. There is little doubt that agricultural life there has deep roots in the past, many centuries ago, as the Wulig inscription suggests. The three Wulig dams provided the inhabitants who were living in the areas around the dams with many benefits, allowing them to irrigate *sawah*s and cultivate fish, but in fact the main goal of their construction was to perform an act of devotion through the religious foundation of the Sang Hyang Ambrita.

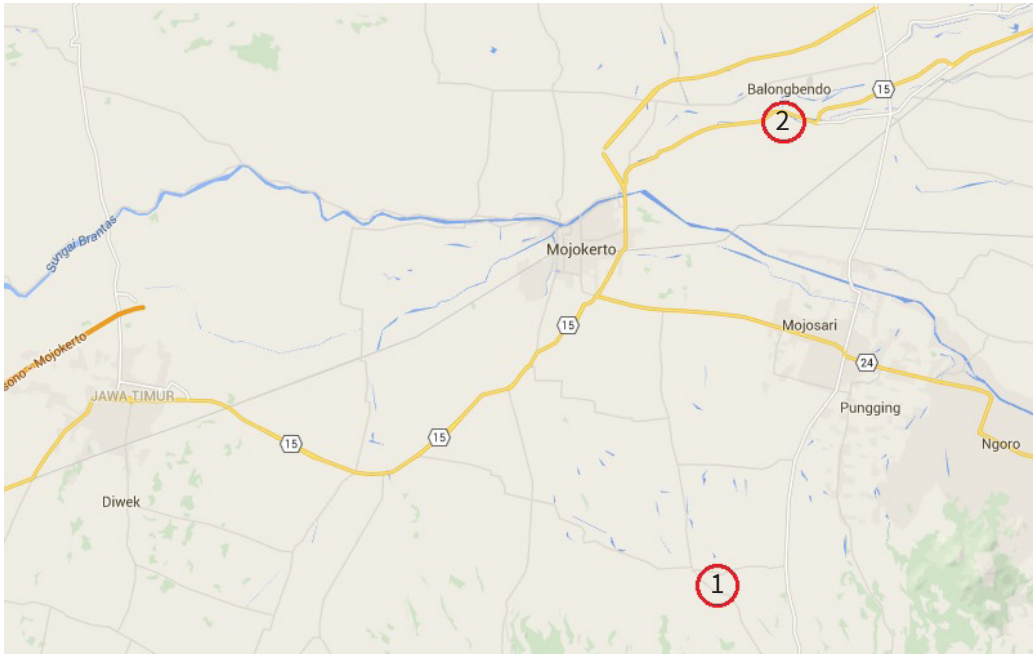

Fig 4.1. The locations of the Wulig inscription and of the Kamalagyan inscription. The region where the Wulig inscription was found (1) and the Kamalagyan inscription (2). (Source: Google Maps, with a modification)

71 Tamya is probably the same place as today's Tameng, a small village (*dusun*) in Padi village, Gondang, Mojokerto.

The people of ancient East Java also constructed dykes, either to support dam construction or as a single construction to control the water. The Kamalagyan inscription of Śaka 959 (1037 CE) provides fairly detailed information on dyke construction in ancient East Java, as the following shows:[72]

1. *||o|| swasti śakawarṣātīta 959 mārggaśīramāsa. tithi pratipada śuklapakṣa, pa, po, śu, wāra duṅulan (graha)cara bāyabyastha, jyeṣṭanakṣatra śakragni dewatā, dhṛtiyoga, wawakaraṇa, irikā diwaśamyājñā śrī*
2. *mahārāja rake halu śrī lokeśwara dharmmawaṅśa airlaṅgānanta wikramottuṅgadewa, tinaḍah rakyān mahāmantri i hino śrī saṅgrāmawijaya prasādottuṅgadewī, umiṅsor i rakryān kanuruhan pu dharmmamūrtti narottamajāna*
3. *naśura, i piṅsornyājñā śrī mahārāja kumonakanikāṅ rāma jātaka i kamalagyan sapasukthāni kabeḥ, thani watĕk paṅkaja, atagan kĕlpurambai, gawe mā 1 masawaḥ tampaḥ 6 hinajyan mā su 6 mā 7 ku 4, len (?)*
4. *drabyahajiniṅ gagā, kbwan pasĕrĕhan, tkariṅ lwaḥ, rĕnĕk, tpitpi, wuluwulu prakāra kabeḥ, piṇḍa samudāya mā su 17 mā 14 ku 4 sā 4 yatikā inaṇḍöan patahila drabya haji mā su 10 aṅkanasuji*
5. *māsa i śrī mahārāja magiliṅgiliṅan tanpārik tanpapādapaṅlĕyö, tanpapagaḍuḥ, tan papilihmas len drabya haji niṅ kalagyan saṇḍaṅan mā su 2 ma 10 milu inaṇḍĕḥ matahila mā su 2 kakala*
6. *ṅan madrabya haji mā 1 ku 2 inaṇḍĕḥ matahila drabya haji mā 1 atĕhĕr tan knā riṅ pintapalaku, buñcaṅ haji turunturun sakupaṅ sātak sukha duḥkha magöṅ maḍmit denikāṅ warggahatur, wargga patiḥ, mwaṅ juruniṅ ka*
7. *lagyan raṇu riṅ dharmma, kewalāněmwa drabyahaji iṅ sīma ḍawuhan i kamalagyan riṅ tambak riṅ wariṅin sapta juga parṇnahanya kāliḥ, sambandha, śrī mahārāja madaměl ḍawuhan riṅ wariṅin sapta lmaḥ nikāṅanak thāni ri kamala*
8. *gyan, puṇyahetu tan swartha, kahaywaknaniṅ thāni sapasuk hilir lasun paliñjwan, sijanatyĕsan pañjigantiṅ, tālan, daśapaṅkaḥ, paṅkaja, tkariṅ sīmaparasīma, kala, kalagyan, thāni jumput, wihāra śā*
9. *la, kamulan, parhyaṅan, parapatapān, makamukhyabhuktyan, saṅ hyaṅ dharmma riṅīśānabhawana maṅaran i surapura, samaṅkana kweḥnikāṅ thāni katahan kaḍĕḍĕtan cariknya denikāṅ kāntĕn tmahan baṅawan amgat ri wa*
10. *riṅin sapta, dumadyakan unānikāṅ drabyahaji mwaṅ hilaṅ nikāṅ carik kabeḥ, āpan durlabha kawnaṅanikatambakanikāṅ baṅawan amgat de parasāmya makabehan, tan pisan piṇḍwa tinamhak parasamya,*
11. *ndātan kawnaṅ juga parṇnahnya, samaṅkana ta śrī mahārāja lumkas*

72 This inscription was found at the village of Klagen, Sidoarjo, East Java. This transcription of the inscription is taken from: Brandes, *Oud-Javaansche Oorkonden*: 134-136.

umatagaknikāṅ tanayan thāni sakalrā re nikĕrkĕ mritāpa śrī mahārāja, inatag kapwa paṅrabḍa mabuñcaṅhajya maḍawuhan saṅpun ta siddha kadamla

12. *nikāṅ ḍawuhan de śrī mahārāja, subaddhāpagĕḥ huwus pĕpĕt hilīnikāṅ bañu, ikaṅ baṅawan amatlū*[73] *hilīnyaṅalor, kapwa ta sukhamanaḥ nikāṅ maparahu samaṅhulu maṅalap bhāṇḍa ri hujuṅ galuḥ tka*
13. *rikāṅ parapuhawaṅ prabaṇyaga saṅkāriṅ dwīpāntara, samañuntĕn ri hujuṅ galuḥ ikaṅ anak thāni sakawāhan kaḍĕḍĕtan sawaḥnya, atyanta sarwwasukha ni manaḥnya makāntaṅka sawaha muwaḥ sawaḥnya kabeḥ an pinunya*
14. *n tinambak hilīnikāṅ baṅawān amgat riṅ wariṅin sapta de śrī mahārāja, mataṅyan ḍawuhan śrī mahārāja parṇnaḥnikāṅ tambak riṅ wariṅin sapta, samaṅkana ta śrī mahārāja haṅanaṅan ri tantguhanikāṅ ḍawuhan*
15. *deni kweḥ nikāṅ wwaṅ mahyūn, maṅlburaṅ yaśa, ri sḍaṅanyan tan tiṅgīn rakṣān parṇnaḥya umahana, mataṅyan ….. ni ikamalagyan tkari kalagyanya katuduḥ momaha i samīpanikāṅ ḍawuhan riṅ wariṅin sapta.*

Translation[74]:

1. ||0|| Hail! The Saka year, has been passed, 959 (1037 CE), the month of Mārggaśira, the first day of the bright half of the month,[75] the day of *Paniruan*, *Pon*, and *Śukra*,[76] the *wuku* of Duṅulan,[77] the *grahacara* of *Bāyabyastha*, the *nakṣatra* of *Jyeṣṭa*, the *dewata* of Śakrāgni, the *yoga* of *Dhṛti*, the *karaṇa* of *Wawa*,[78] when the order of Śrī

73 According to Christie, the word "*amatl*ū" is a misreading of "*amatluk*". See: Christie, *Patterns of Trade in Western Indonesia:* 503*.* However, I have checked the original stone inscription, which is now in Klagen, Sidoarjo, East Java and it should, in fact, be read as "*amatl*ū". Many thanks to Goenawan A. Sambodo who helped me by providing a close-up photo of the Kamalagyan inscription in 2016.

74 Translations of this inscription were also published by Jan Wisseman Christie in: Christie, *Patterns of Trade in Western Indonesia*: 496-503, and by Wirjosuparto in "Apa Sebabnja Kediri dan Daerah Sekitarnja Tampil Kemuka dalam Sedjarah": 17-21.

75 Each Old Javanese month containing 30 *tithis* is divided into two *pakṣas*: śuklapakṣa and *kṛṣṇapakṣa.* Śuklapakṣa is the bright half of the month—or the waxing moon—and śuklapakṣa is the dark half of the month—the waning moon. I think Christie's translation of śuklapakṣa in this inscription as "the dark half of the month" is just an accidental mistake. See: Christie, *Patterns of Trade in Western Indonesia:* 496.

76 Paniruan, Pon, and Śukra are abbreviated as "pa", "po", and "śu" in the inscription. They are the names of the weekdays in three different weeks: the six-day week, the five-day week, and the seven-day week, and they were put on the inscription in that order. See: De Casparis, *Indonesian Chronology*: 49.

77 *Wuku* refers to the names of weeks. There are 30 week-names in the Old Javanese dating system.

78 *Grahacāra* shows the place of a planet, and *B*āyabyastha is one of its positions, in the

2. Mahārāja Rake Halu Śrī Lokeśwara Dharmmawaṅśa Airlaṅgānanta Wikramottuṅgadewa was received by the Rakryān Mahāmantri of Hino Śrī Saṅgrāmawijaya Prasādottuṅgadewī and then passed down to the Rakryān of Kanuruhan Pu Dharmmamūrtti Narottamajānanaśura.
3. Then the passed down order of Śrī Mahārāja was to be carried out by Rāma Jātaka officials at Kamalagyan, all the *thani*, under the *watĕk* of Paṅkaja, who are commanded to convert the *kĕlpurambai* tree field, which has a value 1 *māsa*, into 6 *tampah* of *sawah* fields, at the price of 6 *suwarṇa*, 7 *māsa* and 4 *kupaṅ* in gold.[79] The other things [ordered] are
4. that the royal taxes on the dry rice fields, *sirih* gardens, including river, marsh, and border areas, and grasslands,[80] which have an overall total [of the taxes] of 17 *suwarṇa*, 14 *māsa*, 4 *kupaṅ* and 4 *sāga*,[81] should be reduced to a continuous tax payment of 10 *suwarṇa* in gold each month of Asuji
5. to Śrī Mahārāja.[82] Moreover, there is no *arik* tax, no *pādapaṅlĕyö* tax, no *pagaduḥ* tax, and no *piliḥmas* tax.[83] Another thing is that the *kalagyan saṇḍaṅan*[84] levy of 2 *suwarṇa* and 10 *māsa* in gold is also to be reduced, to pay [only] 2 *suwarṇa* in gold. The *kakalaṅan*[85]
6. tax of 1 *māsa* and 2 *kupaṅ* is to be reduced, to pay [only] 1 *māsa*. Also, they

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north-west. *Nakṣatra* is a lunar mansion and the *yoga* "combines [the] longitudes of the sun and the moon" See: Eade and Gislén, *Early Javanese Inscriptions*: 4-5. *Karaṇa* is half a *tithi*.

79 *Suwarṇa*, *māsa*, and *kupang* are units of gold weight. See: J. W. Christie, "Money and Its Uses in the Javanese States of the Ninth to Fifteenth Centuries", *Journal of the Economic and Social History of the Orient* 39 *(1996):* 258-261.

80 *Wuluwulu* is usually translated as an official, but here Christie translates it as grasslands; Christie, *Patterns of Trade in Western Indonesia:* 496*.*

81 *S*āga is a unit of gold weight. See: Christie, "Money and Its Uses in the Javanese States of the Ninth to Fifteenth Centuries": 261.

82 *Magilinggilingan* is actually unclear in this context; it may mean "continuously".

83 *Pārik*, *papādapanglĕyö, papagaduḥ,* and *papiliḥmas* are types of taxes. The *arik* tax is sometimes referred to as *arik-purih*, which, according to Christie, is a tax on producing something. See: Christie, *Patterns of Trade in Western Indonesia:* 501. The *pādapanglĕyö, pagaduḥ* and *piliḥmas* taxes are still unclear.

84 A tax or levy for clothing or decorating a *kalagyan* (a religious dwelling). A *kalagyan* is a distinctive settlement, but it is still unclear what kind of distinction it had. In the Deśawarṇana (Nagarakṛtāgama) it is mentioned as one of the special settlements, similar to *dharmma, sīma, wangśa, hila-hila, hulun hyang, and kuṭi*. See: Stuart Robson, *De*śawarṇana (Nagarakṛtāgama) by Mpu Prapañca (Leiden: KITLV, 1995): 79.

85 *Kakalangan* is "a particular kind of religious establishment"; see: Zoetmulder, *Old Javanese-English Dictionary*: 772.

are not to be subjected to *pintapalaku*[86], royal corvée, *turunturun*[87] of 1 *kupaṅ* 1 *atak*[88], *sukhaduḥka*, much or little, from *warggahatur, wargga patiḥ*, and the head of the

7. religious establishment of Ṛanu (lake) at Dharma. Both receive nothing except [receive] the taxes from the *sīma* of dam at Wariṅin Sapta and the dyke at Kamalagyan. The reason is that Śrī Mahārāja built the dam at Wariṅin Sapta on land belonging to the inhabitants of the *thāni* of Kamalagyan,
8. because it is a [manifestation of his] meritorious act and not for his own advantage. This is agreed by the downstream [inhabitants of the] *thāni* of Lasun, Paliñjwan, Sijanatyĕsan, Pañjigantiṅ, Tālan, Daśapankaḥ, and Paṅkaja, including all the *sīma, kalaṅ, kalagyan, thāni jumput, wihāra*, śāla,
9. *kamulān*, *parhyaṅan* and *parapatapān*, especially Saṅ Hyaṅ Dharmma at Iśānabhawana, [which is] called Surapura. Thus, many *thāni* were hopeless [because] their rice fields overflowed as a result of the change of the [flow of the] river after the *baṅawan* (big river) had been intercepted (dammed?) at Wariṅin
10. Sapta. This caused a decrease in the tax revenues and all the rice fields vanished because it was difficult for the people to be able to dam the big river to intercept [the overflow]. Not only once or twice they had tried to dike the great river [but many times],
11. but were still unsuccessful. Then Śrī Mahārāja started to summon all the villagers of the *thāni* .....[89] Śri Mahārāja. They were all ordered to do the royal corvée to build the [dike of the] dam. The construction of the [dike of the] dam was completed successfully
12. by Śrī Mahārāja, stands stable and sturdy and completely blocks the flow of the water. The [course of the] great river was divided into three flowing north.[90] All are happy, [including] those who sail upstream and take goods

86 According to Christie, this means an "official commandeering"; see: Christie, *Patterns of Trade in Western Indonesia:* 502.

87 The meaning is unclear. Is it a kind of tax? Or perhaps it is a kind of obligation for people to participate in social activities, since the word "*turunturun*" is often put after the word *bu*ñcaṅ haji (royal corvée).

88 *Sakupaṅ sātak* is one hundred and two hundred. According to Robert S. Wicks, it is probably a payment that refers to Chinese copper coins; see: R.S. Wicks, *Money, Markets, and Trade in Early Southeast Asia:* 282. Christie explains that this phrase "became the standard formula for expressing the general idea of tax payments in small units"; see: Christie, "Money and Its Uses in the Javanese States of the Ninth to Fifteenth Centuries": 268.

89 The phrase "*sakalr*ā re nikĕrkĕ mritāpa" cannot be understood.

90 Christie translated this as "has been deflected" because she argues that it is from Old Javanese word "*amatluk*" as a misreading of "*amatl*ū". See: Christie, *Patterns of Trade*

at Hujuṅ Galuh, including

13. ship captains and traders from other islands who meet each other at Hujuṅ Galuh. The villagers who have the *sawah*s which were flooded and inundated are all very happy [because] the floods have ended. Also, all their *sawah* fields are [basically] a gift
14. from Śrī Mahārāja [which are manifestated by] diking [and] cutting off the flow of the *baṅawān* (great river) at Wariṅin Sapta. Therefore, the dam of Śrī Mahārāja is placed [as a single entity with] the dyke at Wariṅin Sapta. Because Śrī Mahārāja thinks that the dam [with its dyke] might be weakened
15. by many people who want to destroy the meritorious deed. While it is not protected, it would be the right time [for the surrounding area of the dam] to be inhabited. Thus, the villagers[91] of Kamalagyan, including its religious establishment, have been ordered to dwell near the dam at Wariṅin Sapta.

Thus, the inscription records the order given by King Airlaṅga to the elders of Kamalagyan village concerning the construction of a dyke (*tambak*) in Kamalagyan in order to secure a dam (*ḍawuhan*) in Wariṅin Sapta. This was needed in order to lessen the effects of the water that was overflowing from the river to the *sawah*s in Kamalagyan, causing the *sawah* fields to vanish and a consequent decrease in tax revenues. The villagers had tried to overcome this disaster themselves, but they failed. Therefore, the king ordered that land (a *kĕlpurambai* tree field) be converted into ricefields so yields from the ricefields could be used for the upkeep of the dam and its religious establishment. Tax exemptions and tax reductions were also made in order to compensate for the construction and upkeep of the dyke and dam. After the dyke was finished the river's course was altered, moving northwards. As a result, the rice fields were protected from the floods and the traders who used the watercourse had their expectations met.

The inscription contains several interesting points. The first is that this inscription shows clearly how the king intervened in water infrastructure affairs. Such a direct royal order to build a water-control structure is very rare in Old Javanese inscriptions. However, if we study it in detail, it is obvious that the involvement of the royal court was limited to giving the order to establish the *sīma*. All expenses related to the building of the dyke and dam and their upkeep were charged to the local community: the construction was built by a corvée and

in Western Indonesia: 503. However, when I re-read the word on the original stone inscription, it is very obvious that it has to be read as "*amatl*ū", so then it should be translated as "has been divided into three".

91 In Brandes' transcription the words "*anak th*āni" (translated as villagers) are missing, only the aksara "*ni*", perhaps cannot be read. But, Sutjipto Wirjosuparto suggests it should be "*anak th*āni" and so that it fits with its context. See: Wirjosuparto, "Apa Sebabnja Kediri dan Daerah Sekitarnja Tampil Kemuka dalam Sedjarah": 16.

the upkeep was in the hands of a religious foundation that received the required money from tax breaks. Moreover, the security of the dam and the dyke was the responsibility of the people of Kamalagyan, some of whose inhabitants were settled near the construction to oversee it and look after it.

Another interesting point is found in lines 18 to 22 of the inscription:

18. *…. ḍalānyan lmaḥnya ḍinawuhan śrī mahārāja, dumadyakan kṛtāniṅ rāt, mwaṅ punarjīwanibhuktyan saṅ hyaṅ sarwwadharmma, sīmaparasīma, kalakalagyan*
19. *thāni jumput, wihāra, śāla, kamulān, parhyaṅan, parapatapān kabeḥ, makatĕwĕka paṅḍiri śrī mahārāja makaḍatwan i kahuripan, an sira sākṣāt sumiram ikīṅ rāt kabĕḥ riṅ anurāgāmṛta, mahudanakan kīrtti, u*
20. *maṅun sakaparipūrṇnākna saṅ hyaṅ sarwwadharmma, ri paměpěgni kayowanāniran sinīwi ri yawadwīpamaṇḍala, hetuniran paṅlrākan dharmmakuśalamūla, tirutirūniṅ rāt kabeḥ, kapwa magawaya yaśa, āpan maṅkana pinakaswabhāwanikaṅ*
21. *sira ratu cakrawartta, umaṅun pamaṅgihanikāṅ rāt hita pratidina, paṅliṅgānanikāṅ sabhuwana ri tan swartha kewala śrī mahārāja, yāwat kawaṅunaniṅ yaśa donanya, an kapwa kinalimbaṅ juga denira, sahana saṅ hyaṅ sarwwadharmma ka*
22. *beḥ, ….*[92]

Translation:

18. … the land was converted to a dam by Śrī Mahārāja, [it] would bring about prosperities to the world, and to revive the advantages of Saṅ Hyaṅ Sarwwadharmma, [to] all *sīmas, kalagyans*,
19. *thāni jumput, wihāra, śāla, kamulān, parhyaṅan,* [and] all *patapān*. It was the [best] moment of the reign of Śrī Mahārāja, who had his capital at Kahuripan, as if he poured the elixir of life upon the entire world, to give a rain of merit,
20. to build every perfection of Saṅ Hyaṅ Sarwwadharmma. From youth to old age, he serves the maṇḍala of the island of Java. His motive for spreading the origin of the holiness of *dharmma* should be a worthy example to the whole world and also a virtue; this is his nature as
21. a *cakravartin* (an ideal world-ruler), to build a place where the welfare of the world is found every day, as a leader of the whole world, not merely for Śrī Mahārāja's own benefit, but [also] creating merits for the world. All are noticed by him, all places of Saṅ Hyaṅ Sarwwadharmma.
22. …

92 Brandes, *Oud-Javaansche Oorkonden*: 136

These passages show the religious merits of constructing the dam and dyke and demonstrate the ruler's supernatural power, described by the expression "as if he pours the elixir of life upon the entire world". In this metaphor, as water streams from a dam, so does the ruler's duty as *cakravartin* lead to virtues for the entire world.[93] It seems, therefore, that the benefit of the dam and dyke for the local people was merely a cover for a ruler advancing his own interests.

Another inscription, Kuśmala inscription 1272 Śaka (1350 CE), details, in a slightly different way, how the building of a dam was associated with the glory of the king himself. Again, it shows how the waterworks were also used to increase and celebrate the ruler's power. As well as the king being showered with praise such as "causing of welfare to the world, creating the happiness of the inhabitants of the eastern valley of Daha" and "to build a meritorious benevolent life, to the delight of the world", the inscription also highlights the good work of Raṅga Sapu, who carried out the construction of the dam. He is praised as having been of good character, skillful, and full of virtue. Lines 2 to 16 of the inscription are below:[94]

2. *... irikā diwaśa ni kasampurnnan ikanaṅ rawuhan śilamat i*
3. *kuśmala de rakryan dĕmuṅ, saṅ martabun raṅga sapu, makamaṅgala rakakiṅ amurwwa*
4. *bumi, mapariwāra raṅga hawarawar, ju... saṅ apañji pupon makana saṅ ājña*
5. *pāduka bāṭare matahun śri bāṭara wijaya rājasānantawikramotuṅga*
6. *dewa, jāgaddhita hetu, magawaya sukani parasāmya sakahawat luraḥ*
7. *wetan i daha, samaṅkana bilāsa pādukā baṭare matahun ama*
8. *ṅun kirttyanurāgātmaka kasukanirāt raṅga sapu karo wiku pakṣa sampurnna*
9. *ni rawuhan. Siddhir astu amānuṣa kadarśaniya nikanaṅ yaśa ra*
10. *wuhan atita durgga mahalĕp, tlas maparipurnna de rasika raṅga sapu tu*
11. *hu widagdha tiṅkahiṅ ulah, ndatan sah aṅāran pupon rasika pa*
12. *ñji pinujipuji sadhu śaktiguṇawan wnaṅ gumawaya, i saṅ prabu tama*
13. *n palĕpalĕh inutusnira narapati. yaśa atiśaya śobita ahalĕ*
14. *p asuṅ paramasukanikaṅ janāsiṅ umulat, sira rakwa tikaṅ rakṣa ni*
15. *tya pamuliḥ kali marawuhan arddhapalĕ mapagĕh. Mawipraksa*
16. *ti śewadharmma ri naradhipa.*

93 Compare with: Christie, "Water from the Ancestors": 18-19.

94 The inscription is only of 18 lines; the first line to the first half of second line contains mostly a dating of the inscription and the line 16 to the end of line 18 is a closing part of the inscription. The transcription of the Kuśmala inscription is taken from: P.V. van Stein Callenfels, "De Inscriptie van Kandangan", *TBG LVIII* (1919): 337-338 and, van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band II:* 370.

Translation:[95]

2. … this is the time of the completion of the Śilamat dam[96] at
3. Kuśmala by Rakryan Dĕmuṅ [and] Saṅ Martabun Raṅga Sapu, with the approval of the elder brother of
4. Amurwwabhumi, under the protection of the Raṅga Hawarawar, ju… Apañji Pupon, this is what the order of
5. Pāduka Bāṭare Matahun Śrī Bāṭara Wijaya Rājasanantawikramotuṅgadewa,
6. who looks after the welfare of the world [and] creates happiness for the inhabitants of the eastern valley of
7. Daha. Thus, the desire of Pāduka Bāṭare Matahun is to build a
8. meritorious benevolent life, to the delight of the world. Raṅga Sapu with Wiku[97] firmly decided to make
9. the dam complete. May there be perfection.[98] The dam work has a heavenly quality of beauty and it is
10. very strong and excellent. Having finished his completion [of the dam], Raṅga Sapu is truly
11. skillful in the performance of all acts. Indeed, it (his expertise) is inseparable with the name of Pupon, the *Pañji*,
12. who is getting praised for his good character, his extraordinary strength and virtue.
13. He has the right to carry it out for the king and to be ordered by *Narapati*[99] (the King) without negligence. This superior, splendid, and beautiful work

95 Compare my translation with Van den Veerdonk's and Van Stein Callenfels', in: Van den Veerdonk, De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band II: 371; Van Stein Callenfels, "De Inscriptie van Kandangan": 339.

96 I have a different translation of the term "śilamat" with Jan van den Veerdonk and van Stein Callenfels' translation. They translate "*rawuhan* śilamat" as "*de stenen dam*". However, actually śilamat is the name of the dam as it is seen in lines 17-18 of the inscription: "*huwus makangāran kĕta śilamat i kuśmala prakaśita*" (At last, it is called as the Śilamat in Kuśmala, so be widely known as it). See their translations in: Van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band II:* 371; Van Stein Callenfels, "De Inscriptie van Kandangan": 339.

97 The wiku was probably one of the priests or monks in the village of Kuśmala. Van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band II:* 371; Van Stein Callenfels, "De Inscriptie van Kandangan": 339.

98 *Siddhir astu*.

99 The inscription uses the terms *narapati* and *naradhipa*—which have the same meaning—to refer to the king. The writer also mentions the king's full name: Pāduka Bāṭare Matahun Śrī Bāṭara Wijaya Rājasanantawikramotunggadewa, who was the king of Majapahit.

provides the highest joy
14. to all who see it. He is indeed the man who takes care of it continually as a means of
15. restoring the river, dam constructing, completely joined and sturdy. May it protect
16. the Śiwa virtues of *Naradhipa* (the king)…

The ancient East Javanese people also built canals to irrigate their rice fields. The Suměńka 981 Śaka (1059 CE), Hariñjiń A 709 Śaka (787 CE), and Hariñjiń B 843 Śaka (921 CE) inscriptions record the efforts made by the local community to provide water for their agricultural lands. The Suměńka inscription, which was found around the area of Surabaya, mentions a *sīma* grant from the king to the local community of Suměńka that would help them repair a canal that had been built by Paduka Mpuńku, a former ruler.[100] Unfortunately, some parts of this inscription are unclear, so it does not provide much information regarding the repair of the canal. The Hariñjiń A and B inscriptions were written on the same stone block, with Hariñjiń A on the front and Hariñjiń B on the back. The content of the inscriptions relates to a *sīma* granted to Bhagawanta Bari for the benefit of a *mulaḍawuhan*, a religious foundation with a dam and a canal.[101] Inscription B is a confirmation of the original *sīma* grant, which was inaugurated in 921 CE and is recorded in inscription A. The inscriptions were found at Sukabhumi plantation, Siman, Pare, on the slopes of Mount Kelud, and were issued in the early ninth and tenth centuries, suggesting that an irrigation system existed in the area in the early ninth century.

An inscription that records a water pipe in ancient Java is the Kubukubu inscription from 905 CE. This records a *sīma* grant for Rakryan Hujuń Dyaḥ Mańarak and Rakryān Matuha related to a water pipe in Samunduń and Kubukubu:

1. *…. tatkāla ḍapunta mañjala. muań sań mańha*
2. *mbin sań diha. sań dhipa. ḍapu hyań rupin. sumusuk iki tgal i kubu kubu bhadrī śīma i rakryān hujuń dyaḥ mańarak. mwań rakryān matu*
3. *ha rěkai majawuntan mańjurwa iń pakaraṇan i himad mańiwhī caru ańkan juluń. sańkāna ni wway nya i sań-apatiḥ i kahyunan. mana*
4. *mpil talań rwań tapak °i samuduń tka ri kubu kubu patań tapak*…[102]

100 Paduka Mpungku was identified by Boechari as Airlangga: Boechari, "Sri Maharaja Garasakan", *Madjalah Ilmu-ilmu Sastra Indonesia* 4/1-*2* (1968): 1-26. The transcription of this inscription is in Louis-Charles Damais, "Etudes d'épigraphie Indonésienne: IV. Discussion de la date des inscriptions", *Bulletin de l'Ecole française d'Extrême-Orient* 47 (1955): 142.

101 The transcription of these are in: Van Stein Callenfels, "De inscriptie van Soekaboemi": 115-130.

102 Boechari, *Prasasti Koleksi Museum Nasional I*: 156-158.

Translation[103]:

1. … when Ḍapunta Mañjala and Saṅ Maṅha
2. mbin Saṅ Diha, Saṅ Dhipa, and Ḍapu Hyaṅ Rupin demarcated *tgal* (dry fields) in Kubukubu Bhadrī to be a *sīma* of Rakryan Hujuṅ Dyaḥ Maṅarak and Rakryān Matu
3. ha. Rakai Majawuntan, acting as Juru in Himad, gives offerings (*caru*) each Juluṅ.[104] Because water was brought to Kahyuṅan
4. by *talaṅ* (a water pipe), 2 *tapak*[105] in Samuduṅ, to Kubukubu 4 *tapak*…

The inscription is now kept in Museum Nasional Jakarta, and unfortunately the precise location of its origin is unclear; according to Boechari, it used to be the personal property of someone in Malang.[106] This is a particularly important inscription because it confirms that the East Javanese community had knowledge of the technology required to move water through pipes. In Old Javanese *kakawin* literature, we occasionally find the term *talang* denoting a type of waterpipe used by the ancient Javanese in the ninth century CE. It is often mentioned that this was made of bamboo.[107] However, waterpipes made of clay have been found in Trowulan, so it is probable that *talaṅ* could also refer to such earthenware pipes.[108]

In addition to the above inscriptions, there are three more very interesting inscriptions related to ancient Javanese irrigation and hydraulic infrastructure: the Seloliman inscription, the Jenggring inscription, and the Keputran inscription.[109] These three inscriptions are related to tunnel construction and give very important data about the dates the tunnels were constructed. The Seloliman inscription, which was found in a tunnel near the village of Seloliman, a sub-district of Trawas, in Mojokerto, is a 12 x 20 cm stone block with the following Old Javanese text: "*tithi yaśa tiga kaki purṇa 1280"* (the time [when] the meritorious work of Tiga Kaki has been completed, in 1280 Śaka [= 1358 CE]).[110] The Jenggring inscription gives a date

103 Other translations of this inscription, for a comparison with my translation, have been published by: H.B. Sarkar, *Corpus of the Inscriptions of Java* vol. I (Calcutta: Firma K.L. Mukhopadhyay, 1972): 53-54, and E. Wurjantoro, *Anugerah Sri Maharaja. Kumpulan Alihaksara dan Alihbahasa Prasasti-prasasti Jawa Kuna dari Abad VIII-XI* (Depok: Departemen Arkeologi, Fakultas Ilmu Pengetahuan Budaya, Universitas Indonesia, 2018): 429-436.

104 *Julung* is a name of the *wuku*.

105 *Tapak* is a unit of measurement.

106 Boechari, *Prasasti Koleksi Museum Nasional I*: 155.

107 See: Chapter 4.

108 See: Chapter 6.

109 These three inscriptions were first reported in *Oudheidkundig Veslag* 1936; see: W.F. Stutterheim, *Oudheidkundig Veslag 1936* (Bandoeng: A.C. Nix & Co., 1937): 16.

110 In the *Oudheidkundig Verslag* 1936 page 16, footnote 1, it is translated as "*Het tijdstip van het voleindigen van het waterwerk der Tiga kaki (letterlijk: drie grootvaders) is 1358*

Fig. 4.2. Seloliman inscriptions (left) and Jenggring inscription (right). The photo of the Jenggring inscription in *Oudheidkundig Verslag 1936* was set upside-down, so I have turned the photo the right way up. (Photos: A. Gall via: OV, 1936: 592.

for the construction of a tunnel in Jenggring (Jabung), probably also in Mojokerto: 1276 Śaka (1354 CE). This inscription was carved on a stone block, but it was inscribed on and written over an older stone block inscription. Most of the earlier inscription is illegible, while the younger script can be read as "*kaśarupama[…]i* 1276". Stutterheim's report in *Oudheidkundig Verslag 1936* deciphered it differently, namely as a chronogram or *sĕngkalan*: "*kaśa rupa mati gaguṅira*" or 1010 Śaka (1088 CE).[111] However, it is clear to me that the second line of the inscription should be read as the year 1276 Śaka (1354 CE). Paleographically, my reading is supported by the fact that the style of the script is similar to that of the Seloliman inscription, particularly if we compare the *aksara* "1" and "2" in the last line of both inscriptions, which is convincing evidence that the final line of the Jenggring inscription does indeed record a year. Unfortunately, the meaning of the "*kaśarupama*[…]*i*" remains unclear.

A.D."

111 In *Oudheidkundig Verslag* 1936, page 16, footnote 2, the chronogram is deciphered as *kaśa* = *alang alang* but also (*ak*ā*śa*) means airspace = 0; *rupa* = 1; *mati* = 0; and *gaguṅ* (*gaga* = 1) or in Śaka year is 1010. However, as it says in the report this reading remains uncertain. See: Stutterheim, *Oudheidkundig Verslag 1936*: 16.

The third inscription, the Keputran inscription, was found in Keputran, near Kutorejo, in Mojokerto, has dimensions of 16 x 39 x 88 cm, and reads: "*iki yasanira (k)i puput hālaḥ papan* 1277" (this is the meritorious work of Ki Puput Hālaḥ Papan in 1277 Śaka [1355 CE]). Since the three inscriptions were issued in the years 1358 CE, 1354 CE, and 1355 CE, they indicate that, at that time, the construction of tunnels in the area in question (southern Mojokerto) was highly developed. Moreover, the most important contribution of these inscriptions to research into tunnel construction in East Java is that they provide definitive dates for the tunnels where previous research had given them only approximate ones.

In sum, these inscriptions provide us with remarkable information related to the construction of water works in East Java. It also confirms that the building of various pieces of water infrastructure, both large and small, had started several centuries before the most powerful polities ruled the area. Moreover, the information contained within the inscriptions suggests that there was deep involvement by both commoners and local officials in the construction of the water infrastructure and that its upkeep and maintenance were in the hands of the local inhabitants, local officials, and religious foundation(s). However, several of the waterworks built were claimed, by the king, to demonstrate his great supernatural power.

4.6. RIVERINE COMMERCIAL ACTIVITIES

The inscriptions regarding ancient East Javanese trade are limited in nature, specifically because East Javanese epigraphic sources are primarily *sīma* inscriptions. Most of the data on trade can be found in the part of the inscriptions that describes the regulation of taxes following the establishment of a *sīma*. In that part of the inscriptions, one of the groups of people occasionally mentioned are the *masamwyawahāra* (those who engage in commerce). They had four ways to move their wares around: by *pikul* (transporting them using a carrying-pole slung over the shoulder), carts, pack-horses, and water transport.[112] This part of the chapter will focus on the trade activities carried out by water transport, especially those along the Brantas river.

The Old Javanese texts—especially *kakawin*s—and inscriptions never mention the local names of the rivers when they describe them; instead, most of the *kakawins* mention the names of the rivers using Indian terms, and for that reason it is difficult to determine the rivers in question. However, some stanzas in the *Pararaton* and *Kiduṅ Harṣawijaya* give an indication of the location of a river that we can infer as being the Brantas, although its name is never mentioned in these Old Javanese texts. Instead, they call the river *baṅawan* or *baṅawan Caṅgu*, as mentioned in Kidung

112 Christie's work discusses the ancient Javanese traders in detail, but this sub-chapter will be more focused on commercial activities along the Brantas river. See: Christie, *Patterns of Trade in Western Indonesia: Ninth through Thirteenth Centuries A.D.*: 132-288.

Harsawijaya, which certainly refers to the Brantas river.[113]

A trading route along the Brantas river is recorded in a number of inscriptions, including Kaladi 831 Śaka (909 CE), Manañjung, Dhimaṇāśrama (undated, probably Airlaṅga's reign), Kamalagyan 959 Śaka (1037 CE), and Caṅgu/Trowulan I 1280 Śaka (1358 CE). The most famous and busy port on this river was Hujuṅ Galuh, a place to which traders came to meet, and this even included traders from other islands (*dwīpāntara*).[114] The Manañjuṅ and Rĕmpaḥ ports, mentioned in the Manañjuṅ inscription (undated, probably from the early eleventh century), were also important ports on the lower Brantas river.[115] The Dhimaṇāśrama inscription, which probably dates from the tenth or early eleventh century and was found in the Brantas delta region, suggests that there was a busy port near the Dhimaṇāśrama monastery because it mentions many kinds of boats.[116] The Caṅgu inscription lists ports and crossing places along the Brantas and Bengawan Solo rivers, and I quote these lists below; these are found in plate V.a. and V.b.:[117]

V.a

1. *nuṣa, i tĕmon, parajĕṅan, i pakaṭekan, i wuṅlu, i rabutri, i bañu mṛdu, i gocor, i tambak, i pujut,*
2. *i mirĕṅ, iṅ dmak, i kluṅ, i pagḍaṅan, i mabuwur, i goḍoṅ(?), i rumasan, i caṅgu, i raṇḍu gowok, i wahas, i nagara,*
3. *i sarba, i wariṅin pitu, i lagada, i pamotan, i tulaṅan, i panumbaṅan, i jruk, i truṅ, i kambaṅ srī, i tḍa, i gsaṅ, i*
4. *bukul, i śūrabhaya, muwaḥ prakāraniṅ naditīra pradeśa sthānaniṅ anāmbaṅi i maḍantĕn, i wariṅin wok, i bajrapura, i*
5. *sambo, i jerebeṅ, i pabulaṅan, i balawi, i luwayu, i katapaṅ, i pagaran, i kamuḍi, i parijik, i paruṅ, i pasi*
6. *wuran, i kĕḍal, i bhaṅkal, i wiḍaṅ, i pakbohan, i lowara(?), i ḍuri, i rāśi, i rewun, i tgalan, i dalaṅara, i*

113 Berg, *Kidung Harṣa-Wijaya:* 65 and 156. Berg identified *baṅawan* Canggu as "*naam van de Brantas ter hoogte van Canggu*".

114 See the transcription and translation of lines 12-13 of the Kamalagyan inscription in the previous sub-chapter.

115 Christie, *Patterns of Trade in Western Indonesia: Ninth through Thirteenth Centuries A.D.*: 242.

116 A.S. Nugroho, "Aktivitas Perekonomian di Delta Brantas pada Abad Ke-10 Masehi", *Pattingalloang. Jurnal Pemikiran, Pendidikan dan Penelitian Kesejarahan* 7/3 (2020): 273-283

117 See the transcription in: Boechari, *Prasasti Koleksi Museum Nasional I*: 116-117; Van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band II:* 378 and 380; Pigeaud, *Java in the Fourteenth Century. Vol I*: 110.

V.b

1. *sumbaṅ, i malo, i ṅijo, i kawaṅen, i suḍaḥ, i kukutu, i balun, i marĕbo, i turan, i jipaṅ, i ṅawi, i waṅkalaṅ,*
2. *i pnūḥ, i wuluṅ, i baraṅ, i pakatelan, i wareṅ, iṅ amban, i kĕmbu, i wulayu, sarwwe, ika ta kabeḥ, nadītīrapradeśa, sthā*
3. *nanya ṅ anambaṅi sayawadwīpamaṇḍala, …*

The list ends with the phrases: "*sarwwe*, *ika ta kabeḥ, nadītīrapradeśa, sthānanya ṅ anambaṅi sayawadwīpamaṇḍala"* (All those are the villages on the banks of the rivers, places of the river-crossings of all regions of the Island of Java). The ports along the Brantas river are listed in plate V.a. lines 1-4, while the harbors along the Bengawan Solo are given in V.a. 4- V.b. 2. Unfortunately, plate IV of the inscription, which most probably mentioned the names of other harbors, is missing. On the extant list are the names of 34 harbors along the Brantas river. The location of 20 of these cannot be identified. The location of the other fourteen can be located on the basis of similar village names that are still known and inhabited today. The locations of these are highlighted on the map below (Fig. 4.3.).

These ports are listed, in order, from upstream to downstream on the Brantas river, with the exception of Wringin Pitu, Pamotan, and Tulangan, which are no longer on the Brantas, instead being far to the south now. Van Stein Callenfels and Van Vuuren have suggested that the Brantas river had, at that time, split off near Serbo, to the south to Wringinpitu, before going eastward, passing through Tulangan and Pamotan on its way to the sea.[118]

The Caṅgu inscription seems to confirm that the ports and river crossing harbors along the Brantas river played an important role in the transportation infrastructure of East Java. For this reason, the king granted the port villages an inscription ensuring their protection and upkeep. Moreover, the ruler also issued regulations, recorded in the inscriptions, to protect the ferrymen's profession.[119] The records indicate that the royal court paid significant attention to the stability and security of ferry transport. Thus, it had the authority to impose regulations concerning river transportation. The inscription also makes clear that the transportation regulations were issued by the court, not the local authorities.

Another commercial port on the Brantas delta was located near Kaladi-Gayam-Pyapya, as recorded in the Kaladi inscription 831 Śaka (909 CE), which Jones assumes was located on the east coast of Sidoarjo district.[120] The Kaladi inscription

118 Van Stein Callenfels and Van Vuuren, "Bijdrage tot de Topographie van de Residentie Soerabaia in de 14de Eeuw": 69-70.

119 Plate IX and X of the inscription. See the transcription and Dutch translation: Van den Veerdonk, *De Tekstuele Structuur van de Oud-Javaanse Vorstelijke Inscripties uit de Periode Singhasari –Majapahit, 1255-1486, Band II:* 382-387.

120 Jones, *Early Tenth Century Java from the Inscriptions*: 178-179.

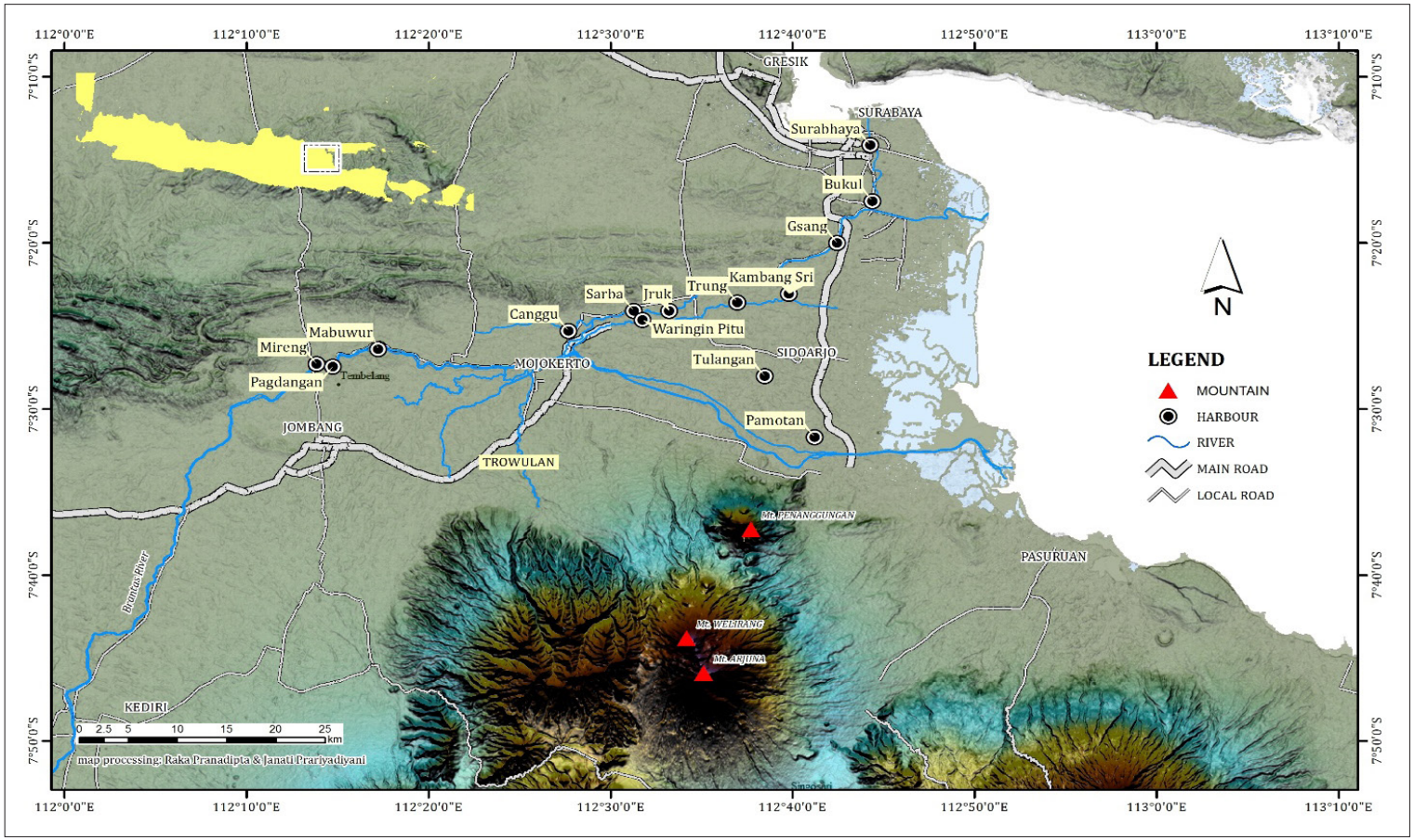

Fig. 4.3. Harbors along the Brantas river recorded in the Caṅgu inscription. This map is based on Van Stein Callenfels' interpretation; see: P.V. van Stein Callenfels and L. van Vuuren, "Bijdrage tot de Topographie van de Residentie Soerabaia in de 14de Eeuw", *Tijdschrift van het Koninklijk Nederlandsch Aardrijkskundig Genootschap* 41/1 (1924): 68-70, and the Appendix. (Map by Tjahjono Prasodjo). See notes in the next page.

Notes:

1: Mireṅ	=	Mireng	8: Tulaṅan	=	Tulangan
2: Pagḍaṅan	=	Gedang Kulon, Jombang	9: Jruk	=	Jeruk Legi
3: Mabuwur	=	Buwur,	10: Truṅ	=	Terung
4: Caṅgu	=	Serbo	11: Kambaṅ Śrī	=	Bangsri
5: Sarba	=	Canggu	12: Gsaṅ	=	Pagesangan
6: Wariṅin Pitu	=	Wringinpitu	13: Bukul	=	Bungkul
7: Pamotan	=	Pamotan Wetan	14: Śurabhaya	=	Surabaya

was issued to establish a *sīma* for three villages: Kaladi, Gayam, and Pyapya. One of the reasons for this was that traders on the river (known as *hilirān*) were being threatened by bandits, and it was hoped that the criminals would disappear after the area had become a *sīma*. The inscription also details that the *sīma*'s borders were defined by rivers.[121] The presence of traders in the villages shows that there was probably a port there that facilitated inland-coastal trading; this may have been a small local port located on one of the Brantas tributaries.

These inscriptions reveal the various kinds of boats that were used by traders or fishermen in navigating the Brantas river. The inscriptions from East Java that mention boats are: Watukura 1A 824 Śaka (902 CE), Palĕbuhan 849 Śaka (927 CE), Saṅguran 850 Śaka (928 CE), Liṅgasutan 851 Śaka (929 CE), Jĕrujĕru 852 Śaka (930 CE), Cuṅgraṅ I 851 Śaka (928 CE), Sarahan 852 Śaka (929 CE), Manañjuṅ, Dhimaṇāśrama, Kambaṅ Putih, and Kamalagyan 959 Śaka (1037 CE). Of all these, it is the Dhimaṇāśrama inscription that provides the largest number of boat-types.[122] The relevant information is written in the part of the inscription that provides a list of those people engaged in commerce (*sambyawahara*) who should not be subjected to royal tax collectors. The various types of boat found in the inscriptions are listed below:

- *Maramwan* (owing-boat)
- *parahu masuṅhara (*boats with masts)
- *parahu hiliran* (downstream boats)
- *parahu akirim agöṅ* (large shipping boats)
- *parahu akirim tāmbātābā* (boats for shipping medicinal spices)
- *parahu amayaṅ payaṅ* (drag-net fishing boats)

121 See the transcription of this inscription in: Boechari, *Prasasti Koleksi Museum Nasional I*: 147-153.

122 Christie, *Patterns of Trade in Western Indonesia:* 504-512; Brandes*, Oud-Javaansche Oorkonden*: 243-247; F.H. van Naerssen, Inscripties van het Rijksmuseum van Volkenkunde te Leiden", *BKI 97* (1938): 501-515; P.V. van Stein Callenfels and L. van Vuuren, "Bijdrage tot de Topographie van de Residentie Soerabaia in de 14de Eeuw", *Tijdschrift van het Koninklijk Nederlandsch Aardrijkskundig Genootschap*, 41/1 (1924): 57-81.

- *parahu amukĕt kakap* (sea perch drag-net fishing boats)
- *parahu amukĕt kŗp* (grouper drag-net fishing boats)
- *parahu* ataḍaḥ (?)
- *parahu aṅlamboan* (? Boats)
- *parahu amariṅ* (*waring* cast-net boats)
- *parahu aṅlam* (?)
- *amuntamunta* (?)
- *parahu pukĕt ḍago* (sprat drag-net fishing boats)
- *parahu kirim dwal baryyan* (boats which ship various commodities)
- *parahu kirim pañjaṅ* (long shipping boats)
- *parahu aṅlaha*[ṅ] (sugar-palm sap boats)
- *parahu añjala* (cast-net boats)
- *parahu añjalāwirāwir* (hanging down/cast-net boats)
- *parahu añjariṅ balanak* (boats with fixed gill net to catch grey mullet fish)
- *parahu jariṅ kakab* (boats with fixed gill net to catch *kakap*/snapper fish)
- *parahu añjala bsār* (large cast-net boats)
- *parahu amuwūwuwū* (large fish trap boats)
- *parahu amintur* (creel-trap crab boats)
- *parahu añjariṅ kwaṅkwaṅ* (kawaṅ fish/ *Scomberomorus* boats)
- *parahu amibit* (line fishing boats)
- *parahu wariṅ sugus* (net boats)
- *parahu wariṅ tuṇḍuṅ* (tuṇḍuṅ net boats)
- *parahu wariṅ taḍah* (taḍah net boats)
- *parahu aṅhilīhilī* (downstream boats)
- *laṅkapān: (?)*
- *wlaḥ galaḥ* (boats equipped with paddles or poles)
- *kalima tuṇḍan* (boats with 5 decks)
- *parahu pabawa* kalima tuṇḍan (*pabawa* boats with 5 decks)
- *parahu pakbowān sawiji kapāt tuṇḍan* (cattle boats with 4 decks)
- *parahu jurag* (*jurag* boats)
- *parahu paṅgagaran* (paddle boats)
- *parahu palawijan* (horticultural product traders' boats)
- *parahu paṅṅayan* (*paṅgayan* boats)

This list shows that there were three main boat-groups, categorized by function: fishing boats, trading boats, and all-purpose boats. Most were fishing boats. These had various types of fishing tools and could operate on both the river and the sea. From the equipment they used it seems that the boats equipped with nets for catching sea fish—such as *kakab* (snappers), *kŗp* (groupers) and *kwaṅkwaṅ* (mackerel)—operated at sea. Some boats caught estuary fish, such as *balanak* (grey mullet), which are coastal species that are often found in estuaries and rivers. These

boats and fishermen indicate that these communities were from the Brantas delta region. The transport boats were probably used by traders and ordinary people; the *kirim dwal baryyan* were likely boats used to transport various commodities and which travelled along the Brantas river. Other boats carried specific goods, such as the *palawija* (which transported non-rice horticultural products) and *aṅlahaṅ* (sugar-palm sap). All-purpose boats are probably what they called *parahu hiliran* and *parahu aṅhilīhilī*, and these went back and forth along the Brantas river.[123]

The interaction between hinterland commodity production and river transport has been explored by a number of scholars. Kenneth R. Hall explains this relationship as follows:

> Because of the increased external demand for Javanese rice, there emerged a hierarchical market network that united communities of local exchange with Java's coastal ports. Yet at the topmost levels of this marketing system there was a conscious separation of political and commercial function. Ports of trade were not political centers, and the state's political center was not a major commercial center. Majapahit's capital was located well in the interior up the Brantas River from the coast, where it was less likely to have been subject to direct contact with outsiders.[124]

However, Bennet Bronson has a different view about the role and status of the centre of the exchange network. As we have seen already in Chapter 1, Bronson proposes a hypothetical model of economic and political interactions between upstream and downstream, one that took the form of an exchange network: "The model focuses on a single hypothetical class of ancient exchange networks, one which involves the control of a drainage basin opening to the sea by a centre located at or near the mouth of that basin's major river."[125] This hypothesis is drawn in Figure 1.1, and it explains how the political and economic centre being located in a river estuary allowed it to serve as the, or at least a, centre of power for managing and controlling an exchange network. This concept has been adapted by Pierre-Yves Manguin to explain the socio-spatial structuration process of coastal political systems in insular Southeast Asia, and specifically Sriwijaya, on the basis of Malay literary texts and

123 In some parts of the story of Wijaya's journeys in *Kidung Harṣa-Wijaya*, during his struggle to re-take power from Jayakatwang it is said he took some trips from Madura to Canggu (the name of a port on the bank of Brantas river) in a boat. To reach Canggu from the Madura strait, Wijaya and his followers had to travel by water along the Brantas river. See: Berg, *Kidung Harṣa-Wijaya*: 65 and 156.

124 K.R. Hall, *A History of Early Southeast Asia: Maritime Trade and Societal Development, 100-1500* (Lanham, MD [etc.]: Rowman & Littlefield, 2011): 278.

125 B. Bronson, "Exchange at the Upstream and Downstream Ends: Notes toward a Functional Model of the Coastal State in Southeast Asia", in: *Economic Exchange and Social Interaction in Southeast Asia: Perspectives from Prehistory, History, and Ethnography*, ed. Karl L. Hutterer (Ann Arbor: Center for South and Southeast Asian Studies, The University of Michigan, 1977): 43.

both epigraphic and archaeological data.[126] He argues that the Sriwijaya political system was a harbor-centreed one which played a significant role in permitting the emergence of that system. Furthermore, he suggests that the Sriwijaya harbor city was not only connected with its "vassals" in the river basin but with other political centres outside Sumatra—Sriwijaya's political and economic peripheries—as well. Indeed, there was in Sumatra the territorial concept of *negeri*, which was primarily a mercantile polity that controlled trade along a river. Based on *Hikayat Raja Raja Pasai*, Hill defines a *negeri* as "a fairly large community, centred usually on a river estuary, an entrepot for foreign merchants, with some political influence over the surrounding territory".[127]

In mainland Southeast Asia, polities such as Bagan, Dvārāvatī and Ayutthaya, except Angkor, used the river to connect coast and interior, transporting both goods and people up- and downstream. Bagan is a good example of a capital that was situated high upstream in the country's agricultural heartland, yet being perfectly able to control the middle and lower regions through the Irrawaddy. The Ayutthaya polity, however, was a polity where the capital was closer to the coast and as such was at a short distance from both agricultural produce and, through the estuary of the Chao Phraya, to maritime commerce.

For the East Javanese polities, the situation comes quite close to that of Ayutthaya. In In the eleventh century, East Java's main port was at Hujung Galuh, while in the fourteenth century Cańgu seemed to be the main port of the Brantas river, while the political centre of the first port was located in Kahuripan and the latter was in Trowulan, both of which were situated at some distance from the Brantas river estuary.[128] Like most *nagara* states of the mainland and quite different

126 P. Manguin, "The Amorphous Nature of Coastal Polities in Insular Southeast Asia: Restricted Centres, Extended Peripheries", *Moussons* 5 (2002): 73-99.

127 A.H. Hill, "Hikayat Raja-Raja Pasai", *Journal of the Malayan Branch of the Royal Asiatic Society*, Vol. 33, No. 2 (1960): 173.

128 The location of Hujuṅ Galuh is still debated. Some scholars, like Van Naerssen, think that it was a coastal port; see: F.H. van Naerssen, "The Economic and Administrative History of Early Indonesia", in: F.H. van Naerssen, F., & R.C. de Iongh, eds. *The Economic and Administrative History of Early Indonesia* (Leiden: E.J. Brill, 1977): 67. However, I agree with De Casparis who explains that Hujuṅ Galuh was located far enough from the estuary: *"Tentang letaknja Hudjunggaluh tsb. pada umumnja dikatakan bahwa bertempat di Surabaja jang sekarang. Kami berpendapat bahwa itu tidak mungkin. Karena dalam prasasti Kelagen dikatakan bahwa pengaturan sungai itu sangat menggembirakan para pedagang dari pulau² jang lain jang sekarang dapat belajar terus sampai ke Hudjunggaluh, maka Hudjunggaluh tsb. tentu letaknja lebih disebelah hulu sungai dari Kelagen. Tempatnja mungkin tidak djauh dari Modjokerto jang sekarang"* ("Regarding Hudjunggaluh's location ... in general it is said that it is in present-day Surabaja. We argue that this is impossible. Since, in the Kelagen inscription, is said that the management of the river was very pleasing to the other islands' traders who could now sail all the way to Hudjunggaluh, it means that Hudjunggaluh was, of course, located further upstream than Kelagen. It may not be far from the present-day Modjokerto").

from the *negeri* Sriwijaya in Sumatra, Majapahit was a polity that thanks to the Brantas river could combine the best of both worlds, connecting the rich agricultural resources of the interior to the commercial wealth of the ports along the coast.[129] It were the hinterland river ports that served as internal terminals to collect local agricultural products to be transported for sale to the coastal ports. Obvioulsy, these same terminals and ports served as ideal tax offices for the court. In other words, thanks to the river network that linked court to ports, political control could be more indirect than direct, more remote than territorial.

After the second half of the fourteenth century, when the Surabaya port is recorded for the first time in the Caṅgu inscription (1358 CE), further developments in maritime trade occurred in East Java.[130] As was also experienced by other polities in Southeast Asia, such as the Thai, Myanmar, Vietnam, and Sumatra polities, the rise of global maritime trade triggered the development of commercial activities in the ports of Java, particularly those on the northern coast of east Java where we witness the emergence of new ports like Śurabhaya, Gresik and Tuban, already anticipating the later shift of political power towards the coast under Muslim and Dutch rulers.[131]

4.7. CONCLUSION

In sum, the East Javanese inscriptions provide significant data regarding the economy, society, and politics of the communities in the Brantas river basin. In addition, it is important to understand that these inscriptions are not historical documents in the sense of having been written as historical records; rather, they are legal documents by which rulers granted a *sīma*. However, these issues should not prevent the use of the inscriptions as historical sources, and this chapter has

See: J.G. de Casparis, *Airlangga* (Surabaja: Penerbitan Universitas, Universitas Airlangga, 1958): 20. For the role of Caṅgu as a river port, see also M.B. Sanjoyo, "Pemanfaatan Sungai Brantas pada Masa Kerajaan Kediri Hingga Majapahit". *Santhet (Jurnal Sejarah, Pendidikan, dan Humaniora)* 5/ 2 (2021): 138-146; M.B. Sanjoyo, "Canggu: Pelabuhan Sungai Masa Majapahit Abad XIV – XVI", *Mozaik. Jurnal Kajian Sejarah* 10/2 (2019): 1-16.

129 Kathirithamy-Wells has emphasized one characteristic of the relation between a port, which was located separately from its political center, with that center: "Even when port and polity were located separately, they were inherently linked, as in the case of Funan and Oc-eo, Majapahit and the river port of Canggu, seventeenth century Pegu and Syriam, or Ayutthaya and coastal Bangkok". See: Kathirithamy-Wells, "Introduction: An Overview": 2.

130 S. Pinardi and Winston SD Mambo, "Perdagangan pada Masa Majapahit", in: *700 Tahun Majapahit. Suatu Bunga Rampai*, eds. Sartono Kartodirjo, et al. (Surabaya: Dinas Pariwisata Daerah Propinsi Tingkat I Jawa Timur, 1993): 177-204.

131 A. Reid, *A History of Southeast Asia: Critical Crossroads* (Chichester: Wiley Blackwell, 2015): 77; B.W. Andaya and L.Y. Andaya, *A History of Early Modern Southeast Asia, 1400-1830* (Cambridge: Cambridge University Press, 2015): 31-35, 85, 87-90.

attempted to demonstrate the usefulness of using them to reconstruct ancient East Javanese life in the Brantas river basin.

The information supplied by the East Javanese inscriptions described above reveals, among other things, that there was a working relationship between the rulers and the local communities regarding water management. The intervention of the royal court is, in fact, seen in only a limited number of cases, and usually control of the water used for irrigation rested on the local communities. The royal court would intervene in the control of water only in cases of water-related hazards and water levies; day-to-day water management was handled by the local communities. As such, I tend to agree with Jan Wisseman Christie's opinions rather than those of N.C. van Setten van der Meer and F.H. van Naerssen. Based on her research on *sawah* in ancient Java, Van Setten van der Meer argues that the rulers of the ancient Javanese kingdoms played a significant role in controlling the water system[132] and suggests that there were supra-village institutions that managed the irrigation system.[133] On the other hand, Christie argues that it was managed by the local religious institutions.[134] However, as I have argued, Christie's opinion is not wholly accurate, as the court still played the important role of setting the water taxes or fees and imposing regulations related to the security and protection of the water control infrastructure, as recorded in the Wulig and Kamalagyan inscriptions.

Another important conclusion is that most of the agricultural centres where water control was needed were located throughout the inner part of the Brantas river basin, on mountainsides or the alluvial fans of mountain ranges (see Fig 4.4), and that water management endeavours were required in these regions. In the inner region of the Brantas river basin sits, at its centre, a group of mountains (Penanggungan, Welirang, Arjuna, Kawi, and Kelud) that are encircled by the Brantas river. As a result, there is a relatively steep area of land where water control is required for *sawah* cultivation. Fig. 4.4 highlights several irrigated agricultural centres on the basis of clusters of water management-related inscriptions: (1) around Malang, (2) Pare, Kediri, (3) the southern region of Mojokerto, (4) a region between Mount Penanggungan and the Porong river, and (5) the Brantas delta. While the four clusters are situated on mountain slopes and alluvial fans, another is located in the Brantas delta.

132 N.C. Van Setten Van Der Meer, *Sawah Cultivation in Ancient Java: Aspects of Development during the Indo-Javanese Period, 5th to 15th Century* (Canberra: Faculty of Asian Studies in Association with Australian National University Press, 1979): 22-23.

133 F.H. van Naerssen and R.C. De Iongh, *The Economic and Administrative History of Early Indonesia* (Leiden: Brill, 1977): 27, 56-57. See also: S. Kartodirdjo, "Masyarakat dan Sistem Politik Majapahit", in: *700 Tahun Majapahit. Suatu Bunga Rampai*, eds. Sartono Kartodirjo, et al. (Surabaya: Dinas Pariwisata Daerah Propinsi Tingkat I Jawa Timur, 1993): 34-35.

134 J. W. Christie, *Theatre States and Oriental Despotisms: Early Southeast Asia in the Eyes of the West* (Hull: Center for South-East Asian Studies, 1985): 25-27; Christie, "Water from the Ancestors": 19.

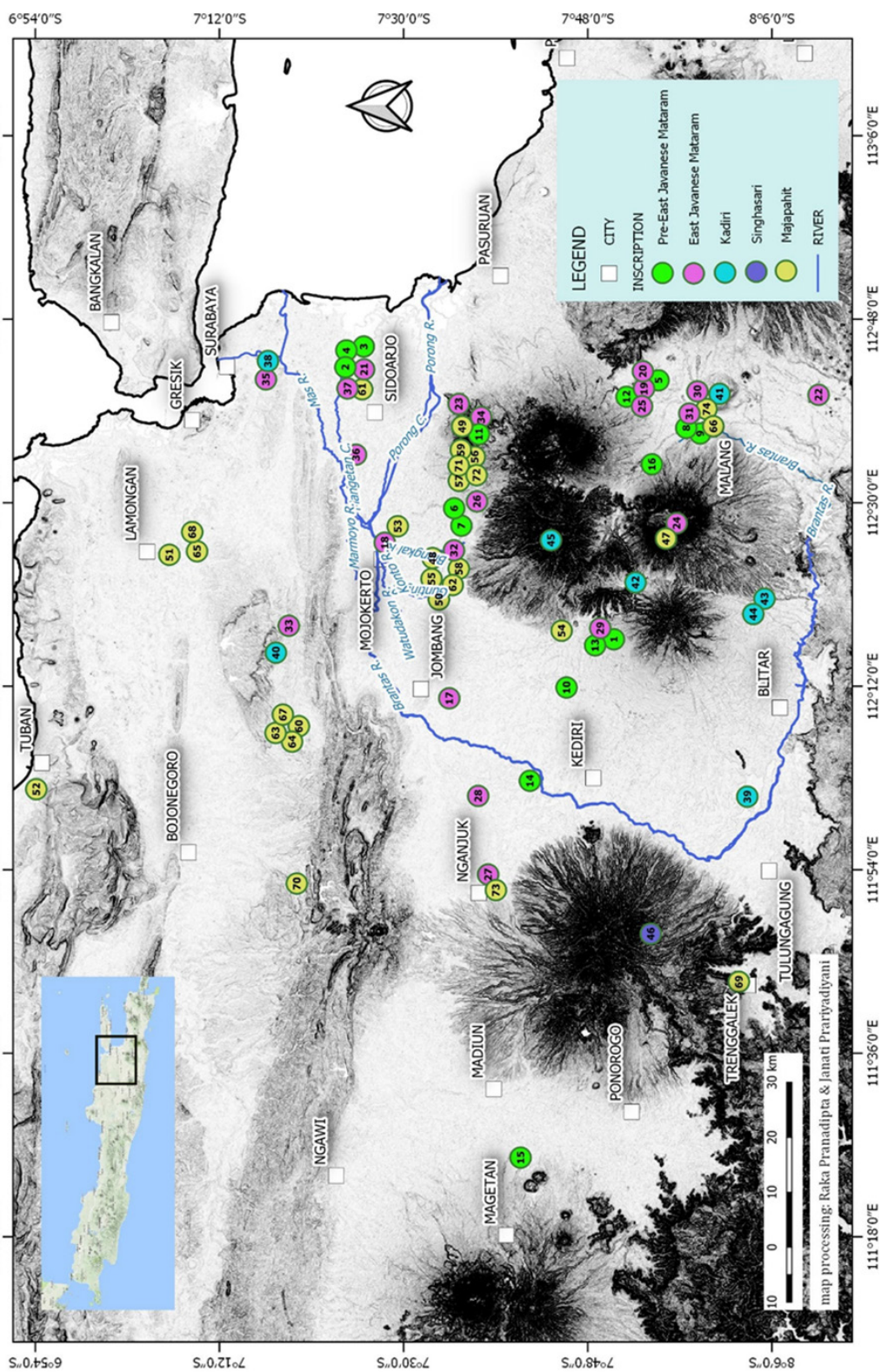

Fig. 4.4. The distribution of inscriptions dealing with water management in the Brantas river basin (Map by Tjahjono Prasodjo). See notes in the next page.

Inscriptions

1 Hariñjiṅ A, 787
2 Waharu Kuti, 840
3 Kañcana, 860
4 Waharu I, 873
5 Baliṅawan, 891
6 Watukura I, 902
7 Ketanen, 904
8 Kubu Kubu, 905
9 Kubukubu, 905
10 Ganesa Pare, 908
11 Kaladi, 909
12 Sugih Manek, 915
13 Hariñjiṅ B, 921
14 Kinawĕ, 927
15 Palĕbuhan, 927
16 Saṅguran, 928
17 Poh Rintiṅ, 929
18 Saraṅan, 929
19 Guluṅ guluṅ, 929
20 Liṅgasuntan, 929
21 Waharu II, 929
22 Turyyan, 929
23 Cuṅgraṅ I, 929
24 Cuṅgraṅ II, 929
25 Jru jru, 930
26 Wulig, 934
27 Añjukladaṅ, 935
28 Hriṅ, 937
29 Paraḍaḥ, 943
30 Kanuruhan, 943
31 Muñcaṅ, 944
32 Kamban, 971
33 Cane, 1021
34 Terep I dan II, 1032
35 Baru, 1034
36 Kamalagyan, 1037
37 Gandhakuti, 1042
38 Sumĕngka, 1059
39 Padlĕgan, 1116
40 Patakan, 11th Century
41 Manañjuṅ, 11th Century
42 Hantaṅ, 1135
43 Panumbaṅan, 1140
44 Talan, 1136/1146
45 Jariṅ, 1181
46 Pĕnampihan/ Sarwwadharmma, 1269
47 Kudadu, 1294
48 Dhimaṇāśrama, 13th/14th century
49 Sukamĕrta, 1296
50 Balawi, 1305
51 Balambangan/ Jayanagara/ Lamongan, early 14th Century
52 Kambaṅ Putih, early 14th Century
53 Tuhañaru/ Sidatĕka, 1323
54 Kusmala, 1350
55 Pĕlĕm, 1350-1389
56 Jenggriṅ, 1354
57 Keputran, 1355
58 Caṅgu/Trowulan I, 1358
59 Seloliman, 1358
60 Biluluk I, 1366
61 Bungur B, 1(367)
62 Karaṅ Bogĕm/ Tirah/ Trowulan V, 1386
63 Biluluk V (Karaṅ Bogĕm), 1387
64 Biluluk II, 1391
65 Śelamaṇḍi I, 1394
66 Lumpang/ Katiden II, 1395
67 Biluluk III, 1395
68 Śelamaṇḍi II, 1395
69 Wariṅin Pitu/ Surodakan, 1447
70 Pamintihan, 1473
71 Trailokyapuri I, 1486
72 Trailokyapuri IV, late 15th century
73 Saṇḍuṅan, n.d.
74 Kalimusan, n.d.

(N.B.: all Dates are in CE.; n.d. = no date)

These clusters represent the most intensive areas in East Java where irrigated rice fields (*sawah*s) were cultivated. The *sawah*s were located near settlements of a village which were composed of several hamlets and the inhabitants of the village did rice farming. In Old Javanese texts this paddy field landscape is called *pasawahan*, and the activity of working in paddy fields is *asawah-sawah* or *masawah*.[135] The farmers also constructed water works. The Old Javanese *Kakawin* Arjunawijaya informs us about the irrigation system. According to Supomo, the local inhabitants built a dam constructed with stones, trunks, and branches to irrigate the rice fields. By damming the river, it was possible to divert water to some small canal to irrigate rice fields.[136]

The riparian communities in the Brantas river basin were not solely dependent on agricultural activity. According to the Old Javanese text, Sumanasāntaka, the village inhabitants had occupations of cattleman, rice farmer, fish farmer, and salt manufacturer.[137] The epigraphic sources give evidence of fishing and commerce being parts of life along the Brantas river. In contrast to the role of the court in regard to the water control system, which does not seem to have been significant, it seems that the court did have a large degree of control over commercial river activities along the Brantas river. This was specifically to gain both politically and economically and in order to maintain and strengthen its political power. River trade was one of the ways in which the East Javanese states generated income, primarily through commodity- and transportation taxes, while controlling and managing the Brantas river, both upstream and downstream, also played an important role in their efforts to keep their grip on political power.

135 Zoetmulder, *Old Javanese-English* Dictionary: 1715.

136 Supomo, *Arjunawijaya. A Kakawin of Mpu Tantular. Vol. I: Introduction and Text* (The Hague: Martinus Nijhoff, 1977): 58.

137 P. Worsley, *et al*., *Mpu Monaguṇa's Sumanasāntaka: An Old Javanese Epic Poem, Its Indian Source and Balinese Illustrations* (Leiden: Brill, 2013): 635. See also: T. Prasodjo, "Penggambaran Lanskap Jawa Kuno dalam Kakawin", in: Kuasa Makna: Perpektif Baru dalam Arkeologi Indonesia, ed. D.A. Tanudirjo (Yogyakarta: Departemen Arkeologi, Fakultas Ilmu Budaya Universitas Gadjah Mada, 2019): 174-175.

Chapter 5

Archaeological Records of Brantas River Basin Water Engineering

In the previous chapter, I explored the textual sources (Old Javanese texts and inscriptions) that can be used to reconstruct the water management of East Java. In this chapter, I will present non-textual material culture and archaeological records to reconstruct further Old Javanese hydraulic infrastructure. Most of the archaeological records I use are findings from East Java. They range from ancient monuments, such as bathing places (*patirthaans*), through archaeological features such as dams, canals, ponds, tunnels, and wells, to relatively small archaeological data like temple reliefs, water pipes, and waterspouts.[1]

The populations of the East Javanese states occupied both the upland and the lowland zones of the region. Because of the variation in the geomorphological characteristics of the landscape from the mountainous areas to the lowland zones—such as the delta areas—communities were forced to develop various water control strategies in order to secure a supply of water for their populations and agricultural activities. Thus, mastery of engineering skills was essential to secure a water supply, something that included everything from planning and designing to practical building skills. In Charles R. Ortloff's study comparing the water control systems practised by ancient New World and Old World societies, he concluded that societies coped with their water supply needs by using different ways of developing water

1 An archaeological feature is any material remains, such as a physical structure, that has been made or modified by humans. The term refers specifically to non-portable material remains that cannot be removed from their site.

management skills, ones which varied in accordance with the distinct environment of each area. Some left traces that can be seen in their archaeological remains, and a few of them preserved their water control system for many centuries, on occasion until today.[2]

Archaeological remains related to water engineering in East Java, especially in the Brantas river basin, are spread across the entire Brantas area, in both the highland and the lowland zones, from the Malang highlands to its delta. In this area, the East Javanese polities set up many hydraulic systems to support their way of life. The archaeological evidence I will present below demonstrates that the East Javanese polities had consistent water control regimes for the whole of their existence. I will present the archaeological records related to East Javanese water engineering on the basis of scale: first, large-scale water engineering and, second, small-scale water engineering.

5.1. LARGE-SCALE WATER ENGINEERING

For the communities of the early East Javanese kingdoms, a basic water supply that was used to support the population and agricultural activity was provided by springs, rivers, wells, and rainfall. The springs and wells allowed people to draw water from groundwater, a natural underground reservoir that lies in the earth's water-table, while rivers acquire their water from groundwater discharge such as springs and from surface rainfall run-off. For many centuries, humans have used such freshwater supplies to support their lives as well as employing them in engineering projects in order to improve their quality of life.[3] The provision of fresh water sometimes requires human involvement, leading to innovations in water supply technology that are used alongside the natural water supply. Two of the main mechanical problems related to water technology that require solving are: how to lift water to a higher level; and how to divert or distribute the water somewhere else. One example of a water lifting technology is a well, in which the water is lifted vertically, either through a well fitted with a lifting device or just a dipping well. An example of the latter technology is the diversion dam and a weir, sometimes equipped with sluice gates.[4]

Both these principles of water technology were followed by ancient builders

2 Ch. R. Ortloff, *Water Engineering in the Ancient World: Archaeological and Climate Perspectives on Societies of Ancient South America, the Middle East, and South-East Asia* (Oxford: Oxford University Press, 2009): 383.

3 Helen Chapman Davies provides many examples of the technology of the utilization of groundwater; see: H. C. Davies, *The Archaeology of Water* (Gloucestershire: The History Press Ltd., 2008).

4 V.L. Scarborough, *The Flow of Power: Ancient Water Systems and Landscapes* (Sante Fe: School of American Research, 2003): 39-40.

of the East Javanese waterworks, and they can be seen in water engineering archaeological finds in the Brantas river basin. Such remains can be found in many areas of the river basin, in both upland and lowland areas, and as regards large-scale water engineering projects there are remains of dams, ponds, weirs, canals, underground tunnels, and wells, among others.

The majority of the large-scale water engineering within the Brantas basin is related to irrigation and to settlement water supply systems. The ancient irrigated region that stretches between the Anjasmoro-Welirang mountain ranges and the Brantas river is the best example of large-scale water engineering in East Java. This region, which currently is in the Mojokerto and Jombang districts, is around 30 x 30 km. In the southern part of the region are two mountain ranges, called Anjasmoro and Welirang; as such, this southern area is steeper than the northern part. Streams and small rivers flow from south to north and eventually join with the Brantas river. The two main rivers are the Gunting and the Brangkal, but on the mountainous slopes of the southern part run smaller rivers like the Pikatan, Kromong, Landean, and Boro. The region has been an agricultural area at least since the early tenth century CE, as evidenced by the Sarangan inscription 851 Śaka (929 CE) and the Wulig inscription 856 Śaka (934 CE), which demonstrate that dams were built for irrigation purposes and that the area became more intensively cultivated in the period of the Majapahit kingdom.[5]

The slopes of the Anjasmoro and Welirang mountain ranges were an important part of the region's hydrological system because they functioned as a water catchment area for the whole region. The western part of the region is fed by two rivers, the Gunting and the Brangkal. The Gunting runs northwards from the western slopes of Anjasmoro mountain, while the Brangkal is fed by a number of streams and small rivers from the central part of the Anjasmoro-Welirang mountain ranges—including small rivers such as the Pikatan, Kromong, Landean, Pandaan, Mantring, Grosok, and Boro—which merge to become the Brangkal. These two rivers, the Gunting and the Brangkal, were important parts of the region's hydrological system, especially in the Majapahit period when a large urban settlement known as Trowulan flourished there.

In 1926, Maclaine Pont published a report in *Oudheidkundig Verslag* concerning archaeological information related to the area between Majapahit (Trowulan) and Penanggungan. He cooperated with the Eschauzier sugar factory to investigate a disused irrigation works. This investigation resulted in a map of the dams (*waduks*) in the region, which identified around 18 of them, although he describes only 11 in detail.

Based on his field observations, especially of the geomorphology and topography of the landscape, as well as the characteristics of the river's flow, he explained that the region—which was, as he put it, the "Uncultivated lands

5 See the discussion of inscriptions in Chapter 4.

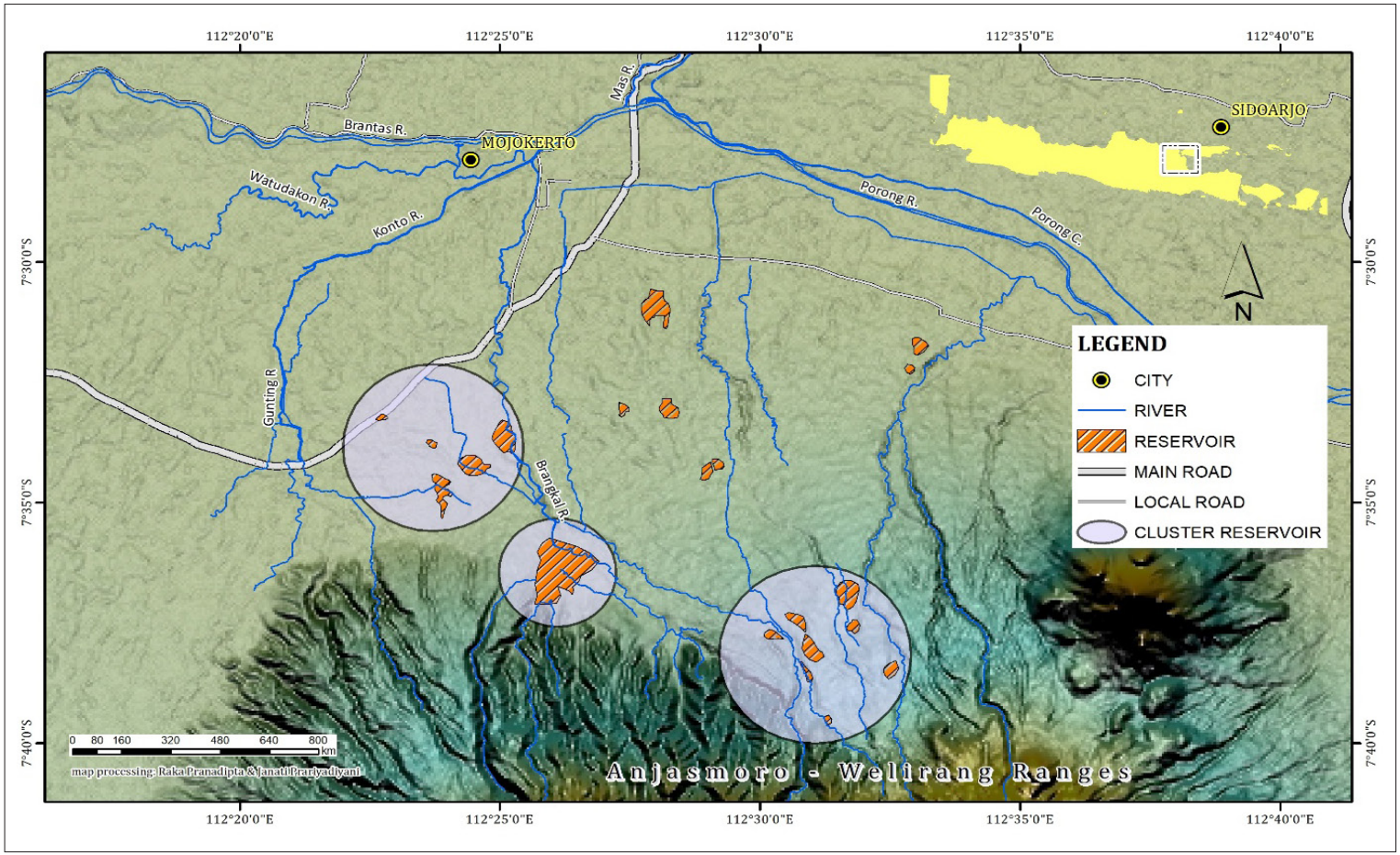

Fig. 5.1. The irrigated region between the Anjasmoro-Welirang ranges and the Brantas river, with its rivers and dam clusters (redrawn from Maclaine Pont's map by Tjahjono Prasodjo).

of the people of Trik"—was safe and prosperous for the Majapahit people.[6] The map and the list of the dams he provided give some idea of how large-scale water engineering was carried out by both rulers and subjects at least since the tenth century CE. The dams' functions seem to have varied in the details, although their main purpose was as a place to collect and hold a body of water. I observe at least three different variations regarding the functions of the dams in the region (Fig. 5.1.). The first of these groups of dams is located in the south-eastern part and consists of dams near the villages of Ketanen, Slawe, Kemiri, Wates, Candirejo, Randegan, and Wonokerto. The location of each dam is high on the mountain slopes—more than 350 metres above sea level—with steep terrain in which rivers, like the Pikatan and the Kromong, flow very fast. In order to slow the river's flow, the dams were built to collect and store some of its water, which could then easily be horizontally distributed for irrigation via man-made canals linked to it. Several of these dams date back to the tenth CE century, according to inscription records.[7] The second group can be found in the central area of the region around the Baureno dam(s), about 100 metres above sea level. Baureno was probably either a single large dam or a cluster of small dams, and the site was located in a large valley formed by a number of streams (the Boro, Mantring, Grosok, Pandaan, and Landean). Today, the area is a wide natural basin with a small modern dam on it. Near the dam is a small ruined temple called Candi Lima. The ancient Baureno dam clearly served as a reservoir for irrigating the surrounding areas and as a barrier meant to capture the debris flows that occasionally occurred on mountainous slopes and thereby protect areas downstream. The final group of dams is located in the western part of the central area, which is to the southeast of the Majapahit urban settlement of Trowulan. It seems that, in addition to the dams' purposes related to irrigation, they also served as a means of protection against flooding for the settlements to the north. As well as providing water for agriculture and drinking water, four dams in this area—the Temon, Kumitir, Domas, and Kraton—were built to control the river flow, especially as the Brangkal river becomes bigger after a numbers of rivers merge with it near Baureno.

As well as those large water reservoirs, there are smaller reservoirs or ponds. The best example of the existence of smaller reservoirs for community water supply is the presence of reservoirs on the Trowulan archaeological site, where there are two types. The first type is a man-made reservoir with a brick-constructed wall. In Trowulan, this type of water reservoir is represented by Kolam (pool/pond) Segaran; there were probably many more in the Majapahit period, but most have vanished. The Segaran pond is 375 metres long, 175 metres wide, and 2.88 metres deep, with pool walls 1.60 metres thick. The other type of reservoir is a natural

6 Maclaine Pont, "Eenige Oudheidkundige".

7 See: Chapter 4, especially Chapter 4.5, which contains information about this from the inscriptions.

Fig. 5.2. Kolam Segaran (left) and Balong Dowo (right). (Photos by Tjahjono Prasodjo)

pond called a *balong* by the locals. There are two *balongs* that can be seen now, Balong Dowo and Balong Bunder. Today, these standing bodies of water get their water from rainfall only, but it is possible that in the past a small water channel also supplied them.[8] Furthermore, other man-made ponds can be found at various other archaeological sites in East Java. One of these is at the Semarum site in Trenggalek, at a village in Semarum, which is a sub-district of Durenan. Like the Segaran in Trowulan, the pond at the Semarum is made of bricks. Unfortunately, the brick structure of the pond wall is in ruins and only part of it can be found. The structure is 1.10 metres high, 67 cm wide, and 24 metres long. Based on research conducted by Balai Arkeologi Yogyakarta, the man-made pond is estimated to measure at least 24 x 24 metres and dates from the eleventh to the thirteenth centuries CE.[9]

Regarding the irrigation systems of ancient East Java, the archaeological records show that *sawah* fields were mainly located outside the urban settlements and were provided with irrigated water from the dams via their water delivery systems. Relief panels from the Minakjinggo temple, now kept in Museum Majapahit in Trowulan, contain landscape scenes in which people cultivate the land. The first relief (left side) in Fig. 5.3, below, depicts a man working on the land with a tool, probable a hoe, and it is clear that the cultivated land is outside the area of settlement. The second panel depicts *sawah* fields that have dykes bordering each swathe of *sawah* fields, and it is clear that the *sawah* fields are located in a non-urban landscape or outside a settled area. This situation concurs with the ancient Javanese text records that most of the *sawah* fields were cultivated on the borders of or away from settled areas.

Landscapes containing *sawah* (paddy fields) are frequently mentioned in Old

8 See also A.S. Wibowo, "Fungsi Kolam-Buatan di Ibukota Majapahit", *Majalah Arkeologi* 1/2 (1977): 47.

9 H. Priswanto, "Hasil Penelitian Terbaru: Bentuk dan Karakter Situs Semarum", *Berkala Arkeologi*, 35/2 (2015): 140-141. The date is relative, and is based on the interpretation of ceramics found at the site (Majapahit-like ceramics and Song ceramics).

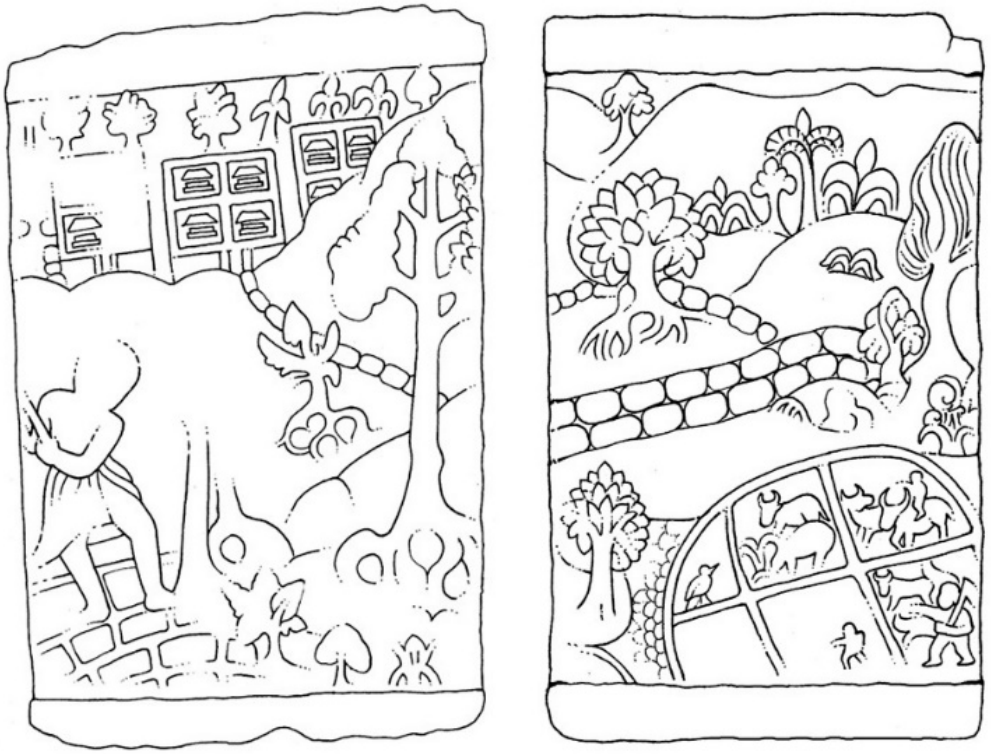

Fig. 5.3. Two sketches of two relief panels. Collections of Museum Majapahit, Trowulan, but originally from Minakjinggo Temple, Trowulan. (Sketched by Swa Setyawan Adinegoro).

Javanese texts.[10] This sort of irrigated rice field was located both in valleys far from the capital and in villages surrounding the capital itself. In Old Javanese texts this paddy field landscape is called a *pasawahan*, and the activity of working in paddy fields is called *asawah-sawah* or *masawah*.[11] In canto 22: 5, Arjunawijaya illustrates the activities of people farming in a rice field:

> *Sampun prāptĕṅ tĕgal mwaṅ sawah i tĕpi nikaṅ rājyakaṇṭhâtiramya,*
> *kirṇĕkaṅ wwaṅ makāryâṅgaru hana maṅurit mwaṅ tikaṅ wahw atandur;*
> *rary aṅhwan riṅ galĕṅ söh sapi nika malayū lĕmbu goñjoṅnya meṅas,*
> *kagyat de niṅ kudôṣṭrâṅhrik adulur i harĕp sāmajanyâtirodra.*[12]

10 Tjahjono Prasodjo, "Penggambaran Lanskap Jawa Kuno dalam Kakawin", in: *Kuasa Makna. Perspektif Baru dalam Arkeologi Indonesia* (Yogyakarta: Departemen Arkeologi, FIB UGM, 2019.): 151-178.

11 Zoetmulder, *Old Javanese-English Dictionary*: 1715.

12 Supomo, *Arjunawijaya. A Kakawin of Mpu Tantular. Vol. I: Introduction and Text* (The Hague: Martinus Nijhoff, 1977): 119.

> The procession now came to a beautiful scene: an area of dry-fields and rice cultivation, just at the outskirts of the city.
> A great many people were working there: some harrowing, some making seed plots, others transplanting rice seedlings;
> on the dykes, children were tending many cows, which scattered in all directions as they were startled by the neighing of the horses and the braying of the camels passing by in procession, preceded by fearsome elephants.[13]

To irrigate the *sawah* fields, equipment was required to move water from the store or source to the fields. The ancient East Javanese developed a variety of means of supplying water to irrigate the land, some of which were canals and underground tunnels. The remains of this hydrological engineering were discovered in many sites within the Brantas river basin, many of which are still in use. In 1923, E.W. Maurenbrecher made an archaeological inventory of the Malang District and reported in *Oudheidkundig Verslag* at least five underground tunnels, in the villages of Oro-oro Dowo, Bunulrejo, Arjosari, Jedong, and Guyangan, in the district of Malang.[14] Blasius Suprapta mentions at least three more underground tunnels in Malang, namely at Lowokwaru (sub-district Lowokwaru), Karuman (sub-district Lowokwaru), and Polowijen (sub-district Blimbing).[15] Another report, in *Oudheidkundig Verslag over 1936*, states that three underground tunnels were found in Selaliman, Jenggring, and Keputren, all around Mojokerto.[16] In Selaliman, an inscription with the date of 1280 Śaka (1358 CE) was found inside a 40-metre water tunnel, while in a similar tunnel at Keputren was discovered an inscription with the date of 1227 Śaka (1355 CE).[17] These dates detail the time of the waterworks'

13 Supomo, *Arjunawijaya. A Kakawin of Mpu Tantular. Vol. I;* and S. Supomo, *Arjunawijaya. A Kakawin of Mpu Tantular. Vol. II: Translation* (The Hague: Martinus Nijhoff, 1977): 217. An interesting aspect here is its mention of a camel (*uṣṭra*). The camel is not indigenous to Indonesia, but three old Javanese texts, namely *Arjunawijaya*, *Sutasoma* and *Nāgarakṛtāgama* (*Deśawarṇana*), mention camels. Pigeuad's comments on non-native animals in Java is probably correct: "Donkeys and camels are not native to Java. Just like elephants they were probably imported (from India) only to be used in Royal processions to enhance the splendour of the display", see: Th. G. Th. Pigeaud, *Java in the 14th Century. A Study in Cultural History*, Vol 4 (The Hague: Martinus Nijhoff, 1962): 158.

14 E.W. Maurenbrecher, "Verbeteringen en Aanvullingen op den Inventaris der Hindoe-Oudheden (Rapport 1923) voor de Districten Malang, Penanggoengan en Ngantang van de Afdeeling Malang, Residentie Pasoeroean", *OV* (1923): 173 and 180.

15 B. Suprapta, *Makna Gubahan Ruang Situs-situs Hindhu-buddha Masa Sinhasari Abad XII Sampai XIII Masehi Di Saujana Dataran Tinggi Malang dan Sekitarnya*, Dissertation, Universitas Gadjah Mada, 2015.

16 W.F. Stutterheim, *Oudheidkundig Verslag 1936* (Bandoeng: A.C. Nix & Co., 1937): 16. Selaliman village now is called Seloliman, and is in the sub-district of Trawas, Mojokerto. Keputren is now probably called Keputran, a small village in Kutorejo, Mojokerto.

17 For descriptions of the inscriptions, see: Chapter 4.

construction. Besides finding such remains in the areas of Malang and Mojokerto, other waterworks were discovered in the vicinity of Kediri, as seen in the table below:

Tabel 5.1. List of Water Tunnels in Kediri and its surrounding Area. This list is based on my visit in 2016 and additional information from Novi Bahrul Munib (personal communication).

No.	Tunnel Name/Location	Village (*Desa*)	Sub-District (*Kecamatan*)
1	Goa Surowono	Canggu	Bada
2	Jlurung Sentono Maling	Gambyok	Grogol
3	Goa Baruklinting	Bogem	Gurah
4	Arung Sukorejo	Sukorejo	Gurah
5	Sumber Sumurup	Karangtengah	Kandangan
6	Sumber Jeblok	Keling	Kepung
7	Sumber Beji	Brumbung	Kepung
8	Sebanen	Nambaan	Ngasem
9	Sumber Gumuling	Bulupasar	Pagu
10	Situs Semen	Semen	Pagu
11	Mangiran	Lamong	Pare
12	Sumber Bringin 1	Bringin	Pare
13	Sumber Bringin 2	Bringin	Pare
14	Sumber Corah	Pare	Pare
15	Tegalarum	Langenharjo	Plaseman
16	Sumber Begendul	Sidowareg	Plemahan
17	Genukwatu/Genukrejo	Puhjarak	Plemahan
18	Sumber Bulu	Pagu	Wates
19	Kali Pesu	Pagu	Wates
20	Sumberjati	Pagu	Wates

Most of the water tunnels listed in table 5.1 were constructed underground and either carved through a compact sedimentary rock layer or constructed out of brick (see: Fig. 5.4 for the sedimentary rock carved-construction water tunnels and Fig. 5.6 for the brick water tunnels). The tunnels are of differing lengths, heights, and widths; some are 2 to 4 metres in length while the others are hundreds of metres long. The width and height of the tunnels are likewise varied. Subterranean water channel technology in East Java was occasionally linked to surface canal technology, with the result that, along a single water stream system, there would alternately be underground tunnels and surface canals.

Another type of subterranean water channel is demonstrated by an

Fig.5.4. Water tunnels at Begendul, Kediri (left) and Genuk Watu, Kediri (right). (Photos by Tjahjono Prasodjo)

underground water tunnel called the Surowono tunnel, in the village of Canggu (sub-district of Badas, Kediri), which is similar to the water-tapping technology known as *qanat* that is used in many areas of Western China, Central Asia, and the Middle East. The Surowono tunnel is around 400 metres long, has 4 access shafts with an outlet, and was carved through compact sedimentary rock. There is a distance of 50 to 60 metres between the shafts, each of which is 5 to 10 metres deep. Moreover, the width of the tunnel is also varied, being around one metre in some places but much less in others, while the height of the tunnel also varies, with the largest distance to the roof of the tunnel from the bottom being 170 cm while, near the outlet, the height narrows. Water flows through the underground water gallery and disgorges into an outlet, before flowing on to join a small river. The Surowono tunnel is still used by the local community for irrigation and domestic use today.

As well as underground water tunnels that were constructed by cutting through compact sedimentary rock to make a water gallery, ancient East Javanese engineers constructed underground tunnels using bricks. One example of such ancient water works is found near Pagu village, in the Wates sub-district of Kediri, on the bank of a small river called the Pesu. There are at least three tunnels along the riverbank, one of whose remains are 5 metres long, 1.5 metres high, and 1.6 metres wide at the widest point. The tunnel walls are constructed of brick veneer, with bricks being piled one on top of another without mortar. Each brick measures 21 x 42 x 8 cm.[18] The dimensions of the bricks are reminiscent of the ancient bricks used during the classical period of East Java, but no absolute dating has yet been carried out. Not far

18 BPCB Mojokerto, *Ekskavasi Penyelamatan Situs Pagu Kecamatan Wates, Kab. Kediri 2012* (Mojokerto: Balai Pelestarian Cagar Budaya Mojokerto, 2012): 18-20.

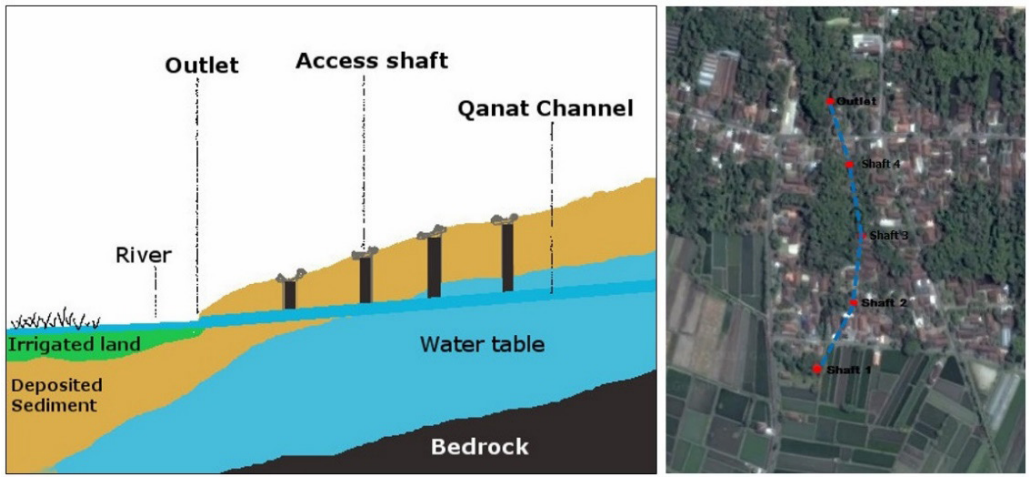

Fig. 5.5. Section of a *qanat* (left) and the Surowono tunnel (right). (Drawn [left] and plotted on Google Map [right] by Tjahjono Prasodjo)

Fig. 5.6. Brick constructed water tunnel near Pesu River, village of Pagu, Sub-district of Wates, Kediri. (Photos: BPCB Mojokerto, *Ekskavasi Penyelamatan Situs Pagu Kecamatan Wates, Kab. Kediri*: 32, 36, 37.).

from the riverbank, a *yoni* (the pedestal for the *liṅga*, a form of the Hindu god Śiwa), two statues, and a brick foundation were found. If both remains have a contextual function, then it would confirm that the tunnels were from the same period as the *yoni*, statues, and foundation, which themselves were from the classical period of East Java. Since only part of the tunnel remains have been found, the source of the tunnel's water cannot be identified. However, to the east of the site and not far from it are two springs that were probably the water sources of the tunnels in the past.

Another part of the large-scale water engineering projects are the debated archaeological remains of the Trowulan canal. In the past, it was believed that there was a large canal system at the Trowulan site, formed of criss-crossing canals, each

of around 12 metres wide, and which were built in the ancient city of Trowulan. Earlier archaeological researchers believed that the canals functioned as both a means of transportation and irrigation infrastructure. In 1981, a team of geographers undertook research at Trowulan using a remote sensing technique and found on an aerial photograph of the Trowulan area a landscape feature that they took to be an ancient canal system (Fig. 5.7.).[19] This canal network was believed to be 20-45 metres wide, 4 metres deep, and around 23 kilometres long in total[20] However, this interpretation of the Trowulan "canal" has been challenged by Hermanislamet, Gomperts *et al*., Yuwono, and Munandar.[21] Both Hermanislamet and Gomperts *et al*. question the existence of these canals. According to Hermanislamet, it is not possible to identify the feature as constituting a canal system, while Gomperts *et al*. explain:

> However, taking into consideration Stutterheim's map, our observations at the site, as well as expert hydrological considerations, it is possible that these canals could have been ditches, vallums or drains a few metres wide running along the four main roads leading to the crossroads, rather than fully engineered broad waterways per se.[22]

Additionally, Yuwono states that some archaeological findings, such as ancient wells, were found in the feature that was believed to be a canal, while some parts of it even contain roads that have a higher surface level than the surrounding areas. Moreover, a canal network that was almost 50 metres wide would need a large number of

19 However, the photogrammetrists were not able to determine whether it was a canal or a road network. See: K. Darmoyuwono, et al., *Penerapan Teknik Penginderaan Jauh untuk Inventarisasi dan Pemetaan Peninggalan Purbakala Daerah Trowulan, Mojokerto, Jawa Timur* (Jakarta: Badan Koordinasi Survey dan Pemetaan Nasional, 1981): 15, 31. On the interpretation of the canal, see also: Mundardjito et al., *Rencana Induk Arkeologi Bekas Kota Kerajaan Majapahit Trowulan* (Jakarta: Departemen Pendidikan dan Kebudayaan, Direktorat Jenderal Kebudayaan, Direktorat Perlindungan dan Pembinaan Peninggalan Sejarah dan Purbakala , 1986); K. Arifin, *Waduk dan Kanal di Pusat kerajaan Majapahit Trowulan-Jawa Timur*, Diss. University of Jakarta (Jakarta, 1983); K. Arifin, "Sisa-sisa Bangunan Air Zaman Kerajaan Majapahit di Trowulan" in: *Pertemuan Ilmiah Arkeologi IV. Buku I Evolusi Manusia, Lingkungan Hidup, dan Teknologi* (Jakarta: Pusat Penelitian Arkeologi Nasional, 1986): 169-187.

20 S. Simoen et al., *Penelitian Geolistrik Detail di Sepanjang Saluran Bekas Ibukota Kerajaan di Trowulan, Mojokerto, Jawa Timur*. (Yogyakarta: Gajah Mada University, Faculty of Geography, 1983): 30-47.

21 B. Hermanislamet, *Tata Ruang Kota Majapahit: Analisis Keruangan Bekas Pusat Kerajaan Hindu Jawa Abad XIV di Trowulan Jawa Timur*, Diss. Universitas Gadjah Mada (Yogyakarta: 1999): 69; A. Gomperts, A. Haag, and P. Carey, "Stutterheim's enigma: The Mystery of his Mapping of the Majapahit Kraton at Trowulan in 1941", *BKI* 164/4 (2008): 421; J.S.E. Yuwono, *Menelisik Ulang Jaringan Kanal Kuna Majapahit Di Trowulan, (http://geoarkeologi.blog.ugm.ac.id/files/2013/03/2013_kanal-trowulan1.pdf)*; and A.A. Munandar, *Tak Ada Kanal Di Majapahit* (Jakarta: Penerbit Wedatama Widya Sastra, 2013): 23-88.

22 Hermanislamet, *Tata Ruang Kota Majapahit: 69*; Gomperts, Haag, and Carey, "Stutterheim's enigma": 421.

Fig. 5.7. Map of the Trowulan canal network (blue colour), 1986 version. (Source: Mundardjito et al., 1986 with modification).

bridges to enable the inhabitants of the city to move around it, but so far no such bridge remains have been found. Based on these arguments, he seriously doubts the past existence of the canal network.[23] Munandar also casts doubt on it, arguing that the low and long features were in fact places where the common people lived, which would fit with the religious concept that the common people should live in the lower areas of the land while the more important people should live in the higher areas.[24]

23 Yuwono, *Menelisik Ulang Jaringan Kanal Kuna Majapahit Di Trowulan*: 3-4.

24 He uses the concept of *triangga (triloka)* and *sanga mandala* to explain that the religious

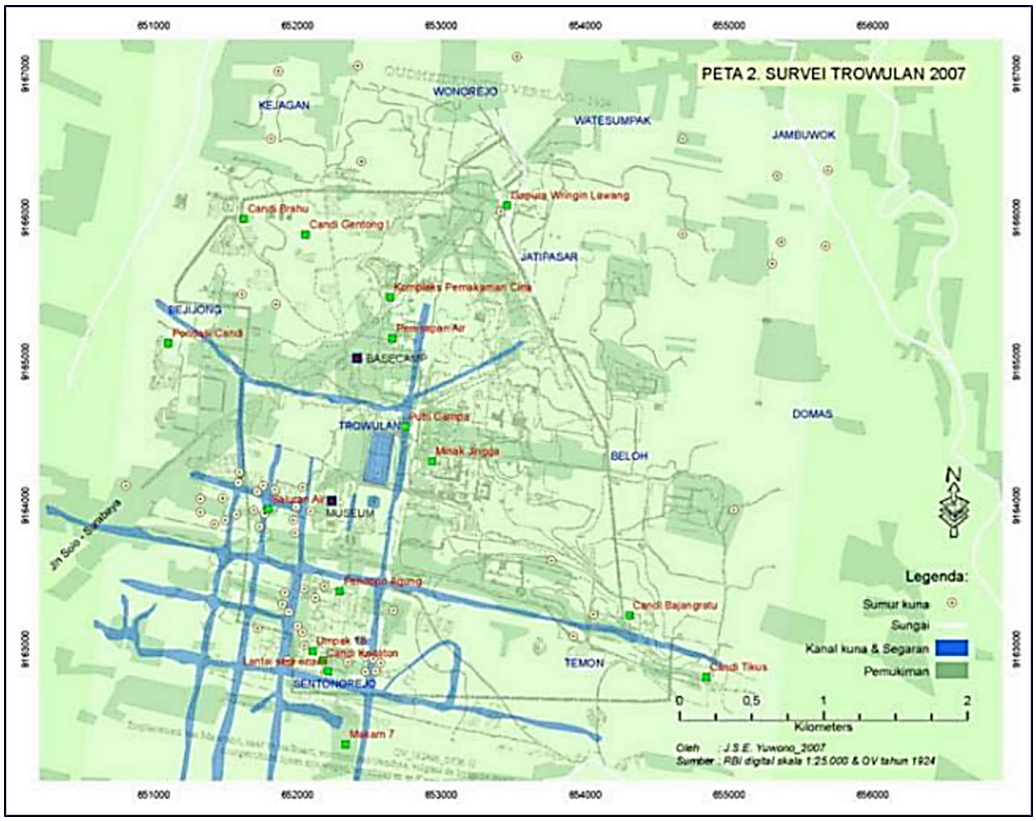

Fig. 5.8. The 2007 version Map of the Trowulan canal network. (Source: J.S.E. Yuwono in http://geoarkeologi.blog.ugm.ac.id/files/2013/03/2013_kanal-trowulan1.pdf).

I agree that interpreting the anomaly in the colour tone on the aerial photograph (Fig 5.7.) as demonstrating that they were canals should be questioned, but Munandar's interpretation of the low strip of land as the place of inhabitation of people from the lower caste is similarly weak. The concepts of *triangga* (*triloka*) and *sanga mandala* are not useful for explaining the settlement patterns of Trowulan because they are inconsistent with the grid pattern of the landscape as a result of being divided by the long and criss-crossing strips of low ground. If lower caste people did live along entire strips of the lower ground then they would also occupy the land that, according to both concepts, were the areas belonging to higher caste people because the strips of low ground cut across and crisscross the entire landscape of Trowulan. I prefer to interpret the anomaly of the colour tone on the aerial photograph not wholly as being evidence of ancient canals. Instead, only a

concepts were applied when setting up the settlement pattern of Trowulan. See: Munandar, *Tak Ada Kanal Di Majapahit*: 23-88.

limited number of them were small canals, while the majority should be viewed as ancient roads with, probably, ditches alongside them and most certainly not 50 metres wide.[25] However, significant attention should be paid to the landscape dynamic of Trowulan caused by human activities over time. The canals and roads of the past would not have been as wide as they are today, instead being much smaller than they are at present; humans most probably altered the topography of the landscape, including making the low land strips increasingly wide for reasons of agriculture or, for example, sugar cane plantation expansion.

5.2. SMALL-SCALE WATER ENGINEERING

In addition to the remains of large-scale water engineering, there are also the remains of water works on a smaller scale that can be traced back to the ancient East Javanese period. In small-scale water engineering, wells are the main source from which people could draw water. The use of wells was common in ancient East Java, especially in areas of settlement. They were dug by hand, probably using a shovel-like tool, until they reached underground aquifers. Most of the wells have a circular cross-section measuring 1 to 1.5 metres in diametre, but some are square with sides of one metre each. The well was lined with bricks, stones, or earthenware rings to prevent it from collapsing (Fig. 5.10.a,b,d.).[26] The upper part of the well, above the surface, had a stone or earthenware ring or bricks both for safety purposes and to prevent dirt and surface water from entering the wells. In one of the relief panels from the Panataran Temple, a water well with its upper wall is depicted; it also shows a man carrying a bucket approaching the well (Fig. 5.10.e.).[27]

It seems that these wells were not used solely for domestic purposes. Instead, their function was related to their location. While wells that were located near or had an association with a settlement were used to provide fresh water for households, wells located far from inhabited areas mainly had purposes related to a particular community activity, such as for watering plants or brick making, a process which requires water.

In the Trowulan site, several wells were found close together within a relatively small space, which seems to indicate either the use of communal wells—possibly because some kind of activity was performed there that needed a lot of water—

25 For this interpretation of the features as roads with small drains, see the cited statement of Gomperts et al. on the previous page.

26 The cylindrical earthenware ring has, on average, a diameter of 1 to 1.5 metres, is around one metre high, and 1 to 2 centimetres thick. A local term for this earthenware ring is jobong. There are two types of brick: a rectangular block brick used for lining square wells and a block brick with its opposite side curved which is used for circular wells. See also: A. Sukardjo, "Sumur", *Warta Hindu Dharma* 506 (2009): 23-24.

27 A detailed description of the panel has been provided by Marijke Klokke in: M.J. Klokke, *The Tantri Reliefs on Ancient Javanese Candi* (Leiden: KITLV Press, 1993): 231-233.

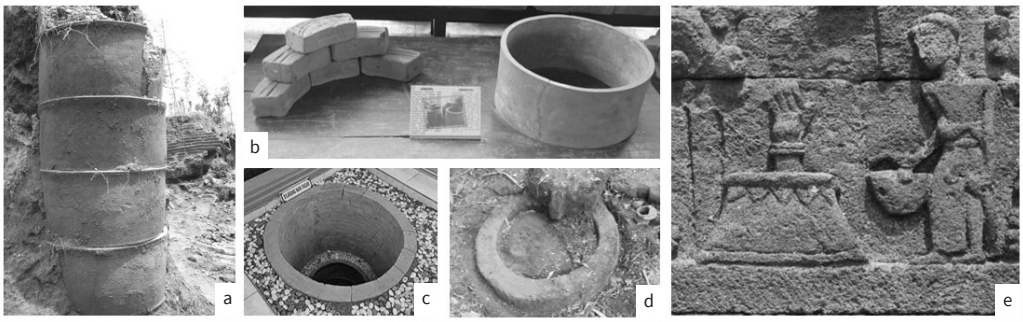

Fig. 5.10. Remains of ancient East Javanese wells (left and middle) and a well depicted on the Panataran Temple (right). (Photos: [a] and [d] by Novi Bahrul Munib; [e] from Lydia Kieven, 2013, Fig.7.32 cropped from the original)

Fig. 5.11. Sewage channel system at a house remain in Trowulan Open Museum.(Photos by Tjahjono Prasodjo)

or that different people built wells on the same location because it had the best underground aquifers in the area.[28]

Regarding the use of water for domestic purposes, the inhabitants of Trowulan created a drainage system in order to remove waste water from houses and their yards.[29] The remains of a Trowulan house that is displayed in the open-air Trowulan

28 Locations at Trowulan where a concentration of wells were found include Nglinguk, Sentonorejo, Kedaton, Batuk Palung, and Pandansili. See: Sukardjo, "Sumur": 23; and also the result of a recent archaeological survey on a high density of wells spreading over a 400 m^2 area at Nglinguk, Trowulan in: A.A. Munandar et al., *Air dan Kosmologi di Situs Majapahit* (Depok: Fakultas Ilmu Budaya Universitas Indonesia, 2014): 68.

29 In part of the Gomperts et al. article is detailed the water management of the Majapahit Capital, and it is demonstrated that such a sewage system existed in the city. See:

Fig. 5.12. The relief panel from Trowulan. (Photo: Krom, 1923: plate 67)

museum show part of a domestic sewage channel system. Fig. 5.11 shows a 10-20 centimetre wide brick-structured sewage channel network surrounding the remains of a chamber foundation with an earthenware water container in the middle, indicating that it was a bathroom. From each household the sewage ran out to an outer sewerage—most probably an open drain—which also collected surface water runoff from the whole settlement area.

A relief from Trowulan (Fig. 5.12) depicts a landscape of houses and their local setting, which contains a winding river with two bridges over it.[30] The most remarkable element of the depiction relating to sewerage is that, from a wall surrounding the houses, water flows from a conduit at the bottom and seems to run down to the river. This water channel is almost certainly a sewer channel from the settlement area, taking sewage to the river.

Outside Trowulan, a similar sewage system was recently found at the village of Semen, in the Pagu sub-district of Kediri. A rescue excavation was conducted at the site by *Balai Pelestarian Cagar Budaya Mojokerto* in 2014, producing some intriguing findings. Based on the relative dating of ceramic findings, the site dates back to around the fourteenth century CE. The team discovered the remains of a settlement and a small brick ditch measuring 30 cm wide by around 4 metres long (Fig. 5.13). The ditch starts from near the remains of this settlement and ends at the banks of

Gomperts, A. Haag and P. Carey, "The Archaeological Identification of the Majapahit Royal Palace: Prapañca's 1365 Description Projected onto Satellite Imagery", *Journal of the Siam Society* 102 (2014): 98-100.

30 According to Krom, the panel is part of series of reliefs, but the series is incomplete. Today, the relief is in the Museum Nasional Jakarta. See: N.J. Krom, *Inleiding tot de Hindoe-Javaansche kunst. Tweede Deel* ('s-Gravenhage: Martinus Nijhoff, 1923): 186-187.

Fig. 5.13. The brick ditch found at Semen site, Pagu, Kediri. Photo (a) was taken during the excavation in 2014 and (b) was the situation in 2016. (Photo (a): Balai Pelestarian Cagar Budaya Mojokerto, 2014: 28; Photo (b) by Tjahjono Prasodjo)

the small Kemanten river, which flows very close to the site.[31] It seems clear that this brick ditch was used to transport sewage to the river.

Regarding ditches, a number of Trowulan archaeological sites provide us with evidence of ancient ditches. There are two types of construction, underground water tunnels and open-air ditches, both of which are made of brick. One of the underground tunnels, found near the Brahu temple in Bejijong (Trowulan), was found to be 28 metres long and 1.5 metres wide when it was excavated in 2005 (Fig. 5.14, left-side photo).[32] The exact function of the tunnel is not yet known, although it may have been used as drainage for the area around the Brahu and Gentong temples. However, it was brick-built ditches that were most commonly built by the inhabitants of Trowulan. Recently, an ancient ditch was discovered at Nglinguk, Trowulan.[33] This is of brick construction and contains a number of interesting features, particularly a sluice-like gate, demonstrated by the presence of

31 Balai Pelestarian Cagar Budaya Mojokerto, *Laporan Ekskavasi Penyelamatan Situs Semen Kec. Pagu Kab. Kediri*. Excavation Report (2014). When I visited the site in August 2016, the channel was still intact, but it transversely crosses a small road, which threatens its preservation.

32 The height of the tunnel is at least 0.85 cm, but it is probably larger than that since the excavation was stopped at that level when water had started to flood the bottom of the pit. See: Kelompok Kerja Perlindungan, *Laporan Penyelamatan Temuan Saluran Air di Desa Bejijong, Kecamatan Trowulan, Kabupaten Mojokerto* (Balai Pelestarian Peninggalan Purbakala Trowulan Wilayah Kerja Propinsi Jawa Timur, 2005).

33 Balai Pelestarian Cagar Budaya Trowulan, *Laporan Ekskavasi Nglinguk* (unpublished, 2015).

Fig. 5.14. Underground brick tunnel at Bejijong (left). Nglinguk water controlling infrastructure (right). (Photos: Balai Pelestarian Cagar Budaya Mojokerto; The photos are taken from Kelompok Kerja Perlindungan, *Laporan Penggalian Penyelamatan Temuan Saluran Air di Desa Bejijong, Kecamatan Trowulan,Kabupaten Mojokerto* (Trowulan: Balai Pelestarian Peninggalan Purbakala Trowulan, 2005)).

Fig. 5.15. Nglinguk Ditch with sluice notch (left) and tranversed brick structure (right). (Photos: Balai Pelestarian Cagar Budaya Mojokerto)

a long vertical notch into which a sluice plate could be placed (Fig. 5.15). Moreover, a brick - or possibly a wood - structure was mounted transversely as a barrier across the width of the ditch to block water flow; as such, it probably functioned as a weir. It appears that people were attempting to control both the level of the water and its flow rate using both of these structures. Another brick structure was found at Nglinguk (Fig.5.14, right-side photo). It consists of a small brick building with a ditch underneath, and has been interpreted as a means of water control.[34]

Additionally, as part of their small-scale water management, the East Javanese developed pipe technology, and in particular pipes that were made of fired clay,

34 Suaka Peninggalan Sejarah dan Purbakala Trowulan, *Laporan Hasil Penggalian Penyelamatan Bangunan Air di Dusun Nglinguk, Kecamatan Trowulan, Kabupaten Mojokerto* (unpublished, 1999).

Fig. 5.16. Fired clay pipes and fired clay waterspouts: collections of Museum Majapahit at Trowulan. (Photos by Tjahjono Prasodjo)

Fig. 5.17. Reliefs depicting various water-spouts, from Candi Yudha (left, Photo: OD-12057, cropped from the original), Candi Rimbi (middle, Photo: Marine Schoettel), and Candi Kendalisono (right, Photo: OD-12637, cropped from the original).

bamboo, and stone (especially for the spout part). Pipes made of fired clay with a length of about 40 cm and a diameter of 8-10 cm were found across the Trowulan site, and some of them were collected and are now kept in the Museum Majapahit at Trowulan. The pipes were assembled as shown in Fig. 5.16 (bottom right-side photo), with two or more pipes being joined together to form a longer pipeline; to make it easier for them to be joined together, one end of the pipe was made narrower so they could fit inside each other. However, we do not know how the joints were made impermeable as no research has been carried out into this question. Most of the pipes are long and straight, but there are also T-shaped pipes and curved pipes as shown in Fig. 5.16 (top right-side photo). As well as pipes, the East Javanese also made small waterspouts from fired clay, which have various different shapes.

Concerning waterspouts, some East Javanese reliefs depict bathing places which exhibit various types of waterspouts. Two reliefs, seen in Fig. 5.17, portray

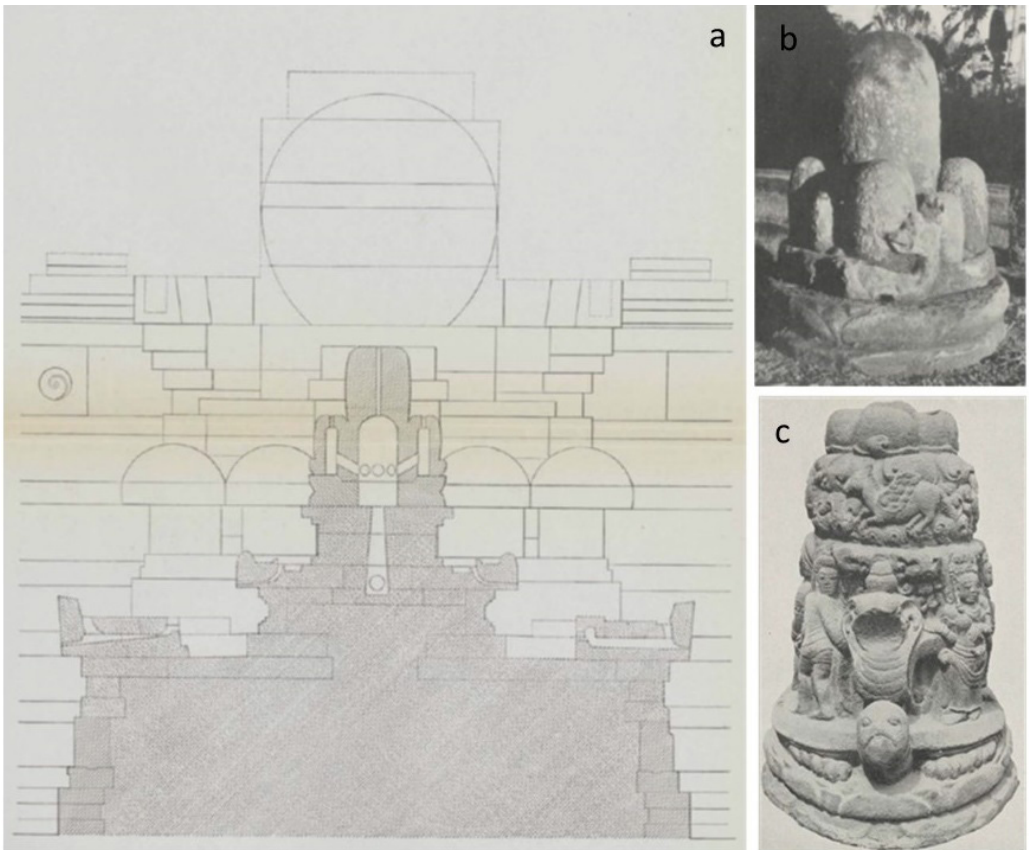

Fig. 5.18. Stutterheim's sketch of pipe engineering in Jolotundo temple (a) and a photo of the waterspout (b). Another type of a waterspout from Sirahkencong (c). (Photos and sketch from Stutterheim, 1937: 212, 214, 215)

people taking a bath and, in front of them, water coming from waterspouts. These waterspouts have the shape of *makara* (Hindu mythological water-creature) and were probably made of stone. Similar *makara*-shaped waterspouts are on display at the Majapahit Museum in Trowulan. The last relief (on the right-side in Fig. 5.17) depicts a couple sitting together—a woman is sitting on the lap of a man who is playing a musical instrument—near a lake that has three streams emanating from different water pipes. In this case, the waterspouts and the pipes were made of bamboo, demonstrated by the small lines, carved like bamboo nodes, on the pipe. The use of bamboo in pipes is also confirmed by Old Javanese texts, for example in the *Śiwarātrikalpa*, an old Javanese text from the fifteenth century CE, in which it is said that water is conveyed from a spring using bamboo pipes.[35]

35 A. Teeuw *et al*., **Śiwarātrikalpa** *of Mpu Tanakuṅ. An Old Javanese Poem, its Indian Source,*

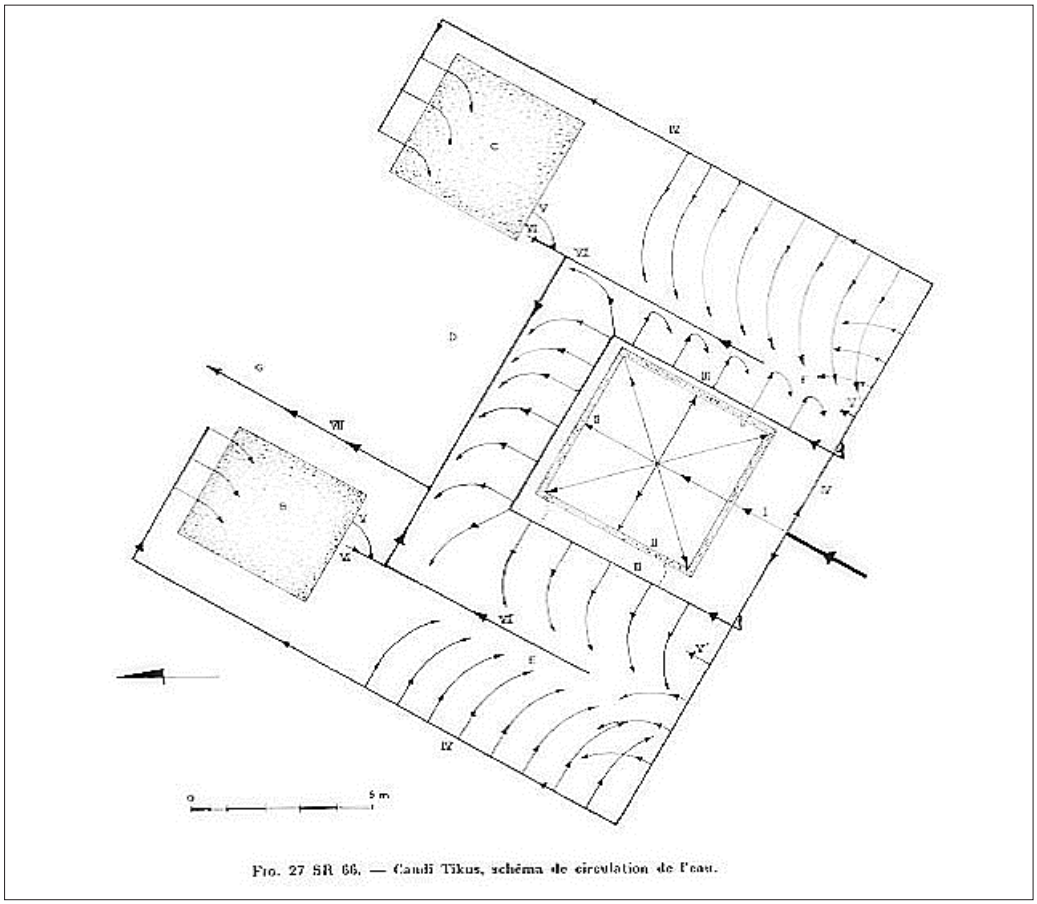

Fig. 5.19. Dumarçay's illustration of water circulation in the Tikus temple. (Source: Dumarçay, 1982: Fig. 27)

Relatively small-scale water infrastructure was also employed in temple buildings, and more specifically temples in which water was used as the main component in rituals and/or structural architecture. These temples are known as *petirtaan/pathirth*ān, meaning bathing places or, as I prefer to call them, holy-water temples.[36] As Judith Patt has emphasized, there was an association between water symbolism and how technology was used to manipulate water, and the holy-water temples contain good examples of the sophisticated water engineering of the East

and Balinese Illustrations (Amsterdam: Springer-Science and Business Media, B.V., 1969): 74-75.

36 Ninie Susanti *et al*. conducted research on *Patirth*ān and made a list of 24 East Javanese *Patirthān*, 18 of which are located in the Brantas river basin area: Malang (10), Mojokerto (3), Kediri (1), Tulungagung (1), and Blitar (3). See: N. Susanti *et al*., *Patirthān. Masa Lalu dan Masa Kini* (Jakarta: Wedatama Widya Sastra, 2013): 74-77.

Javanese.[37] They utilized two principal properties of water—fluidity and gravity—to convey water from the source to a holy-water temple. In many cases, they also created a system of pipes within the temples and fashioned decorated waterspouts. Stutterheim has described one such ancient waterwork, found in the *pathirthān* of Jolotundo,[38] and has produced a drawing that explains the piping system of the Jolotundo waterworks (Fig.5.18). Another example of pipe engineering within a temple is to be found in the Tikus temple, Trowulan. Fig. 5.19 illustrates how water circulated in the Tikus temple, as reconstructed by J. Dumarçay.[39]

5.3. CONCLUSION

Water management practices in ancient East Java were not solely carried out for agricultural purposes. While ancient Javanese communities did rely on agriculture and thereby tried to maximize its production by managing the water supply, the water management practised by the East Javanese was a much broader phenomenon. The archaeological survey that I have conducted for this dissertation demonstrates how water management was applied to many aspects of daily life.

At the very least, I propose there were four aspects of water management practises in ancient East Javanese societies. First, for agriculture they built large-scale engineering because agriculture requires water. *Sawah* cultivation would have required the vast majority of the agricultural demand for water. To convey water to the fields, a community—probably without the support of the ruler—built water channels in the form of open canals or subterranean tunnels to cope with topological barriers. Secondly, large-scale engineering was also constructed to prevent natural disasters, primarily large-scale flooding. When creating dams for irrigation, Old Javanese community sought to avoid subjecting the inhabitants to flooding, meaning that they were both knowledgeable about and put into practice flood management. Thirdly, in smaller-scale water engineering, the community who lived in urban and sub-urban areas developed various ways of ensuring that their living conditions were comfortable and healthy. They created a sanitary sewage system at the level of individual households as well as at settlement level. Moreover, they ensured that there was enough water brought to the settlement by constructing water control installations. Fourthly, on the smallest-scale water engineering level—that of a single building, and specifically holy-water temples—the design of the water control not only had a material relevance but may also have had an aesthetic or religious basis.

37 J.A. Patt, *The Use and Symbolism of Water in Ancient Indonesian Art and Architecture*, Dissertation (1979): 492.

38 W.F. Stutterheim, "Het Zijnrijke Waterwerk van Djalatoenda", *TBG 77* (1937): 21-50.

39 J. Dumarçay, "Notes d'architecture Javanaise et Khmère", *Bulletin de l'Ecole française d'Extrême-Orient* 71 (1982): 91-94 and Fig. 27. See also: I. G.N. Anom, *Pemugaran Candi Tikus* (Jakarta: Departemen Pendidikan dan Kebudayaan, 1994): 13-14.

The concept of *amṛta* (holy water) was part of the water engineering of the holy water temples and the temples are adorned with beautiful ornamental elements.

There is one question remaining. The archaeological data related to water engineering in ancient East Java provide enough information to reach some conclusions about water technology and the hierarchical water engineering levels. However, a clarification of the relationship between water infrastructure, East Javanese society, and the rulers requires discussion. The next chapter will do so.

Conclusion

This thesis explores the relationship between state power and water-management in medieval East Java. More specifically, it studies the balance between the state and local communities in the creation and management of waterworks in the Brantas river basin during the tenth to sixteenth century CE. In a long-term comparative perspective, taking into account the experience of other Southeast Asian states, the thesis builds on archaeological and epigraphical evidence to demonstrate that East Javanese water management was primarily driven by local communities. In other words, it was the East Javanese village (*wanua* and *watĕk*) that built waterworks to control and manage the local demand and supply of water. In my thesis, a village-scale territory refers to an administrative division of the East Javanese kingdom which included a clustered human settlement, as well as the land, the rivers, the valleys and the hills that were part of it. Administratively, villages (*wanua*s) were under direct jurisdiction of a *watĕk* (a group of villages) and *watĕk*s were incorporated into the kingdom. Together they formed a three-tier system of government: court-*watĕk*-*wanua*. A *rakai* or *rakryan* was the head of a *watĕk*, while a *wanua* was governed by a group of *rama* (elders) and several village officials. I use *wanua* and *watĕk* as generic terms to refer to a village and a group of villages. Although the term *wanua* changed to other terms, such as *thāni*, *karaman*, and *desa*, between the ninth to fourteenth century, the nature of its administrative structure remained the same.

Archaeological remains in East Java provide information on various types of

water works in both the upland and the lowland areas, including dams, ponds, weirs, canals, underground tunnels, and wells. Remains of dams can be traced in an area between the Anjasmoro-Welirang ranges and the Brantas river, such as the Baureno and Kumitir dams. Apart from a few large water reservoirs, there are numerous smaller reservoirs, ponds and wells, as well as smaller devices, such as the clay pipes and waterspout artefacts exhibited in Museum Majapahit at Trowulan. Remains of canals and underground tunnels are found in particular in and around Trowulan and Kediri. Most of this hardware was used to collect water for irrigating agricultural land, primarily at the micro level of the village community.

The epigraphical evidence confirms that the East Javanese water works were built and managed on a small scale by the local communities at a village (*wanua*) level. The East Javanese inscriptions provide information on water officials who worked in managing water, such as *air haji*, *lěbləb*, *hulair*, *hulu wuattan*, *mawuai*, *manambańi*, *jukuṅ*, and *matamwak*. From these eight officials there were only two, the *air haji* and *lěbləb*, who are known to have served the royal court as water tax collectors. All others worked for the local community, as they are mentioned in inscriptions together with village (*wanua*) officials. What is more, these officials figure much more prominently in the East Javanese inscriptions than the court officials. Hence, the local officials appear to be the prime agents in constructing and maintaining the water infrastructure implying a decentralizing tendency leading to more self-management by villagers.

If we compare the decentralized case of East Java with other water management regimes in Southeast Asia some remarkable differences emerge. First of all, much more top-down initiative was coming from the central court in the ancient Burmese and Thai polities, although there too, implementation was in the hands of local officials. Zooming in on the Chao Phraya river basin, this is true for at least the Chiangmai, Sukhothai, and the Lanna eras. Interestingly, however, it is in the later Ayutthaya period, that the central state was losing its hold on the water management, giving more agency to local farmers, be they individuals or farmers organized in groups. The socio-political differences between mainland Southeast Asia and East Java require further study, but it seems that basic geographical and climatological differences played a crucial role in making the water management regimes in mainland Southeast Asia more top-down than in East Java.

The differences between the physical environment of mainland Southeast Asia and that of East Java are mainly twofold. The first difference concerns their rivers, as the rivers of mainland Southeast Asia are very long and flow from north to south, forming large, extended basins, while in East Java a narrower basin is shaped by a smaller river. The Brantas river basin has an area of only 11,800 km^2, which is much smaller than that of the Irrawaddy, for instance, which has an area of 413,700 km^2. The second feature is the existence of volcanoes in East Java, which are missing in the landscape of Burma, Thailand, and Cambodia. The volcanoes of the Brantas river

basin are situated in its inner region, where the basin is bordered by the river's course, which forms, approximately, three-quarters of a circle. There are at least five volcanoes in the basin: Penanggungan, Welirang, Arjuna, Kawi, and Kelud. These two features led to different ways of managing water in mainland Southeast Asia and East Java. Because of the very short distance between the river and the mountain slopes, the plains of the Brantas river basin's valleys are narrow, meaning agriculture is limited, while some of them are floodplains. Therefore, agricultural land was expanded to the alluvial fans and mountainsides. In order to cultivate these areas, a specific water management process was needed, one that would ensure easy access to water through the construction of related infrastructure, such as canals and dams, to hold water and prevent it from flowing down the steep river.

How important geography and climate can be, has been demonstrated in this thesis by providing a new explanation for the eastward shift of the Javanese political centre during the so-called Medieval Climate Anomaly in 900-1300 CE. Although there is still much uncertainty about its precise repercussions for the Indonesian Archipelago, it seems that Central Java was struck by a fatal combination of a volcanic eruption with excessive rainfall, lava and water producing flows of mud (*lahar*) that destroyed the area surrounding the Merapi. In the longer run, the political shift to East Java may have been facilitated by higher-than-average rainfall levels for Java during this period. This study suggests that this same Medieval Climate Anomaly provided a more favourable climate for East Java, with higher-than-average rainfall levels in this relatively dry part of Java, which may have been one of the main reasons for consolidating the eastward shift. However, at present all this remains mere speculation, as climatic change in this region of the world is under ongoing investigation.

The evidence for local agency of East Javanese water management adduced in this study, contradicts earlier findings of J.G. de Casparis, who observed increasingly centralizing tendencies within the state between the tenth to fifteenth century. It also complicates the idea of a linear trajectory of ever-increasing centralization of Southeast Asian states as suggested by world-historians like Victor Lieberman. Van Naerssen and Boechari, both also dealing with the role of the state, proposed a two-layered structure consisting of the king (the *rakai* who could unify other *rakais* into the kingdom, after which he called himself *mahārāja*) and a group of local rulers (*rakai*s or *rakryan*s of several villages or *watěk*). The relationship between these two levels was interdependent, but politically speaking, the local rulers were autonomous. Jan Wisseman Christie refined this structure by adding another layer, thus arriving at the three levels of *kraton*—*watěk*—*wanua*, or court—group of villages—village. This study does support Jan Wisseman Christie's conclusion that the horizontal connections at the *wanua* level were much closer than the vertical connections between the *kraton* and the *watěk*s. Because several villages (w*anua*s) were bonded together in a *watěk* (group of villages), it was easy for the members of

the *watĕk* to create networks and make horizontal connections.

Overall, the results of this thesis support the layered interpretation of Wisseman Christie. Figure 6.1. shows the relationship between the court and the villages. It highlights the self-organizing principles of the local communities as represented by local officials. The majority of water management activities, which are planning, constructing, maintaining, and securing infrastructure, were managed by local communities and local rulers.

Records from the Seloliman inscription of 1358 CE and the Kaputran inscription of 1355 CE give explicit examples of water tunnel constructions that were initiated by villagers; in these cases they are named Tiga Kaki and Ki Pupuh Hālaḥ Papan. Above all, responsibility for managing, maintaining, and securing it were all the responsibility of local officials. Most of these officials, such as the *hulair/hulu bañu, hulu wuatan, mananbańi*, *matamwak,* and *jukuń,* worked for a local ruler such as a *rakryan* and so had the authority to control and regulate water resources and infrastructure. Moreover, security measures surrounding the water infrastructure were in the hands of people who lived near that infrastructure, and the court demanded the participation of the local community in developing precautions and safeguards to protect the construction from being destroyed by natural disasters or human action. This is seen in the Kamalagyan inscription of 1037 CE, in which the safeguarding of the dam and dyke was in the hands of the nearby community. The village water enterprise also created a network of water users between neighbouring villages. Most likely, the water network came into existence when water users from different villages used the same water source, such as a dam or a canal.

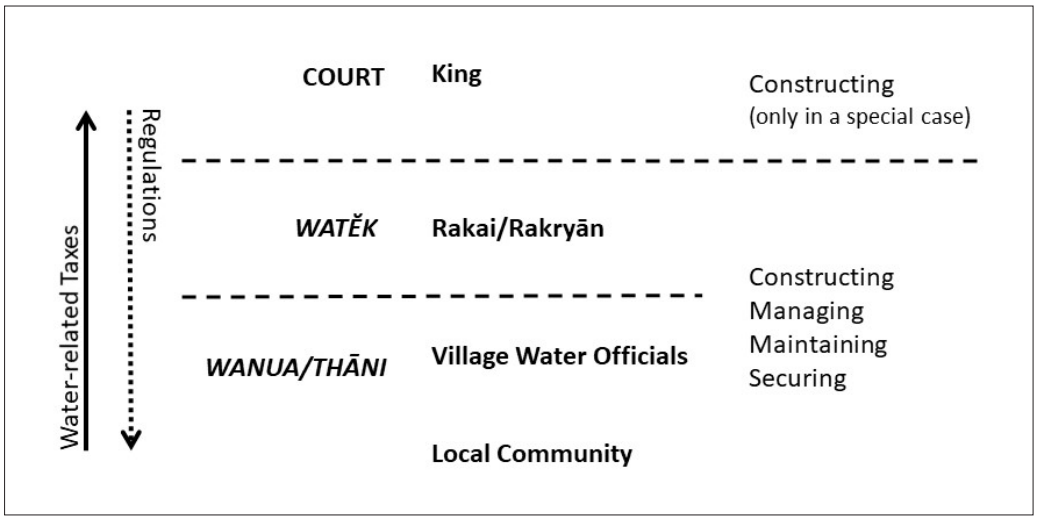

Fig. 6.1. Water management bureaucracy of East Javanese states. (Schema by Tjahjono Prasodjo)

The only exception was when the East Javanese court intervened in the restoration of a dike, a flood-preventing embankment, on the bank of the Brantas river, as reported in the Kamalagyan inscription. The reason behind this intervention was not only to prevent and protect people's land from flooding but also, and primarily, to secure the state from any economic decline resulting from crop failure and the disruption of river trading traffic. Thus, the intervention was motivated by fear of deprived revenue from transportation and crop taxes which might cause a shortage of liquidity.

More direct state intervention can also be observed at the level of water transportation. Epigraphical evidence strongly suggests a Majapahit state that tries to regulate the logistics of water transportation. Figure 6.2 maps the East Javanese transportation network, showing a hierarchy of port types along the Brantas river. Port A is located at the mouth of the river, near the sea, and functioned as an entrepôt for overseas trade. According to the Caṅgu inscription (1358 CE) from the Majapahit period, this port is Śurabhaya. Port B is situated near the capital and served as a gateway through which traders visited the capital in order to do business. It can be ascertained that this port was located in Caṅgu, an important port in the Majapahit era. The capital of the Majapahit Kingdom was located further upstream in Trowulan, at a point that is at the closest interface between irrigated fields and riverine transport. Port C sat on a confluence between the main river

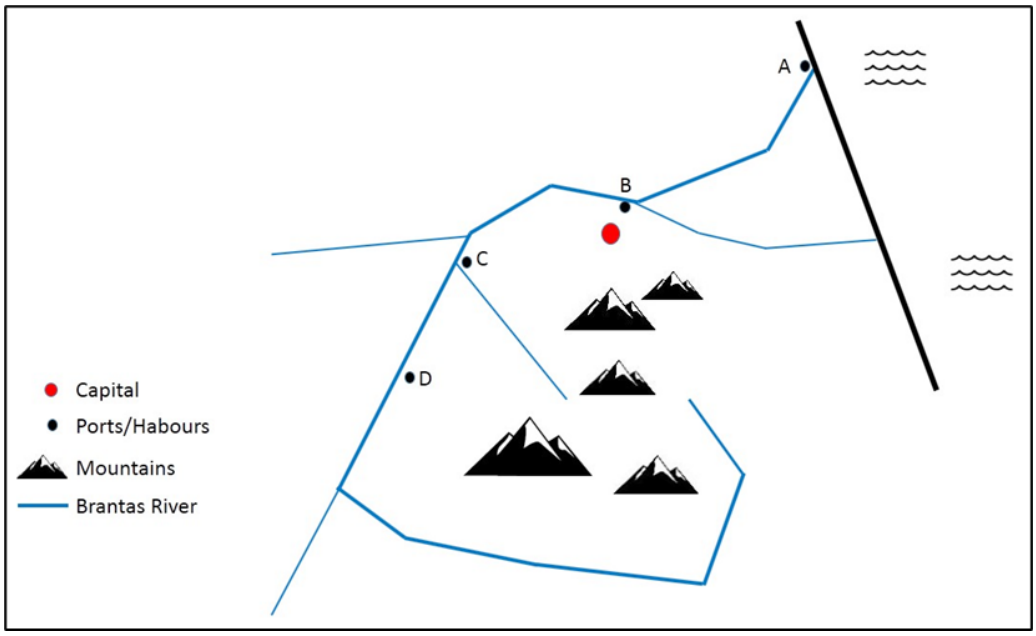

Fig. 6.2. The network of connectivity between capital and river ports in the Majapahit era. (Map by Tjahjono Prasodjo)

and one of its tributaries and served as a meeting place for river- and hinterland traders who used the tributaries to transport their goods. One of the ports which is mentioned in the Caṅgu inscription is Mabuwur. Similar to port C, port D was also a port that was a meeting point, but one to which hinterland traders transported their goods overland. Ports, such as Mireṅ and Pagḍaṅan, acted as D types of ports in Majapahit era. Rice and other natural products reached these ports from areas across the river basin and, especially, the fertile regions, such as the floodplains and slopes of the Penanggungan, Arjuna, Welirang, and Kelud mountains.

Although we have stressed that East Javanese polities, including Majapahit, should be perceived as a decentralized realm consisting of dispersed *watěk*s, we also witness a state that was perfectly able to control its realm by leaving the practical water management at the level of the *watěk*s and *wanua*s. A more remote control was exercised by taking control at certain riverine choke points at the very interface of the kingdom's settled and mobile resources. This kind of indirect control through taxation and regulation was facilitated by the increasing importance of maritime trade which created more sources of more liquid income for the state. Overall, at least from the point of view of water management, this thesis strongly suggests that the kings of Majapahit and other East Javanese kingdoms were in a position to rule a decentralized polity. Compared to the states of mainland Southeast Asia, the East Javanese polity makes a much more decentralized impression in which the state, by regulating the riverine transport system, merely oversees a political economy that was driven by the bottom-up initiative of local communities.

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Summary

The PhD thesis discusses the relationship between the central courts and local communities in the constructing and managing of water systems in the Brantas river basin between the tenth and the sixteenth centuries CE. Moreover, the study looks into what extend Java's specific longue durée conditions of topography and climate have determined these systems, exploring the temporal and spatial dynamics of the system. Nearby systems as existed in mainland Southeast Asia are compared with the systems in East Java. Although employing a comparative approach, the focus of this research is about East Java itself.

The primary sources that are used in my research are divided into two types of sources, namely old Javanese inscriptions and archaeological records. For the first group, around 80 such inscriptions have been studied, all of which relate to water management in ancient East Java and dating back from the eighth to fifteenth centuries. The second group of sources used are archaeological records. The archaeological remains I employ within this thesis are mainly found in the Brantas river basin, from its headwater to its delta, both in the highland and the lowland zones. The type of archaeological evidence includes canals, dams, reservoirs, tunnels, underground tunnels, ditches, wells, water pipes, water-spouts, as well as images shown by temple reliefs. These archaeological records were acquired through field surveys in 2016 (in Trowulan, Mojokerto, Sidoarjo, Pare, Kediri, and Malang) and through library research using academic studies, Dutch colonial reports, and related books.

An examination of ancient water management in mainland Southeast Asia is used to observe how a particular physical geography of river basins contributed to the shaping river-basin polities. A comparative approach was conducted by the method of cross-national comparison between ancient polities in Burma, Thailand and Cambodia at the one side, and in East Java at the other side. This method of comparison sought a better understanding of ancient water management in Southeast Asia. The exploration of water management in the said three regions of mainland Southeast Asia resulted in an affirmation of the assumption that the particular relationship between political power and water management is correlated with geographical characteristics, the state's economic base as an agrarian state, climate change, and the socio-political structure of the region.

The initial enhancement of the East Javanese water management was marked by the time when the Javanese political centre shifted from the Central Java to the East Java. The shift of the political centre triggered by a combination of a climate change and a volcanic disaster occurred around tenth century in Central Java. After the shift, the polity had to deal with new environmental challenges in the East Java, mainly because of the existence of Brantas river, although there was less instability than in Central Java. The basin of Brantas river where the political centres of the East Javanese kingdoms located from tenth to sixteenth century experienced dynamics of its hydrological systems which have evolved due to a variety of natural and anthropogenic influences, including changes in land and water use caused by human inhabitation, agriculture, climate change, modifications to water infrastructure, and water use.

On the basis of inscription records, the governmental system of East Javanese polity consisted of three levels, namely *kraton—watĕk—wanua*, or court—group of villages—village which in the system villages were autonomous. Moreover, the horizontal relations at the *wanua* level were much closer than the vertical relations between the *kraton* and the *watĕks*. Since a *watĕk* was a group of several villages, it was easy for the members of the *watĕk* to create networks and make horizontal connections. This system correlated with the water management system that the water management in the basin of Brantas river was influenced by the governmental system and naturally adapted its autonomous local authority. The East Javanese water management applied self-organizing principles of local communities as represented by local officials. Most water management activities, which are planning, constructing, maintaining, and securing infrastructure, were managed by local communities and local rulers. The responsibility for managing, maintaining, and securing were in the hands of local officials. The officials, such as the *hulair/hulu bañu, hulu wuatan, mananbańi, matamwak*, and *jukuṅ*, worked for a local ruler such as a *rakryan* and so had the authority to control and regulate water resources and infrastructure. People surrounding the water infrastructure secured and protected water infrastructures from being destroyed by natural disasters or human action. The exceptions were occurred in two direct state interventions, in regulating logistics of water transportation and in securing agricultural land from a natural disaster. The motif behind these interventions due to avoid deprived revenues from transportation and crop taxes which might cause a shortage of liquidity.

The East Javanese Polities in the Brantas river basin should be considered a decentralized area consisting of scattered *watĕks* and villages. The research of this thesis strongly suggests that the East Javanese polities was perfectly able to control its realm by leaving the practical water management at the level of the *watĕks* and villages. By comparison to the polities of mainland Southeast Asia, the East Javanese polity merely oversees a political economy that was driven by the bottom-up initiative of local communities, so the East Javanese polity suggests and reflects a much more decentralized polity than the mainland Southeast Asian polities.

Samenvatting

Het proefschrift bespreekt de relatie tussen het centrale hof en lokale gemeenschappen bij de aanleg van waterbeheersystemen in het stroomgebied van de Brantas rivier in oostelijk Java tussen de tiende en de zestiende eeuw. Een belangrijke beginvraag daarbij is: in hoeverre hebben Java's specifieke *longue-durée* omstandigheden van klimaat en geografie dit waterbeheerssysteem bepaald? Vervolgens moeten we ons afvragen op welke manier het Javaanse waterbeheersysteem zich ontwikkeld heeft, te beginnen in Centraal Java, vervolgens in Oost-Java rondom de Brantas. Om de meer specifieke kenmerken van dit systeem beter te kunnen begrijpen zullen een aantal theorieën over de relatie staat-en-waterwerken worden besproken en zal vervolgens een vergelijking worden getrokken met de ontwikkeling van waterwerken op het vasteland van Zuidoost-Azië.

De in dit onderzoek gebruikte primaire bronnen kunnen worden onderverdeeld in twee soorten bronnen: (a) inscripties en (b) archeologische vondsten. De eerste groep bestaat uit een tachtigtal inscripties in het Oud-Javaans, die allemaal betrekking hebben op de waterhuishouding in Oost-Java daterend van de achtste tot de vijftiende eeuw. De archeologische overblijfselen van de tweede groep zijn voornamelijk te vinden in het stroomgebied van de Brantas rivier, van de bovenloop tot de delta, zowel in het hoogland als in het laagland. Het soort archeologisch bewijsmateriaal omvat kanalen, dammen, reservoirs, (ondergrondse) tunnels, sloten, waterputten, waterleidingen, waterspuiers en tempelreliëfs. Deze archeologische gegevens zijn voornamelijk in 2016 verkregen door veldonderzoek in Trowulan, Mojokerto, Sidoarjo, Pare, Kediri en Malang, en door uitgebreide bestudering in diverse bibliotheken van primaire en secundaire bronnen, van Javaanse kronieken en koloniale rapporten tot meer recente archeoplogische rapportages en moderne studies.

Het onderzoek naar oude stelsels van waterbeheer op het vasteland van Zuidoost-Azië is ingezet om te kijken hoe de fysieke geografie van bepaalde stroomgebieden heeft bijgedragen aan het ontstaan van specifieke gemeenschappen langs deze stroomgebieden. De comparatieve benadering leidde tot een grensoverschrijdende vergelijking tussen de watersystemen van Birma, Thailand en Cambodja. De uiteenzettingen over het waterbeheer in de genoemde drie regio's van het vasteland van Zuidoost-Azië bevestigen dat de relatie tussen politieke macht

en waterbeheer een sterke correllatie heeft met de geografische en klimatologische kenmerken van het betreffende gebied.

Het vergelijkend perspectief wordt vervolgens voortgezet met een onderzoek naar mogelijke historische antecenten in het watersysteem van Midden-Java. De stelselmatige ontwikkeling van het waterbeheer in Oost-Java begon immers in de tijd dat het politieke centrum van Midden- naar Oost-Java verschoof. Dit werd veroorzaakt door een combinatie van klimaatverandering en de rampzalige vulkaanuitbarstingen die rond de tiende eeuw Midden-Java teisterden. Na die machtsverschuiving kreeg het staatsbestel in Oost-Java te maken met nieuwe milieu-uitdagingen die voornamelijk te maken hadden met ontwikkelingen van de Brantas rivier – deze waren minder dramatisch dan in Midden-Java en leidden tot minder instabiliteit. De politieke centra van de Oost-Javaanse koninkrijken waren gelegen aan de Brantas rivier, en in de tiende tot zestiende eeuw waren deze centra onderhevig aan de dynamiek van de hydrologische systemen, die waren geëvolueerd als gevolg van een verscheidenheid aan natuurlijke én menselijke invloeden.

Na het schetsen van deze bredere comparatieve en historische context richt het tweede deel van deze studie zich meer specifiek op de waterwerken rondom de Brantas rivier in Oost-Java. Uit inscripties blijkt dat het Oost-Javaanse staatsbestel een bestuurssysteem had dat uit drie niveaus bestond: *kraton-watĕk-wanua*, of te wel bovenaan het hof, dan een cluster van dorpen en onderaan de eenheid van een bepaald dorp. In dit bestuurssysteem waren de dorpen tamelijk autonoom. Ook blijkt uit deze inscripties dat de horizontale relaties op *wanua*-niveau veel nauwer waren dan de verticale relaties tussen *kraton* en *watĕks*. Omdat een *watĕk* een groep van verschillende dorpen was, was het voor de leden van de *watĕk* gemakkelijk om hun eigen netwerken te creëren en horizontale verbindingen aan te gaan. Dit decentrale en indirecte bestuurssysteem leidde tot een overeenkomstig systeem van waterbeheer in het betreffende stroomgebied van de Brantas rivier. Bij het Oost-Javaanse waterbeheer werden zelforganiserende principes toegepast, waarbij de coördinatie tussen lokale gemeenschappen werd verzorgd door lokale functionarissen. De meeste waterbeheersactiviteiten hadden betrekking op de planning, de aanleg, het onderhoud en de beveiliging van de infrastructuur. Dit proefschrift toont aan dat al deze activitieten onder het beheer van lokale gemeenschappen en leiders vielen. De betreffende functionarissen, zoals de *hulair/hulu bañu, hulu wuatan, mananbańi, matamwak* en *jukuń*, werkten voor een lokale heerser zoals een *rakryan*, die het gezag had om de watervoorraden en de infrastructuur te reguleren en te controleren. De mensen die in de buurt van bepaalde waterwerken woonden, zorgden er zelf voor dat die beveiligd en beschermd werden tegen vernietiging door natuurrampen of nadelig menselijk handelen. Directe overheidsinterventies vinden we alleen bij het reguleren van de logistiek van het supra-regionale transport over water en ook, meer incidenteel, bij het herstel van waterwerken na meer grootschalige rampspoed. Het motief achter

dit soort overheidsingrijpen was voornamelijk fiscaal van aard: het vermijden van gemiste inkomsten uit handel en landrente.

We zien dat de Oost-Javaanse staten in het stroomgebied van de Brantas een gedecentraliseerd bestuur kennen, uitgevoerd door clusters van dorpen, de *watěks*, en, op het laagste niveau, het dorp (*wanua*, ook wel *dessa* genoemd). Het onderzoek van dit proefschrift toont aan dat de Oost-Javaanse vorsten heel goed in staat waren hun rijken te besturen juist door het praktische waterbeheer over te laten aan de *watěks* en de *wanua's*. In contrast met de meeste situaties in de drie onderzochte staten op het vasteland in Zuidoost-Azië wordt in het Oost-Javaanse staatsbestel slechts centraal toezicht gehouden op het politieke bestuur van de plaatselijke economische eenheden, die succesvol functioneerden dankzij het bottom-up initiatief van de lokale gemeenschappen. Anders dan de situatie op het vasteland van Zuidoost-Azië wordt het Oost-Javaanse staatsbestel dan ook gekenmerkt door een gedecentraliseerd staatsbestel dat is gebaseerd op de *watěk*, op regionaal niveau, en de *wanua*, op lokaal niveau.

Curriculum Vitae

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