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

Prasodjo, T.

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,

---

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/ lĕbalĕb: 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.