Water Management, Patronage Networks and Religious Change: New evidence from the Sanchi dam complex and counterparts in Gujarat and Sri Lanka

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Introduction

As described in earlier papers (Shaw & Sutcliffe 2001; 2003) sixteen ancient dams in the Vidisha and Raisen districts of Madhya Pradesh, central India were documented during a multi-phase archaeological survey carried out between 1998 and 2000 (Shaw 2000; In press -a, -b). Covering about 750 km², the survey centred upon Sanchi, and included the four other known Buddhist sites of Morel-khurd, Sonari, Satdhara and Andher, all established between c. 3rd and 2nd centuries BC (Fig. 1). The discovery of a large number of previously undocumented Buddhist sites, habitational settlements, rock-shelters, and sculptures provided a social and religious context for understanding the dams. The latter vary in height from 1 to 6 m, in length from 80 to 1400 m, and in reservoir volume from 0.03 to 3.0 m³x10⁶. In spite of their variety, they appear to have been constructed to a height sufficient to ensure that the reservoir volume would be in accordance with the volume of runoff from the upstream catchment of each site. The dams were well constructed, with an earthen core, and usually strengthened with masonry protection on the upstream face. Preliminary terminus post quem dates of between 1st century BC and 5th century AD were provided by nāga (serpent) sculptures located on or near some of the embankments (Shaw and Sutcliffe 2001, pp. 68-71). Other chronological pointers were provided by morphological factors such as stone-facing type, and the dates of associated settlements and Buddhist sites. On this basis, the earliest phase of construction was dated provisionally to between 3rd and 1st century BC, with others up to 5th century AD or later. These dates require verification through excavation and the analysis of buried soil surfaces (cf. Myrdal-Runebjer 1994; Risberg et al. 2002).

Hydrological and archaeological analysis of the Sanchi dams has led to a number of preliminary propositions regarding their agricultural and socio-economic function. First, they were built to provide irrigation, possibly for rice, as a response to the increased population levels suggested by the distribution of settlements and Buddhist sites. Secondly, their configuration in relation to the wider archaeological landscape provides an empirical basis for suggesting that they were part of a cultural package that accompanied the spread of Buddhism, urbanization and the development of centralized state polities between c. 3rd and 1st centuries BC. Thirdly, similarities with intersite patterns in Sri Lanka where monastic landlordism is attested from c. 2nd century BC onwards, have led to the suggestion that the Sanchi dams were underlain by similar forms of exchange networks between the saṅgha and the local laity. The main aim of this paper is to develop these ideas further drawing on the results of follow-up fieldwork carried out in 2002. The new material to be presented includes additional evidence relating to spillway design and construction; irrigation function and associated land use; and the length of time over which dam construction or repair continued, following the examination of masonry in the channels through the dams. New theories regarding the patronage of the irrigation works will also be presented, based on the style and distribution of associated nāga sculptures. We will argue that in addition to being representative of the local nāga cult, they doubled as symbols of the local Nāga dynasty whose political prominence in the area is attested by numismatic and epigraphical sources. The suggestion that the Nāgas, as the principal local oligarchy, were closely connected with the patronage of Buddhist sites and dams fills a significant gap in the understanding of local political history: to date this has been based on pan Indian dynastic forces whose relationship to localised polities is poorly understood. Finally, the relative configuration of nāga sculptures, dams and Buddhist sites, is important for assessing the applicability of current theories regarding the relationship between “local” and “pan Indian” religious traditions.

In addition to recording new field observations in the Sanchi area, we will also draw on comparative archaeological and hydrological evidence from Gujarat.
1. Map of Sanchi area.
and Sri Lanka, discussed only briefly in our earlier papers (Shaw and Sutcliffe 2001; 2003). In 2002, the opportunity was taken to visit Junagadh in Gujarat, where the inscription of the Ksatrapa ruler, Rudrādāman, refers not only to the earlier construction and subsequent improvement of the dam during the Mauryan period, but also its successive repair as flood damage occurred (Kielhorn 1905-6). Later repairs are also mentioned in the inscription of Skandagupta (Bhandarkar 1981c; Fleet 1888). Known for over a century from these inscriptions, the physical remains of the dam were only located on the ground relatively recently (Mehta 1968). The main aim of our visit was to verify Mehta’s archaeological claims, which appear not to have been fully incorporated into subsequent historical scholarship. The second aim was to draw on possible technological and historical links between the dam complexes in Sanchi and Gujarat. Comparisons are also possible with the more or less contemporary developments in the dry zone of Sri Lanka, where information is available on advances in dam construction and control structures from c. 3rd century BC onwards (Parker 1909; Brohier 1934 (reprint 1979)). Although the scale of the larger Sri Lankan reservoirs is considerably greater than the Sanchi examples, and the hydrological backgrounds are different, there are historical and technical similarities between the two developments. These inter-regional comparisons shed considerable light on the possible history and function of the Sanchi dams, as well as the administrative systems that lay behind their construction and upkeep. They also provide the basis for building an integrated model of religious and social change, our principal hypothesis being that the control of water harvesting and irrigation facilities was not only a means of political legitimisation for local rulers, but also formed a central component of the Buddhist saṅgha’s propagative strategies.

PART 1 – New evidence from the Sanchi dam complex

Recent field observations

Dam structure

In the course of our recent re-inspection of the Sanchi dams, profiles of four of the larger embankments were measured (Figs. 2-3). The upstream face is generally
much steeper than the downstream face which is relatively flat, with a typical gradient of about 1:10; in the case of the lower dams, there is the possibility that the profile was designed to limit damage in case of overtopping. Studies have shown that the use of homogeneous earthen cores is possible in clay-rich “black cotton soils” areas such as central India. Although such soils are liable to cracking and therefore reducing the stability of the dam, the possibility of breaching (and leakage) is often reduced by early monsoon rains which cause the clay to expand and seal the cracks (Agrawal and Narain 1997, p. 167). Panabokke (pers. comm., 2003) has suggested that the complex masonry facing in the Sanchi area, not generally found in Sri Lanka, serves to counteract the seasonal cracking of these soils. The facing is largely confined to the upstream side and in particular to the middle portion of the face where the reservoir water level would fluctuate. In a number of cases, facing was also noted on the downstream side. It is interesting to note that at Devrajpur, one of the larger dams, the main masonry facing is supplemented by a lining of smaller fragments (Fig. 4), presumably in order to provide filtration behind the masonry.

**Spillways and sluices**

During the visit, particular attention was paid to evidence of spillways (often described in south Asian literature as ‘waste weirs’) and sluices. E.g., a previously observed spillway on the right abutment of the Devrajpur dam (Shaw and Sutcliffe 2001, fig. 12) was examined in more detail. Where the embankment reaches the outcrop, a channel about 10 m wide and 1.3 m deep has been excavated in the rock, with curved masonry restraining walls at the entrance. Several cross-sections of the spillway channel were made, from which the discharge has been estimated on the basis of a broad-crested weir. An approximate estimate of a 50-year return period flood, based on 50-year daily rainfall of 240 mm over a basin of 13.5 km² and a runoff coefficient of 70%, would correspond with a flow of 26 m³/s and a water depth of about 1.5 m. Thus the spillway would be adequate for a 50-year flood without overtopping of the embankment. Moreover, as will be noted later, the 500-year flood is likely to be a relatively low multiple of this flood.

As mentioned in our earlier papers, similar spillways often with temporary dams inserted, are described in the Sri Lankan literature (Parker 1909). Specific examples will be discussed later. Comparisons with spillways in Gujarat (Mehta 1963; 1968), to be discussed in detail below, were also made. Further support for the evidence of a spillway at Devrajpur was provided by the discovery of an almost identical feature at the right (northern) abutment of the Morel Kala dam.
5. Morel Kala: spillway (with quarrying marks visible in lower left corner).

(Fig. 5). It occupies a gap of 13.5 m between the dam and the adjoining hillside, and as indicated by quarrying marks visible in places, appears to have been deliberately lowered to its present level, that is about 1.5 – 1.8 m below the crest of the dam. With a similar catchment area of 12.8 km², this would pass the flood of a similar return period or frequency without overtopping.

Similar rock-cut spillways have not been located at the other late or high dams. However, the evidence of smaller dams in Sri Lanka, discussed later, suggests that rock outcrops adjacent to embankments, could have provided natural spillways without excavation. Also, evidence could have been destroyed by modern roads as at Sanchi, or by modern reconstruction and the building of modern spillways at Chandra and Gulgaon; it is significant to note that the design and location of the simple modern spillway at the northern end of the Gulgaon dam (Fig. 6), positioned about 1.5 m below the dam crest, is not dissimilar to the spillways at Devrajpur and Morel Kala.

In addition, the earlier and lower embankments could have relied on a reasonably level top, so that any overtopping would be distributed over a wide section of the downstream face, limiting the depth and thus the effect of spill. However, there is evidence for multiple breaching at some of these sites, in particular the two smaller dams between Sanchi and Gulgaon. When higher and potentially more vulnerable dams were built somewhat later, spillways were excavated to minimise the risk of damage.

“Monumentalized” control structures: reuse and repair
Further patterns to the present appearance of the dams in the Sanchi area were also noted. They are usually pierced by a stream channel at the deepest point in the dam, or in other words at the natural drainage point for the dam catchment. The clearest examples of this pattern can be seen at the three highest dams, Sanchi, Devrajpur and Morel Kala (Fig. 1). At Sanchi, the main feeder pierces the smaller of the two dams at its southern limit; at Devrajpur at its western, and at Morel Kala at its southern limit. In all cases, except for those sites where recent reconstruction has occurred (e.g., Chandra and Gulgaon), there is clear evidence for the dam having failed at some time in the past. The location of this failure, at the deepest point of the dam where it is pierced by the main feeder stream, points to flood damage as the main cause.

It is interesting to note that a number of sites have remains of masonry at this point. At Devrajpur, a number of light buff sandstone blocks (both plain and decorated) which appear to have been part of a standing structure, were found in the middle of the main feeder stream. According to locals, an inscribed block was also found, but unfortunately its present location is no longer known. Most of the carved pieces can be compared with mouldings from post-Gupta temples throughout Madhya Pradesh: a torus moulding (Fig. 7) is datable to c. 7th century AD on account of its upturned profile, a feature which in later years is usually replaced by a simple semi-circle. Another 7th century indicator is the semicircular curve above the torus; by the 8th century this usually becomes square. A close comparison can be found on the 7th century Siva temple at Mahua (Willis 1997, p. 37, fig. 3, nos. 2-3; pl. 1). The simple knobs on the eave moulding (Fig. 8) are also a characteristic of Pratihāra temple architecture. Such mouldings most commonly occur on temple śikharas, the implication being that there was a Pratihāra period temple somewhere on the dam. This would not be surprising considering the widespread tradition in India of building temples next to streams and tanks. However, this possibility is lessened by the fact that no other Pratihāra remains were found on the dam itself; Brahmanical and Jain architectural and sculptural fragments were found.

10. Morel Kala: Pratihāra temple fragments reused in feeder stream structure.
approximately midway along the dam, but these belong to later temples datable to c. 9th/10th century AD. An alternative explanation is that they formed part of a monumentalized control-structure, although this is not necessarily a mutually exclusive suggestion; i.e., it may also have incorporated shrine-like elements. This suggestion is strengthened by the fact that their location at the most vulnerable part of the dam is in keeping with patterns from other parts of south Asia: as discussed later, the repair and upkeep of dams is often commemorated in a monumental manner due to the merit (both ritual and social) associated with such acts (Morrison 1993; Venkayya 1906).

At Morel Kala, remains of a similar, wall-like structure, consisting of over 22 courses of masonry, were noted in and on either side of the main feeder channel (Fig. 9). Whether it was part of a spillway or control structure, or of attempts to repair damage, is not easy to determine in view of the fragmented nature of the remains. The fact that both dams have spillways excavated in the rock abutments would possibly have reduced the need for additional spillways at the deepest point of the dams. However, additional support for the suggestion that in both cases we are dealing with some kind of control structure is provided by the evidence for repeated repair at Morel Kala: fragments from a post-Gupta temple (c. 7th or 8th century) were noted in the upper four courses of the structure (Fig. 10). This suggests that the dam must have still been in use, and that it continued to be repaired in the period following the Muslim conquests when, we may assume, the temple in question was destroyed. This is not to preclude the possibility, however, that the temple was destroyed by flood action some time before the pre-Sultanate period. Whichever the case, the question of whether the dam was in use continuously from its original construction or whether this represented a later revival cannot be determined without excavation or geoarchaeological investigation. Further consideration of these issues will be given later.

**Sluices**

As noted in earlier papers, no clear evidence for a sluice or outlet has been found at any of the Sanchi dams, although it is hoped that excavation might shed light on the subject. It is possible that the smaller dams used simple pipes that would have left little in the way of archaeological remains. However, more complex facilities were probably needed at the larger dam sites. In later years these systems could have developed along the lines of the Sri Lankan *bisokotuva* sluice and its close equivalents at later south Indian dam sites. At Vijayanagara, for example, water was discharged through pipes laid at bed level, and regulated by the vertical movement of a stone board attached to a rod (Davison-Jenkins 1997). It is interesting to note that at Sanchi there is evidence of a rectangular structure near the upstream face of the smaller of the two dams with masonry remains on the opposite downstream face. Thick undergrowth precluded any conclusive identification, but it is hoped that further investigation will confirm whether any parallels with the Vijayanagara systems can be drawn.

**Irrigation function**

In earlier papers we suggested that the Sanchi dams were built for irrigating crops in the downstream fields. However, one unusual, and puzzling feature of at least two of the dams was noted during the recent field study. At the western end of the Sanchi reservoir, that is along the larger of its two dams which runs between Nagauri and Kacchi Kanakhera hills, the ground level downstream of the dam is higher in elevation (by approx. 1.5 to 2.0 m) than the upstream level. The same applies to the length of the Dhakna dam. It is not easy to suggest an explanation without excavation or aerial prospection. At least at Dhakna, it is difficult to see how the dam could have been used in the later stages of its life for irrigation downstream; it was possibly operated to provide upstream flooding, which could be used to grow crops on the soil moisture. Another explanation is that silt, on being removed from the reservoir, was deposited on the fields downstream, leading in time to the higher ground levels seen today. This may even have occurred some time after the tank had ceased to be in operation. It is significant to note that with several regional variations, the collection of silt is central to reservoir use throughout south Asia. E.g., in Gujarat, it has been suggested that some of the ancient dams in the Devnimori area may have been used as “siling ponds” (Mehta 1963, p. 354). In south India, the main purpose of endowments recorded in the Cola and Pallava dam inscriptions was to pay for regular desiltation (Venkayya 1906). This was because excessive siltation would eventually render the reservoir useless; silt also doubled as an effective fertilizer for the surrounding fields. It is important to stress, however, that siltation does not seem to be a particular problem in this part of Madhya Pradesh. Nevertheless these examples are useful for highlighting the levels of administration needed to run the dams, and as discussed later, also shed light on the link between economic decline and the eventual abandonment of irrigation works. More apt analogies come from traditional land-use practices in Madhya Pradesh such as the *Haveli* system. Designed specially for local clay-rich black cotton soils, this was until recently a common agricultural practice in the upper Narmada valley. Its main function was to collect monsoon runoff in order to maximise the moisture content of the soil over the dry season (Agarwal and Narain 1997, pp. 166-75). Water
would be stored behind 1 to 3 m high bunds, and drained off several days before sowing. It would then be distributed from one field to another until it joined the natural drainage or reservoir (Ibid. 167). Consequently, no further water would be required throughout the growing season. It is possible that some of the smaller dams in the Sanchi area were used in this way. The main point that emerges from the foregoing account, thus, is that there was possibly more than one type of reservoir-based irrigation system throughout the region.

Land use
Another anomaly of the Sanchi dams noted in previous papers is that their storage capacity is at variance with the irrigation needs of present day farmers. Since historical times, local agriculture has been based primarily on rain-fed wheat cultivation. The near absence of irrigation is usually attributed to the high moisture storage capacity of the local black cotton soils, which are recharged by the annual monsoon rains and provide sufficient water to carry the wheat crop from planting to maturity. In recent years some supplementary irrigation has been applied to increase yields, but this has relied on cheap on-field pumping of shallow ground water. However, there is another, less frequently discussed factor: compared to other parts of India, eastern Madhya Pradesh is relatively underpopulated, mainly as a result of a series of catastrophic famines since the 14th century; the notorious drought of 1899 – 1900 is said to account for many of the abandoned settlements in the area (Imperial Gazetteer, vol. ix, pp. 374-5). As noted by Watt (1889, vol. 6, p. 151), the low intensity of local agriculture may have more to do with demography than soil type: it is likely that any significant rise in population would bring about increased production demands and hence the need for irrigation. This raises obvious questions regarding land-use practices prior to the demographic changes outlined above. The most significant point is that according to archaeological survey data for the Vidisha area, settlement density during the early-historic period was significantly higher than it is today. Moreover, the abundance of sculptural fragments and the remains of elaborate temple architecture throughout the area, presents a striking contrast to the overwhelmingly rural appearance of present-day villages. Both of these factors reflect the wider processes of urbanization and political centralization that began with the expansion of the Mauryan empire in c. 3rd century BC, and attested both archaeologically and epigraphically at Sanchi and Vidisha. Secondly, most of the surrounding hilltops are covered with extensive Buddhist remains, datable to c. 3rd/2nd centuries BC. Today, they lie empty, with settlements restricted to the lower slopes or intervening valleys. Both of these processes, that is urbanization and the establishment of large monastic communities, would have exerted significant pressure on local resources; a useful avenue for future research would be to estimate how many monks resided at each monastic centre, in order to measure the impact that Buddhist propagation had on local population densities.

Decline/disuse
By extension, this line of enquiry may also shed light on whether there was any causal link between the decline of Buddhism and the eventual disuse of local irrigation schemes: although the relatively recent depopulation is an important factor, the earlier disappearance of monks, sometime after the 10th century AD, must have had a significant impact on the local economy. As noted earlier, it seems that flood damage rather than sedimentation was the likely physical cause of disuse, sedimentation not being a known problem in the Sanchi area. Additional explanations for the decline of the dams might include factors such as the collapse of associated administrative systems. Interesting parallels are provided by the Cola and Pallava inscriptions, whose principal aim was to record terms and conditions for desiltation (Davison-Jenkins 1997, p. 93). In many cases, it was the drying up of these sources of patronage that led to the eventual abandonment of the reservoirs (Venkayya 1906). In the Sanchi area, changes in the local economy following the decline of Buddhism in c. 10th century AD might have led to a similar breakdown; without the monasteries there would have been less pressure on agricultural production, and changes in patronage networks might have caused the reservoirs to cease to operate as irrigation works. This is not to suggest that some of them did not continue to be used for other purposes such as domestic water supplies, as implied by the evidence at Morel Kala, for example. However, it appears that their final abandonment probably resulted from the radical depopulation following the series of recorded famines from the 14th century onward. Other late factors might include the destruction of the massive Bhojpur lake in 1434 by Hoshang Shah (Dey 1965, p. 55; Appendix c, p. 419-421). It is hoped that future archaeometric research will clarify some of these questions.

The Sanchi dams: social, economic and religious considerations

A rice-based culture?
Our working hypothesis therefore is that the Sanchi reservoirs were built in c. 3rd-2nd century BC in order to increase agricultural output and support the increased population levels indicated by local settlement patterns. Their main function was irrigation, but this does not preclude the possibility that they doubled as domestic...
water-supplies, animal watering-holes, or fish sources. A major question, however, is whether they were built to irrigate pre-existing wheat crops, or whether they were part of a new land-use system, such as wet-rice cultivation. Both are possible suggestions: it is generally accepted that in most parts of India artificial irrigation can increase agricultural output by as much as 30% (Brown 1912, p. 8; Davison-Jenkins 1997, p. 92). However, while today it is relatively simple to provide supplementary irrigation of say 50 mm by pumping recharged ground water where it is required without the need for canal transfer, it would require a complex and extensive canal system to distribute this water from a reservoir over a large area, which would be 20 times as large as the concentrated area of rice cultivation on which a depth of 1000 mm might be required. The high costs involved in constructing and maintaining the dams would have made more sense if they were used for rice cultivation, largely because of the dramatically increased depth and intensity of irrigation. Other factors include the superior yields and nutritional value of rice relative to irrigated wheat. To construct dams and canals to improve wheat yields would seem illogical compared with bringing new land into cultivation, especially when the availability of cultivable land was not a limiting factor in the area.

The foregoing suggestion requires verification through pollen and phytolith analysis, especially because there is no recorded tradition of commercial rice production in the area. Current archaeobotanical research suggests that the epicentre of rice cultivation in ancient India was the Gangetic valley, with evidence for domesticated rice going back to the second millennium BC or earlier (Ghosh and Chakrabarti 1980; Fuller 2000). Limited samples from the Ujjain area in western Madhya Pradesh, and the Deccan suggest that its westward spread did not occur until the early-historic period, and that it formed part of a larger cultural package including urbanization and Buddhism that radiated out of the Gangetic valley. Analyses of early Brahmanical and Buddhist texts show that rice was not only central to the Gangetic valley diet; it also had a whole range of ritual, medicinal, and economic uses (Ghosh and Chakrabarti 1980). Rice was considered an auspicious item in Brahmanical ritual; it was also an important object of donation within the Buddhist context. More indirect references to paddy fields and rice cultivation in Buddhist texts, either as the backdrop to particular narratives, or as a metaphor for Buddhist practices, suggest that in eastern India the earliest Buddhist sangha, along with the earliest city dwellers, grew up within a predominantly rice-growing culture. The major question, however, is what happened when large communities, either monastic or otherwise, moved into non-rice-growing areas? Given the far-ranging importance of rice, from every-day meals to funerary ceremonies, it is not unlikely that some would have wanted to cultivate it in these new areas. For ordinary people the desire for familiarity may have been the main reason; for monks there may have been others. E.g., future avenues of research that would involve ethnographic research and detailed textual analysis include the question of whether wheat or rice was considered more suited to monastic aims. Secondly, textual evidence such as references in the Dhammapada (xxvi. 21) to rice being donated to the sangha by all sections of society, suggests that rice played an integral role in the earliest exchange systems between monks and lay populations. It would not be surprising if these systems were reproduced in new areas with rice figuring prominently in the sangha's propagative strategies.

**Buddhism and agrarian policies: “monastic landlordism”**

The theological response to both of these questions might not be difficult to predict: because monks are supposed to eat whatever is put in their begging bowl, they would have little power in influencing their daily diet. Such a view is based on a “passive” model of Buddhism (eg., Conze 1951), which sees the sangha's participation in social relations as a distortion of its original position as a body of renouncers, concerned solely with individual enlightenment. Evidence for “monastic landlordism” in Sri Lanka has been important for building a more “active” model of Buddhist propagation: many of the ancient dams there bear inscriptions linking them to nearby monasteries whose involvement in agrarian modes of production as instruments of lay patronage, played a major role in the emergence of socially integrated monasticism from the 2nd century BC onwards (Gunawardana 1971). These inscriptions show that Buddhist monasteries were in possession of large tracts of property, including irrigation works and fields, donated by local chieftains (paramakas) as well as private donors (Ibid., p. 24; Paranavitana 1970, vol. I, pp. lxii; lxxxiv). Buddhaghosa, writing some centuries later, describes how the sangha, having received an irrigation work as a gift, would take over the responsibility of its management and profit-control, while local farmers would be granted access to the irrigation works as long as they paid a certain “percentage” of their yields in the form of a “donation” to the sangha (Samantapäśādikā, vol III, p. 697; Gunawardana 1979, pp. 57-9). Monasteries were thus ensured the proceeds from land irrigated by their own tanks, or else given privileged access to others' tanks. By making the monastery the focus for the “accumulation of property and the concentration of administrative authority” (Ibid., pp. 72-3), the sangha assured itself a secure livelihood without compromising canonical rules.
that prohibit monks from participating in agriculture. The dynamics of monastic landlordism thus unfolded through a “three-way mutually beneficial relationship” between patrons, monks and farmers (Gunawardana 1971, p. 24). The success of this arrangement was further ensured by the donation of “service villages” (aramikagama) or “maintenance villages” (bhogagama) which provided constant supplies of labour to the saṅgha (Gunawardana 1979; Culavamsa 46.15). Since it represents a “multicentred society with power devolving on the gentry and the monastic institutions” (Gunawardana 1971, p. 26), this system offers a convincing alternative to the traditional view, borne from a combination of text-based analyses and the theories of Wittfogel (1957), that “Asiatic hydraulic civilisations” were dependent exclusively on centralised, state-controlled forms of administration.

Furthermore, the Sri Lankan material provides a crucial key for understanding the saṅgha’s movement away from “passive”, mendicant forms of monasticism. Monks moved into new areas with a practical tool: the key to sophisticated irrigation for maximizing rice yields. They were not so much concerned with “converting” local populations, but rather offered a set of practical incentives for locals to give their economic support to the monastery. The promise of religious merit (puñyā) is usually posited as the main incentive for buying into this new scheme; there were also worldly advantages such as the promise of increased yields and improved nutrition. Given that the central tenet of Buddhism’s Four Noble Truths is the omnipresence of human suffering (dukkha) as well as its causes and means of alleviation, the fact that the saṅgha’s scheme could also help to alleviate some of the more “mundane” and common causes of suffering, poverty and famine, appears to be more than coincidental. Following this line of logic, one may view the saṅgha’s involvement with irrigation and rice-cultivation as part of a very practical form of evangelism that tackled suffering on an everyday, subsistence level.

Models of religious change in south Asia

“Ritual” v. “functional” approaches

The early history of Buddhist propagation in Sri Lanka therefore differs somewhat from traditional models of religious change in ancient India. The primary focus of the latter has for the most part been on “ritual” dimensions of religious experience, resting heavily on Brahmanical examples of “cultural assimilation” or “Sanskritisation”. Of particular interest has been the saṅgha’s appropriation of local nature spirits, drawing from textual accounts of the Buddha’s subordination, and ultimate ‘conversion’ of powerful nāgas and yāksas. Further insights into the importance of nāga worship within Buddhist practice come from the writings of the 5th century AD Chinese pilgrim, Fa Hsien, who describes monks worshipping at nāga shrines inside monastic compounds in order to ensure adequate rainfall and to protect against “plagues and calamities” (Cohen 1998, p. 377-8). According to Cohen (Ibid., p. 374-80), the well-known nāga shrine in cave 16, Ajanta, would have been worshipped in a similar way. Although Cohen interprets such practices as part of the saṅgha’s localisation strategies, or as a form of “generalised” exchange with local populations, the wider “practical” or economic incentives behind “Buddhist” nāga worship are not examined in any detail.

For more “functional” models of religious change one may refer to studies of the spread of Islam or Christianity. Eaton (1993), for example, has shown how the acceptance of Islam in east Bengal was intricately tied up with the introduction of new agrarian schemes. This type of religious change was not just a reflection of political or economic change; nor did it represent a transplantation of a fixed religious system onto a “passive” community. Rather, it involved a complex relationship between “economic base and ideological superstructure” (Ibid., p. 297), whereby the “ideology of forest-clearing and agrarian expansion, [served] not only to legitimise but to structure the very socioeconomic changes taking place on the frontier” (Ibid., p. 267). In contrast to the traditional “conversion by the sword” theory, Eaton (Ibid., pp. 218, 264) argues that this system was not overtly concerned with “conversion”, but rather accommodated largely “non-Brahmanized” communities, which in turn aligned themselves with the Muslim tradition of merging agrarian expansion with religious building activity; whenever a new village was founded, a temple would be established according to the religious affiliation of the local landlord, while the construction of a mosque would ensure that the economic and ideological links with the hinterland are combined with political ties to the state. Similarly, in Sri Lanka, the saṅgha appears not to have been overtly concerned with conversion. Rather, by setting a precedent for the interplay between land-ownership, agrarian production and religious building activity, the monastery served two interests: for local society it acted as an agent for economic development; and for the saṅgha, it enabled the propagation of Buddhist ideology into the most interior areas.

Monasteries, dams and monasteries in the Sanchi area: an integrated model of religious change

Having pointed out the differences between “functional” and “ritual” or “deity based” models of religious change, it is not to suggest that the two are necessarily mutually opposed. Indeed as shown by the foregoing discussion, both models are empirically identifiable at ancient
Buddhist sites. Quite how they related to each other is another question, which has informed our examination of the archaeological patterns in the Sanchi area. As yet, there is no way of “proving” that monastic land-lordism was prevalent in the Sanchi area; we noted previously that no inscriptions have been found that shed light on the kind of patronage networks and modes of administration which underlay the construction, upkeep and management of the reservoirs. The first point to note, however, is that the dams’ “monumentality” closely rivals that of even the largest monastic structures in the area, showing therefore that the latter were not the only large-scale construction projects during the early centuries BC. Insights into the levels of manpower involved in their construction may be provided at a future stage by comparing their volume with that of major stūpas and monasteries. For the present purpose, a preliminary comparison between the dam below Sanchi hill, and the main stūpa 1, shows that the volume of the dam is approximately nine times that of the latter. This rather crude comparison needs to be tempered with consideration of the high costs generated by the elaborate railing and gateway carvings on stūpa 1. However, it gives an indication of the significant size of investment represented by local dam-building programmes. Quite clearly, the high investment involved in the construction of the dams would only have made sense if an efficient system for ensuring profitability was already in place.

Secondly, the relative configuration of monasteries, reservoirs and settlements is so similar to Sri Lanka that there are grounds for suggesting that they were underlain by a similar socio-religious system. As shown in Figure 1, ten of the dams bear a direct spatial reference to monastic sites. Marshall’s reluctance to deduce any connection between the irrigation reservoir below Sanchi hill and local Buddhism (Marshall et al. 1940, p. 13) was based largely on a reading of early Buddhist texts such as the Anguttara Nikāya (V, 17), which prohibit monks from owning or managing agricultural land. However, the consistency with which the spatial dynamics of the “early-historic complex” are repeated throughout the Sanchi area provides an empirical basis for suggesting some form of interdependent exchange network between local oligarchs, landowners, labourers and monks.

Nāga sculptures in the Sanchi area: Buddhism and “local” agricultural cults

This view is supported further by the distribution of nāga sculptures which in most cases are located on top of, or close to, ancient dams. Typically they are anthropomorphic with serpent coils up the back and a canopy of serpent heads above the head. Their importance in terms of providing terminus post quem dates of between mid 1st century BC and 5th century AD for the dams was discussed in earlier papers. Two additional suggestions are posited below: first, that even during the pre-Gupta period when all such nāgas are situated outwith the formal boundaries of hilltop monastic complexes, their position within the wider “early historic complex” justifies viewing them as part of the “Buddhist landscape”; and secondly, that they doubled as symbols of the local Nāga dynasty who appear to have been closely connected with the patronage of dams and Buddhist sites in the area.15

Beginning with the issue of their spatial positioning, at first glance there is little to suggest any real connection with neighbouring Buddhist sites: the first time that any parallel can be drawn with the patterns observed by Cohen at Ajanta, or Fa Hsien in eastern India, is during the Gupta period, when there is evidence for the construction of nāga shrines within the monastic complex on Sanchi hill itself.16 Prior to this period, they are all situated at a removed distance, as typified by the 1st century BC nāga at Nagauri which in its present position would have stood at the edge of the now dried up reservoir between the Nagauri and Sanchi hills. However, its position is less at odds with later patterns than it at first appears: once the Buddhist monuments on Sanchi hill are viewed within their wider socio-religious landscape including the reservoir and settlement at Nagauri, then the nāga also ceases to be ‘external’ to the monastic complex. More importantly, the nāgas are situated next to reservoirs because of their association with water and fertility; we already know from Fa Hsien’s accounts that by the Gupta period at least, nāga shrines were placed within monastic settings precisely because of this association; there is thus no reason why the nāga shrines on the dams wouldn’t have been treated in a similar way by monks.

Another point which initially seems to shed doubt on the link between Buddhism and nāgas during the early period is that some of the pre-Gupta nāgas follow the iconographic programme of Balarāma-Sanikarṣana, of the chief deities of the Pāñcarātra system one of the Bhāgavata tradition, a prototypical form of Vaiṣṇavism. In keeping with other early Balarāma images in north India (Joshi 1979), most are shown with a plough (hala) in one hand, and a pestle (mūsala) in the other (Shaw and Sutcliffe 2001, fig. 13). As mentioned later, while Balarāma-Sanikarṣana and his younger brother Vāsudeva-Kṛṣṇa were depicted in aniconic form at the 2nd century BC Heliodorus pillar site in Vidisha, Balarāma’s manifestation as a nāga is thought to be a later development involving a process of “cultic assimilation” into the Bhāgavata tradition. There is a danger here, however, of extrapolating back into the past from a set of connections that may only have been formalised in later years. We cannot assume, for
example, that during the 1st century BC, the sectarian link between Balarâma images dotted around the countryside, and the aniconic depictions of the Pâñcarâtra deities in Vidisha was an established fact.17 Balarâma is, after all, a deity of fertility and agriculture. Simply put, he is a nâga with the addition of a plough and pestle, it being of no coincidence, given our hypotheses regarding local rice cultivation, that the mûsala is traditionally associated with the pounding of rice paddy (Joshi 1979, p. 45). To local inhabitants, the question of his possible sectarian affiliations may have been of little concern. Rather, he would have been seen as a nâga standing at the edge of a water body where nâgas belong! The first time that the Vaiśnava orientation of nâga sculptures becomes very explicit is during the Gupta period when many are shown either as Viṣṇu himself, or otherwise with attributes closely associated with Viṣṇu (Shaw Forthcoming). As mentioned above, this is also when nâga shrines become incorporated into monastic compounds for the first time. The assumption is, therefore, that Buddhist monks were less concerned with the nâgas’ shifting sectarian affiliations than with their inherent ritual power, that is, the ability to ensure adequate rainfall and in turn, agricultural success. As attested by the aforementioned textual accounts, this force was an ambivalent one which if not treated properly could also bring about the opposite effect. It follows, therefore, that nâga worship was part of Buddhist practice, not because the saṅgha sought to ‘convert’ local populations, but rather because its effects were in harmony with the saṅgha’s wider economic concerns with agrarian production as an instrument of lay patronage.

Patronage of the Sanchi dams

Putting aside the issue of whether we can posit a causal link between the construction of the dams and the establishment of Buddhism, the crucial question is “who were the principal patrons who paid for their construction?” Here we shall argue that the nâga sculptures had a deeper political significance, as symbols of the dynasty of the same name. In order to explore this issue further, it is necessary first to summarise what is known of the area’s political history between c. 3rd century BC and 6th century AD, the main period of interest in this paper. According to the received historical framework, the period is usually divided into four main phases: Mauryan (c. 3rd century BC), post-Mauryan or “Śûṅga” (c. 2nd to 1st century BC), Sâtavâhana/Ksâtrapa (c. 1st to 4th century AD), and Gupta (c. 4th to 6th century AD). However, as we shall see below, it is important to temper these broad dynastic categories with more localized power dynamics. It is in this respect that we shall consider the role of the rather elusive Nâga clan, powerful local oligarchs who appear to have played some role in the patronage of the dams and Buddhist monuments in the area.

Political history: the “pan Indian” dynastic framework

The earliest epigraphical evidence in the area is the Asokan pillar at Sanchi which provides a time-frame of c. 269-232 BC for the first Buddhist monuments there (Marshall 1940, p. 287).18 Also datable to the Mauryan period is the earliest archaeological evidence for urbanization at nearby Vidisha,19 when it is supposed to have developed into the capital city of Ākara, formerly known as eastern Avânti.20 The histories of Buddhism and urbanism in the area appear therefore to have been closely interlinked.21

The second major epigraphical marker in the area, this time connected to the Pâñcarâtra system of the Bhâgavata tradition, is the Heliodorus pillar inscription just to the north of Vidisha.22 The inscription refers to the erection of a Garudâ pillar by Heliodorus of Taxila, an ambassador of the Indo-Greek king Antialcidas; it also mentions his local host, a king called Bhâgabadra. Although the genealogy of the latter is problematic, coins bearing the name Antialcidas have been found in the north-west, and dated to c. 115-80 BC (Bopearachchi 1989, pp. 63-4). In many historical accounts, the period following the dissolution of the Mauryan empire in c. 232 BC is usually referred to as the “Śûṅga” period. This designation draws largely on textual accounts which describe Puṣyamitra “Śûṅga” as the successor to the Mauryan empire. He is thought to have ruled from Pataliputra, while his son, Agnimitra, resided as viceroy in Vidisha (Kalidasa’s Mâlavikângamitra. V, 370). There are also suggestions that Vidisha later became the Śûṅga capital, following the Indo-Greek invasion of Pataliputra (Sircar 1969, pp. 20, 59-60). This view is based largely on theories which identify Bhâgabadra of the Heliodorus pillar inscription as the 5th ruler of the Purânic list of ten Śûṅga kings (Sircar 1965, i. 88, no. 2). A second inscription refers to the construction of a Bhâgavata temple by king Bhâgavata, generally identified as the 9th Śûṅga king of that name (ASIAR 1913-14, p. 190).23 Reference should also be made to the inscription at Bharhut which mentions Dhanabhuti of the Śûṅga kingdom (Sircar 1965, i, p. 87; Majumdar and Pusalker 1954, pp. 95-8). It should be stressed, however, that given the paucity of textual or epigraphical references to the “Śûṅga” dynasty (Majumdar and Pusalker 1954, pp. 95-8), it is probably better to stick to the less specific term “post-Mauryan”. Further, the nature of the ‘state’ at this time remains somewhat obscure. That it might have been less centralized than traditionally assumed is suggested by the discovery of large numbers of “tribal coins” bearing the names of what may have been autonomous city-states (Bopearachchi and Pieper 1998, p. 35). The two
most important series are those bearing the name Bhagila, and Kurara, both of which appear to have been located in the Vidisha area. The latter is probably related to Kurara, the most frequently mentioned place in the Sanchi donative inscriptions, and may correspond to Kurawar village to the north of Vidisha (Singh 1990; Willis 2000, p. 59). These suggest that even if the “Śūṅgas” were ruling from Vidisha, their authority may only have been of a titular nature. The other major point is that this is the most prolific period of building activity at Sanchi; it is also the time when Buddhism makes its presence felt in the surrounding countryside. Even if we accept the as yet unproven theory that Pusyamitra was inimical towards Buddhism, this appears not to have had a detrimental effect on the sangha’s expansionist activities. As attested by the donative inscriptions at Sanchi, the second phase of Buddhist propagation seems to have been funded by collective patronage more or less independently of the state. Further, there is evidence to suggest that one of the sangha’s principal financiers at this time was the Nāga clan, who as we shall argue below also appear to have been closely connected with the dams discussed in this paper.

During the third major phase, c. 1st to 4th centuries AD, the control of central and western India oscillated back and forth between the Sātavāhanas and their long-standing rivals, the western Ksatrapas. By the first half of the 1st century AD, Malwa appears to have been incorporated into the Sātavāhana empire, with its base in the Deccan. This is attested by the discovery of copper coins bearing the name Sri Satakarni (or Sata) at Vidisha, Ujjayini and Eran (Cribb 2000, p. 45). The same name is also mentioned in the inscription on the top architrave of the southern gateway at Sanchi (Marshall 1940, p. 342, inscrip. 398). As demonstrated by the Rudradāman inscription at Junagadh, the Sātavāhana were ousted temporarily by the Kṣatrapas during the 2nd century AD (Sircar 1969, p. 67). By the mid 3rd century AD, the Vidisha area had also come under Kṣatrapa rule, as attested by coins belonging to Rudrasena II (c. AD 255-78) (Jha and Raigor 1992, pp. 38, 71). It has never been convincingly demonstrated whether the Kusāṇa empire, which covered most of the Gangetic valley and the north-west, also included this part of Malwa. That this may have been the case has been suggested by an inscription carved on the pedestal of a seated Bodhisattva figure at Sanchi (Marshall 1940, pp. 387-8, inscrip. 828; pl. 124b). Three other images carved from Mathura sandstone have been found at Sanchi. All of these, however, appear to have been imports from the Mathura region. By contrast, a significant number of locally produced Kuśāṇa style sculptures, including nāgas, were documented throughout the surrounding countryside during the first author’s regional survey (Shaw and Sutcliffe 2001; Shaw Forthcoming). We should beware of confusing dynastic and stylistic categories, and as stated above there are no grounds for inferring the presence of the actual Kuśāṇa dynasty. What is clear, however, is that the Kṣatrapas were still in control of the area during the late 4th century AD, as attested by the Kanakherha well-inscription. This describes the construction of a well by the Saka chief, Mahādāna Anāyaka Śrīdhara-varman, referred to as a “righteous conqueror” (dharmā-vijayi) (Sircar 1965, pp. 186-7; Ep. Ind., XVI, 230-3; CII, IV, 13-16; Marshall 1940, pp. 392-3, inscrip. 839). The same ruler is also mentioned in a lesser known inscription from Eran to which we will return later (CII, IV, 605-11).

The fourth major phase is the Gupta period (4th to 6th century AD), towards the beginning of which the Kṣatrapas were ousted from the area. Samudragupta’s (c. AD 376-412) Allahabad pillar inscription alludes to the subjugation of Śaka Mahākṣatrapa Rudrasena III during the mid 4th century AD (Bhandarkar 1981a, pp. 10-17), while his Eran inscription attests to the conquest of east Malwa (Sircar 1965, pp. 268-70; Bhandarkar 1981b). The final victory over the western part of the Kṣatrapa dominions, however, did not take place until Chandragupta II (c. AD 376-412); Vidisha appears to have played a significant role as the launching place for this event. This is attested by the inscription in cave 4 at Udayagiri, GE 82 (AD 400/01), which records the commissioning of the shrine by Sabavirasena, minister of Chandragupta II (CII, III, 34-6; Sircar 1969, pp. 271-2).

**The local situation: the Nāga Clan**

While the foregoing summary helps to place Vidisha’s political history within a broad dynastic framework, relatively little is known about how these pan-Indian forces played out at a local grassroots level. We already know from the Bhagila and Kurara series of coins mentioned above that from c. 2nd century BC local tribal leaders were issuing their own city coins, but how these leaders interacted with the larger political forces is still unclear. Similar uncertainties surround the Nāga dynasty, which from at least the 2nd century AD appears to have been one of the most prolific coin-issuers in the Vidisha area; thousands upon thousands of tiny copper Nāga coins have been unearthed at Vidisha (Bhandarkar 1914, 210-11; 1915, p. 88). Taken together with other numismatic, epigraphical and textual evidence, it has been argued that the dynasty originated in Vidisha during the second half of the 2nd century AD, from where it moved north to Mathura, Pawaya, and Kāntipuraya, the three major Nāga centres mentioned in the Viṣṇu Purāṇa. Although their later history is relatively well attested from indirect references in Gupta and Vākāṭaka inscriptions, quite how they related, chronologically or politically, to earlier dynasties such as the Kṣatrapas has not been examined in any detail.
Important insights are provided, for example, by the Śrīdhara-varman inscription from Eran mentioned earlier, which records the erection of a memorial pillar (yaṣṭi) by his military commander (senāpati), a Nāga chief from Maharashtra called Satyanāga (Mirashi, CII, IV, 605-11). This reference supports the image of the Nāgas as a powerful oligarchy with family ties extending far beyond the Vidisha-Eran orbit, and with close allegiances to the Ks.ātrapā authority. There are also strong grounds for suggesting that the Nāgas were already connected with the Vidisha area during earlier periods. The main indicator to this effect is the high number of Nāga-related names in the 1st century BC donative inscriptions at Sanchi. Hitherto these have been interpreted solely within a religious framework, being seen as evidence for the strong influence of local cultic practice in the area (Schopen 1996). Given the prevalence of nāga sculptures discussed earlier, this may well be the case. However, it is not unlikely that both the nāga images and the Nāga appellations in the inscriptions also referred to the local dynasty of the same name.

The strongest indications to this effect occur during the Gupta period, when three major developments in the style and context of nāga images are discernible. The first two have already been mentioned: their incorporation into monastic contexts, and their iconographic recasting from Balara-ma to Viṣṇu. A third development that is intricately bound up with the second, is an increasing ‘royalization’ of nāga iconography. Both of the latter are well illustrated by the free-standing nāga at Ferozpur (Fig. 11). Its similarity to the two Viṣṇu images in cave 6, Udayagiri has already been pointed out by Joanna Williams (1976). It no longer wears the distinctive triple crested turban of the earlier Balarāma images, but rather the kirīṭa mukatā crown of Viṣṇu. The kirīṭa mukatā as a symbol of “noble birth” (Sircar 1966, s.v) may be seen as one of a series of “royal” emblems that during the Gupta period become associated with certain deities, as a part of the legitimising strategies of powerful rulers (Cohen 1998, p. 398; Kulke 1993, p. 11). Another “imperial” reference at Ferozpur is the large lotiform bell-capital surmounted by

11. Ferozpur: Nāga sculptures, c. 5th century AD.
two back-to-back nāga-nāginī couples. Its similarity to the Budhagupta pillar at Eran was noted by Williams (1976, p. 174). This and other Gupta pillars embodied a much older imperial symbology developed during the Mauryan period. E.g., the small capital at Sanchi with its two pairs of addorsed lions (Williams 1982, pl. 141) is a direct copy of the better-known Mauryan original to the south of stūpa 1. In the light of the Guptas’ archaizing tendencies, it is quite possible that the back-to-back arrangement of the nāga-nāginī capital at Ferozpur was also intended as a pun on the original Asokan pillar at Sanchi. Certainly, the transposition into a sculptural idiom usually reserved for symbols of royalty or for “orthodox” deities provides strong evidence of the reorientation in the ritual and political status of the nāga cult during the Gupta period. Further suggestions of royal status include lalitāsana, the position of “royal ease” in which one of the new Gupta nāgas in the area is depicted (Shaw Forthcoming).39

The conflation of identities of Nāgas as kings and nāgas as deities, may have been a competitive reference to the Guptas’ symbolic identification with Viṣṇu, as epitomized by the sculptural programme at Udayagiri (Willis, in press). The possible political connotations of the famous Varāha panel at Udayagiri have been discussed by various authors;40 of particular relevance here is the suggestion that the supplicant nāga figure showing kneeling at Varaha’s feet may be a reference to the changing dynamics between the Gupta and Nāga dynasties discussed below (Bakker 2002, 17). Further, Willis has convincingly shown that the site was intricately bound up with astronomical principles aimed at predicting key events in the agricultural year; the manipulation of water, in particular, seems to be a key element at the site (Willis, in press). Given the Guptas’ known involvement in agrarian expansion in the form of Brahmanical land-grants, it is tempting to see an additional layer of meaning in the relationship between Varāha and the nāga in the Udayagiri panel. Both are shown emerging from the primordial waters, with the nāga being pushed back down with the force of Varāha’s foot on his head: could it be that the Guptas are presenting themselves as the new masters of the land, thus usurping the position of the local Nāgas, who as we have seen, appear to have been closely connected with the Sanchi reservoirs?41 This association is most apparent during the Gupta period, but was probably already in place much earlier, as attested by the Nāga coins at Vidisha and the Nāga appellations in the Sanchi inscriptions. Further evidence to this effect is provided by the spatial and chronological link between nāga/Balārāma sculptures and dams from the 1st century BC onwards.

As just mentioned, these developments should be seen side by side with wider epigraphical evidence, discussed in detail by Hans Bakker (1997; 2002), for the Nāgas’ relationship to the Gupta and Vākātaka dynasties. That the Nāgas came to wield considerable political clout in their own right is suggested by Samudragupta’s (AD 350-376) pillar inscription at Allahabad, which describes the “uprooting singly and in a moment”, and the “forcible extermination” of sections of the Nāga dynasty (Bhandarkar 1981a, pp. 10-17; Bakker 1997, pp. 10-11).42 It has been suggested that the three Nāga kings mentioned by name, Achyuta, Nāgasena and Ganaṇapati, were part of a coalition aimed at putting down Samudragupta. In Bhandarkar’s words, “that the formation of this confederacy was a great menace to the Gupta power and that its destruction was consequently regarded as the greatest of Samudragupta’s military feats is inferred from the fact that this achievement alone has been described in the verse portion with which the Allahabad pillar inscription begins” (Bhandarkar 1981a, p. 11). This inscription is part of a larger body of evidence which demonstrates the Nāga’s political standing by the 5th century. Even following their defeat by Samudragupta, they were obviously considered too dangerous to have as enemies. This is illustrated by the marriage, possibly as an act of pacification, between Candragupta II and one of the Nāga princesses, Kuberaṇāga. Their daughter, Prabhāvatī was married into the Vākātaka family, and subsequently became a formidable ruler in her own right following the premature death of her husband, Rudrasena II. These developments formed the basis of an intricate confederacy between the Gupta, Nāga, and Vākātaka houses during the 5th century AD (Bakker 1997, p. 11). Although the Guptas clearly kept the upper hand, Prabhāvatī’s mixed political and family alliances probably played some part in elevating the political position of her Nāga relatives back in Vidisha (Bakker 2002, pp. 1-3). For instance, her daughter was married off to Prabhāvatī’s half-brother, Ghatotkaca, the viceroy in Vidisha during the reign of her other brother, Kumaragupta (415-454 AD); this ensured that by the time Ghatotkaca’s nephew, Skandagupta (455-467), came to the throne, the three-way Gupta-Nāga-Vākātaka alliance was already intricately intermeshed (CII, III, 276-279).43

In later years, a battle over the throne ensued between Skandagupta (Kumaragupta’s bastard son) and his uncle Ghatotkaca; it has been argued that “the Guptas [at Vidisha] may have been supported by Nāga feudatories who hadn’t yet forgotten their defeat by Samudragupta and were biding their time” (Bakker 2002, p. 17). Bakker suggests that this would have led to the re-enforcement of the “old Vākātaka-Vidishā-Nāga axis”, the Nāgas here being Ghatotkaca’s allies rather than his adversaries, as assumed by earlier writers (Ibid., n. 62; CII, III, p. 81).44 Bakker argues that there may be
some allusion to the ensuing tensions between the western and eastern halves of the Gupta empire in Skandagupta’s Junagadh inscription which refers to the forging, at his order, of an effigy of Garuda “which rendered, devoid of poison, the serpent rulers [ie the Nägas] who uplifted their hoods in pride and arrogance” (Bhandarkar 1981c, pp. 299, 302; Fleet 1888, pp. 56-65). These wider epigraphical allusions to the Nägas as powerful oligarchs with political influence extending far beyond the ‘local’ sphere, thus support the view that they were connected with the patronage of dams and Buddhist sites from an early period, and were represented in the form of nāga sculptures.

PART 2: Comparative framework: Gujarat and Sri Lanka

The Sudarsana lake, Junagadh

A better understanding of the agricultural, religious and political significance of the Sanchi dams is provided by comparisons with other early dams in south Asia. As noted previously, the closest comparison within India itself is the Sudarsana dam at Junagadh, Gujarat. Described in detail in the Rudrada-man inscription (Kielhorn 1905-6), and again in that of Skandagupta (Bhandarkar 1981c; Fleet 1888), its existence has been known for over a century. However, the dam itself was only discovered relatively recently (Mehta 1968), and even so, this important discovery has yet to be properly assimilated into historical scholarship. We felt therefore that a visit to Junagadh was necessary in order to confirm Mehta’s claims, and to assess whether the archaeological evidence might throw light on the likely fate and possible duration of the Sanchi dams. First we shall give a brief summary of the epigraphical evidence before going on to describe the physical remains of the dam. Finally we shall describe the dam’s immediate archaeological setting, which, taken together with references in the inscriptions, sheds further light on the intertwined relationship between political authority, water management and religion in ancient India.

The Girnar Rock inscriptions

The most vivid description of the dam, and the devastating storm that destroyed it, occurs in the inscription of Rudrada-man. Dated to the Saka year 72 (= AD 150) during the reign of Mahâksatrapa Rudrâdana, it is carved next to the earlier Asokan edict on a massive boulder below Girnar hill (Burgess 1876, p. 94, pl. IX) (Fig. 12). Its main subject is Rudrada-man’s repair of the Sudarsana dam (setubandhen) following its destruction
during a violent storm. Details of the dam’s earlier history are also given: its original construction during the reign of Chandragupta Maurya, by the provincial governor, the Vaisya Pusyagupta; and subsequent improvements involving the addition of conduits during the reign of Asoka, by his provincial governor, the “Yavana king”, Tušāspa (Kielhorn 1905-6, p. 41). Rudradāman states that the object of the repairs was to increase his “religious merit and fame (l. 15)”°. By positioning his meritorious act alongside those of his powerful Mauryan predecessors, the Ksatrapa leader is making a clear demonstration of his political stature. The monumentality of his act is magnified further by the provision of an elaborate inventory of neighbouring regions incorporated into his kingdom. Included in this list is Ākaravantī, the area in which Sanchi is located. This tradition is continued by Skandagupta whose repairs during the Gupta year 136 (= AD 455) are recorded in an inscription carved on the same rock (Fleet 1888; Bhandarkar 1981c), and followed by a long list of rival rulers subjugated by him. Taken together with the distribution of Asokan edicts at Sanchi and Junagadh, both the Rudradāman and Skandagupta inscriptions show that the two areas were part of an interlinked political orbit from at least the Mauryan period. This provides strong justification for comparing the irrigation systems of the two areas.

**Physical remains of the Junagadh dam**

According to Mehta (1968) who located the dam by correlating geographical features on the ground with references in the Rudradāman inscription, the dam ran from the northern foot of the medieval fort (Uparkot), extended northwards and then curved around towards the hills in the northeast. Most of the middle and southernmost sections have been destroyed, but Mehta was able to identify two remaining sections of earthwork. The southernmost section abuts the northern side of a rock-cut cave complex called Khapra Kodia. Neither the functional nor chronological relationship between the latter and the dam was explored by Mehta. This important issue, which sheds light on the ideological element of water management at Junagadh, will be discussed in more detail later. Another section of the dam abuts the ridge to the northeast, on the far side of the Sonrekh stream (Fig. 12). Mehta gives the average height of the embankment as 17 m, extending from 10 m above ground level behind the caves, to 22 m above the bed of the Sonrekh stream. After inspection, we suspect he may have included the natural ridge, and have assumed therefore a more realistic average height of 10 m. Mehta estimates the area of the lake as being just over 1 km² (Ibid., p. 24). On this basis, we can estimate a volume of 5 m³ x10⁶; this is larger than many of the Sanchi dams, but is of the same order as the larger works. Our own examination of the embankment for the most part confirmed Mehta’s findings; additional findings were also made, and revisions suggested, particularly regarding some of Mehta’s attempted correlations between physical remains and epigraphical descriptions.

The embankment behind the cave complex, which still has some masonry facing near its top, appears to be at about the same level as the portion of embankment beyond the stream (Fig. 13). That the former was artificial was confirmed by the discovery of pottery embedded in its core. However, the stretch of dam to the northeast of the Sonrekh stream appears to be a combination of man-made and ‘natural’ forms. Pottery noted in the core immediately abutting the bank of the stream confirms that it is artificial at this point, but its northeastern extent appears to be an integral part of the natural escarpment. It is probable that this feature corresponds to the term akritrimena setubandhen used in the Rudradāman inscription, which translated, means a “natural” or literally “non artificial” dam (Kielhorn 1905-6, l. 2). As mentioned above, most of the middle section of the dam, to the south-west of the main Junagadh-Girnar road, is now missing. Although Mehta suggests storm damage as the main culprit, it is important to note that most of this area is covered by a deep quarry. Burgess (1876, p. 145) mentions that the quarry was still active in the 19th century and that it had cut into sections of the Kakra Kodia complex. It is possible that parts of the dam were also destroyed in the same way.

**Spillways and sluices**

Mehta (1968, p. 24, fig. 2) also claimed to have found the physical remains of the “waste-weir” or spillway described in the Rudradāman inscription as “parivōha”. The feature in question is located to the east of the right abutment of the dam, which as mentioned above, appears to be an outcropping of the “natural” ridge. The weir itself is described as “a deep cutting in the rock”, and appears to be similar to those already described at Devrajpur and Morel Kala in central India. Similar weirs were also noted by Mehta (1963, p. 359) in the Devnimori area. Inspection of the site revealed a “natural” (ie, unexcavated) ravine (c. 10 x 10 m in plan) in between the main ridge/“dam” and the adjacent hillside (Fig. 12). This gap appears to have been built up artificially with a bank of earthen material so as to reach c. 5 m below the crest of the ridge. It is possible that this may originally have formed a “temporary dam” as found for example at so many of the Sri Lankan reservoirs. However, although this would be a logical site for a spillway, without a contour survey it is not possible to clarify whether the channel is at the right level.

Mehta (1968, p. 26) also attempted to locate the pranālī mentioned in the Rudradāman inscription. He appears to be misled, however, by the assumption that
the term corresponded to a canal which he goes on to suggest would have been located at the headwater, where the rock-inscription is situated. There appears to be little logic in this suggestion: when the reservoir was below full level, there would be no water near the headworks; somewhere near the dam on the south end would make sense, unless they had a more sophisticated sluice, which could be anywhere along the dam. However, as pointed out in our earlier paper, the term is more likely to have referred to a simple sluice than a canal: the literal meaning of pranāli is “pipe”; this probably implies a small channel for distributing water to the downstream fields, which would leave little in the way of archaeological remains.

The Sudarśana lake in the landscape: dam building, kingship and religion

Attention was also paid to the dam’s immediate archaeological setting in order to provide a comparative framework for the inter-site patterns in the Sanchi area. The first point is that the placement of Rudradāman’s inscription next to the earlier Aśokan edict is not coincidental. Although there is no specific reference to the reservoir in the latter, Aśoka’s involvement in the upkeep of the dam is clear from the historical details in Rudradāman’s inscription. Further, the positioning of the rock, at the headwater of the reservoir is a symbolic embodiment of the intertwined nature of the religious and the social in the world of the ideal Buddhist king. Aśoka, as a Cakravārtin or “World Emperor”, is responsible for ensuring the “order” (dharma), both socially and cosmically, of his empire. The provision of irrigation in order to nurture the earth and feed his people, is also in keeping with the Cakravārtin ideal. The important point, though, is that his royal authority is dependent on religious legitimization, that is through following the dharma and having the approval of the Buddhist sangha. This factor is embodied in the content of Aśoka’s rock-edicts both here at Junagadh and further afield. Although the acts of Rudradāman and Skandagupta are no longer couched in a Buddhist framework, the element of religious legitimization is also powerfully evident in their inscriptions. Rudradāman’s alignment with the orthodox Brahmanical tradition is expressed in his use of purely classical Sanskrit verse, allegedly the first inscription in ancient India to do so. Skandagupta’s inscription is also framed within an explicitly orthodox framework; the first part of the record begins with an invocation to Viṣṇu, followed by five verses in praise of Skandagupta; verse 2 refers to an effigy of Garuḍa, while the second part records the construction of two Viṣṇu temples on mount Urjayat (Bhandarkar 1981, vs. 45-46). The latter corresponds to mount Girmar (Ibid., p. 298), which as we shall discuss below, is the main pilgrimage centre in the area (Fig. 14).
As mentioned earlier, although the “Oriental despot” theory has been more or less over-ridden by the Sri Lankan evidence for monastic landlordism, the same does not apply to ancient India. An uncritical following of problematically dated texts such as the Arthasastra, combined with an inscription-dominated framework of analysis has meant that the construction and maintenance of big dams is still to a large extent seen as the prerogative of an overarching centralized authority. Certainly this is the initial impression that comes across from the Rudrada-man and Skandagupta inscriptions. However, it is important to stress that land-grants from the Gupta period onwards attest to more devolved systems based on the ownership and management of agrarian resources by religious institutions (Kulke 1993, p. 11). In subsequent years, this system becomes fully entrenched, as typified by the tradition of temple-owned tanks described in the Pallava and Cola inscriptions of south India (Morrison 1993, p. 145). On the basis of this later evidence, it is not implausible that the Visnu temple mentioned in the Skandagupta inscription bore a similar kind of relationship to the Sudarsana lake.

What about the earlier periods though? Is there any evidence for a link between water-management and religion at Junagadh in the pre-Gupta period? As at Sanchi, in order to address such questions, it is necessary to look beyond the dam itself to its wider ritual setting. The ancient city of Junagadh seems to have been located in the raised fort area, now known as Uparkot, immediately above the dam (Burgess 1876, p. 94). Today the most important ritual centre in the area is Mount Girnar (Fig. 14). At a height of 1117 m it towers over the town, and every day, hordes of pilgrims climb its 10,000 steps to visit the Jain and Brahmanical temples at its summit. No Buddhist remains directly associated with Asoka have been found (Mitra 1971; p. 141), but the location of the Girnar rock with its Asokan inscription at the base of the hill, is suggestive of a Buddhist presence in the area during this time. Hsuan Tsang, the 7th century Chinese pilgrim, describes over fifty Buddhist monasteries in the area, and about three thousand monks of the Sthavira sect (Burgess 1876, p. 159). Some of these monasteries may have corresponded to the rock-cut cave complexes situated in and around the fort area, to be discussed below. Hsuan Tsang also described “Buddhist chambers and galleries mostly hollowed out in the face of a scarped peak” which as suggested by Burgess, probably correspond to the natural rock-shelters just below the main temple complex at the summit of the hill (1876, p. 159). Some of these may well have had Buddhist associations as early as the Mauryan period.

Water and religion: the rock-cut caves

As just mentioned, there are also several rock-cut cave complexes in Junagadh, three of which are situated on or around the fortified area. According to Burgess, there must have many more before the commencement of destructive quarrying activity in the area. The earliest surviving examples, datable to c. 2nd century AD, are the Baba Pyara complex, situated at the southern foot of the fort; and the Khapra Kodia complex at its northern base. The Uparkot caves located within the fort area itself, are somewhat later, datable to c. 400 AD (Meister et al. 1988, p. 16). Interestingly, they are cut into the rock from above, rather than from the side like the rock-cut complexes in the Deccan. An inscription found in the

Baba Pyara caves, dated in the reign of Kṣatrapa Dāmajada I, or Rudrasimha I, son of Mahākṣatrapa Rudradāman, and dedicated to Jain worship, has led scholars to view the caves as Jaina. Further a row of āṣṭāmangalas carved on the lintel of one of the cell doorways (Burgess 1876, p. 140, pl. XVIII), has been compared to “coeval Jaina āyāgapatas” from Mathura (Meister et al. 1988, p. 16). However, as noted by Burgess (op cit.), the inscription may have been a later addition to the site and given Hsuan Tsang’s account, one may assume that at least some of the caves had Buddhist associations.

The Khapra Kodia caves (Figs. 15-18) are particularly interesting because of their spatial proximity to the Sudarśana dam. Although the caves are mentioned by Mehta he does not comment on their relationship to the dam; nor does Burgess, simply because the dam had not yet been correctly identified as such. An adapted version of the plan and elevation of the caves in the Archaeological Survey of India Junagadh guidebook (Soundara Rajan 1985), is shown in Figure 15, with additional information showing the relationship between the caves and the dam. The cave complex, arranged into two main wings, is cut into the top of an east-west ridge of trap rock. Originally it must have been somewhat larger; portions have been obliterated as a result of modern quarrying activity. To the east is an “L” shaped wing consisting of “habitational quarters” (Ibid), while the western wing is dominated by an open area with four square tanks cut into the rock. Each tank has steps descending into them, and surrounded by channels on all sides (Fig. 18). Several śāṅkhalipi inscriptions were noted on the inner walls of one of the tanks. Interestingly, these are very similar to śāṅkhalipi inscriptions in central India and may be another justification for drawing parallels between the two areas. The gradients of the surrounding area are arranged in such a way as to allow for the movement of water from one area to another. A rock-cut opening leads into an additional single tank area further west. From here, rock-cut steps lead to the summit of the rock where an open channel is cut into the length of flat roof (Fig. 16). As shown in the plan, the remaining section of dam in the south abuts the northern edge of the cave complex, while the eastern edge of the rock would have formed the actual edge of the reservoir (Figs. 16 and 17). This is positioned at a level of about 2.5 m below the crest of the dam, the suggestion being that it was part of the reservoir system. Water, when it reached a certain height would have been channelled, possibly using some form of pipe or sluice, from the reservoir into the open channel on the roof, and down into the tank system below.

This complex water system and its functional relationship to the reservoir clearly requires further investigation through proper contour survey. Further,
there is the question of its chronological relationship to the dam. If we accept the art-historical and epigraphical arguments for a 2nd century AD date, then it would appear to be roughly contemporary to Rudradāman’s repair of the dam. It is, however, possible, that what we see now was an elaboration of an earlier, simpler system. A third question is whether it combined some form of monastic function (either Buddhist or Jain), as suggested by the residential quarters in the eastern wing. Further insights into this question are provided by observations at the two nearby rock-cut complexes mentioned earlier. Although they bear no physical relationship to the reservoir, it is significant that the harvesting and storage of water is displayed in a similar ostentatious manner as at Khapra Kodia. At the Baba Pyara caves, for example, numerous water-channels have been cut into the roof so as to collect and distribute monsoon rainfall into the two excavated tanks outside the lower-level residential cells (Fig. 19). As at Khapra Kodia, the two tanks are positioned at different levels and linked by a deep channel that coils its way around the contoured rock. This would have resulted in an ornamental water garden, which during the monsoon would have been alive with the movement of water from one tank to the other.

Comparisons with rock-cut monasteries in the Deccan are of some relevance here: cisterns and water-collection channels are dominant features at the earliest sites such as Bhaja, Karle and Bedsa; at Kanheri, they are in such abundance that hardly a drop of rainwater would have gone to waste. The entire hillside is carved with monastic cells and halls, each of which is incised by an intricate chain of channels that would ensure a year round water supply. During the monsoon, this labyrinth of water would have been an awesome spectacle for both monks and local visitors. In a country where 90% of the annual rainfall occurs in two to three months, the advantages of such water-harvesting strategies are obvious. Quite clearly, it was essential to the sangha’s survival. It would also have set an example to local communities for whom water-storage would always have been a key concern. Again we come back to the issue of dukkha, the central tenet of Buddhism’s Four Noble Truths. It is significant to note that before the first permanent monastic establishments, monks were compelled to wander from one place to another teaching the dharma. The one time of year that such wandering was forbidden was during the monsoon when they would take up residence in temporary rain-retreats. An obvious point, but one which needs to be stressed, is that the subject of rain would have dominated monks’ thoughts and discussions during this time. The problems of flooding encountered by neighbouring villagers and farmers would also have been hard for the monks to ignore. They would also have been aware from their travels during the rest of the year, that despite this incessant rain, many villagers suffered from drought during the dry months. The development of sophisticated water-harvesting systems not only provided a practical key to the sangha’s transition from a peripatetic to sedentary lifestyle, it could also play a role in its missionary activities. The propagation of these practical skills was, like monastic landlordism in Sri Lanka, a means to alleviate suffering (dukkha); as shown by the donative inscriptions associated with wells and cisterns at the Deccan sites, it was also an instrument for generating patronage networks.

**Hydraulic comparisons between Sanchi and Sri Lanka**

Although comparisons between the Sanchi dams and the Sudarśana lake provide an historical perspective through the evidence of the inscriptions, the early dams in Sri Lanka provide a useful analogy because of the physical survival of examples of the control structures, which were examined and described before their reconstruction in the 19th century (e.g., Parker 1909; Brohier 1934).
The significant differences in climate and hydrology between Sanchi and Sri Lanka will be described in detail later. The annual runoff in the Sanchi area is about 500 mm, compared with only about 170 mm at Anuradhapura. However, the mean annual runoff increases rapidly south of Anuradhapura and reaches about 1000 mm at Elahera (Irrigation Department 1974). This puts the water resources of the two areas into perspective; the runoff is lower but geographically more variable in Sri Lanka and this explains why a number of the dams in Sri Lanka rely on diversion from rivers upstream. In terms of floods, there is also a great contrast between the two areas. Although moderate floods at Sanchi are likely to be higher than in northern Sri Lanka, the rare floods in Sri Lanka are much higher in comparison with normal floods.

These hydrological differences are reflected in the hydraulic structures. The Sanchi dams were individually designed to fit between hills and store water for local irrigation, relying on adequate runoff and a consistent flood regime. In Sri Lanka, on the other hand, two types of ancient irrigation systems developed. There were local networks of small tanks to store runoff from extended basins, but there were a number of larger storage dams, either located to tap large basins directly, or linked together by river diversions and canal systems; the geographical diversity led to advantages in transferring water from wetter areas to areas where storage sites commanded land suitable for irrigation. There are also advantages in deeper reservoirs in terms of evaporation losses, once the construction of sluices to feed irrigated areas downstream had been devised.

Attention has been concentrated on medium or larger reservoir construction, for example the Basavakkulama tank at Anuradhapura known to have been built around 300 BC. However, widespread small tank cascade systems, necessary for existence in the Dry Zone, were constructed by communal effort, and according to oral village tradition were in continual use since this period. Typical cascade systems have been investigated by Panabokke et al. (2002). They consist of networks of small reservoirs designed to store runoff in order to irrigate rice, provide water supply for humans and livestock and to induce groundwater recharge. There is evidence of serial construction, expanding storage as populations grew, and integrating water resource development by regulating flow from tank to tank and thus reducing flood inflow and breaching. According to tradition, the siting of main dams depended on location of a rounded rock outcrop suitable for a natural spillway. Present evidence of major tanks at the lower end of valleys showed that all had ideal spillway sites, some chiselled and lowered in elevation.

There is no evidence of the methods of hydraulic design or sizing of tanks, but a body of empirical relations on rainfall, runoff and storage must have been known by 400-500 AD, when very advanced hydraulic structures had been built; this knowledge could have been extended to design of smaller tanks. The main difference between early major and minor works was in design of sluices. The operation of major works depended on dressed stone cistern types, known as bisokotuwa. Smaller works could make do with simpler devices. There is evidence that tank densities were related to seasonal rainfall and runoff depths. Although the small village tanks survived better than larger works when central government declined from 1200 AD, evidence of the proportion of abandoned tanks suggested that hydrological inadequacy and the prevalence of cyclonic storms and runoff surges leading to breaching were important in different areas.

Five cascades of small village tanks were surveyed by Panabokke et al. (2002); of the two cascades in the Anuradhapura area, the average volume of nearly 60 tanks was about 0.2 m$^3$x10$^6$, much smaller than the average for the Sanchi dams of 1.0 m$^3$x10$^6$. The total tank capacity in these two cascades was estimated as 9.6 m$^3$x10$^6$, or the equivalent of about 130 mm over the total cascade area of 73 km$^2$, which approximates to the average runoff volume. The average depth of these reservoirs was only 1.0 m; these would be less efficient than larger structures.

The larger irrigation structures in Sri Lanka have received most attention in terms of their design or construction. The Basavakkulama tank was followed by a number of major irrigation works, described by Parker (1909), Brohier (1935) and Arumugam (1969) among others. In terms of volume they range from 4 to 42 m$^3$x10$^6$ (Parker 1909), so they are in general an order of magnitude larger than the Sanchi dams. Moreover, they reflect a more sophisticated level of hydraulic engineering because the local basins are in a number of cases inadequate to fill the reservoirs and a complex system of river diversions and inflow canals has been constructed, especially in the Anuradhapura and Polonnaruwa areas (Mendis 2002). There are also a number of dams sited on rivers with large basins where the runoff is adequate to fill the reservoir storage. Comparisons between storage volume and estimated runoff from the natural basins of early dams showed that the ratio of the local runoff to reservoir volume is extremely variable, ranging from 0.34 to as high as 10. This is not surprising, as the locations and climate of the reservoirs vary.

**Flood control**

Evidence from Sri Lanka stresses the importance of spillway capacity at dam sites. Parker (1909) describes and tabulates spillway dimensions at a number of ancient dams; most of these are based on natural rock spillways, though in some cases like Nuwarawewa they
are supported by masonry walls. It is important to note that a number of dams drain relatively small basins and depend on feeder canals; indeed, it is possible that the systems of indirect storage were, intentionally or not, responsible for many of the reservoirs surviving for long periods without overtopping and severe damage. It is also likely that the cascades of small dams provide attenuation of flood peaks.

On the other hand, evidence of Sri Lankan dams with larger natural basins throws some light on the likely fate of the Indian dams. Evidence gained during restoration gives information on the structures and their history. For instance, Brohier (1965) notes that when Nachchaduwa tank was examined before its restoration in 1906, four large breaches in the embankment were discovered showing that the spillway had proved inadequate. Even after restoration with increased storage capacity, this reservoir was subjected in 1957 to the largest flood in living memory. The embankment survived until the bund was completely overtopped by more than 300 mm and a breach 120 m wide occurred on 25 December (Brohier, 1965, p. 22). Arumugam (1969, p. 29) also describes the 1957 storms as unprecedented, with daily rainfall totals recorded at Habarana on 24-26 December of 418, 477 and 345 mm. He notes that serious damage was caused to 35 major irrigation works and 1300 village tanks. It is interesting that several ancient dams, like Kalawewa, Nachchaduwa and Pavatkulam, where flood damage was severe, are those where dams were built across sites with significant upstream basins.

On the other hand, a number of the ancient dams, with small catchments supported by river off-takes, have survived intact.

It is significant that similar means of flood control have been used in Sri Lanka and central India. In the larger of the central Indian dams, e.g., Devrajpur and Morel Kala, there are spillways located on the flanks of the embankments and excavated in the rock outcrops on which the dams have been based. At both these sites there are remains of masonry in the natural channels through the dams, which might have formed part of control structures. Excavated spillway remains have not been located at the other sites, but reliance could have been placed on flow over natural outcrops or the construction of level embankments, reinforced by masonry protection and a shallow downstream slope. The depth of overtopping and the downstream velocity would be relatively small if the embankment were precisely level, though inevitably flow would concentrate at lower points. Flood records suggest that in central India there is a relatively small increase between normal and rare floods. At the later sites where dam heights are more ambitious, the spillways are more complex. At this stage any conclusions must be tentative. However, there is sufficient evidence of similarity of dating and design of the dams at Sanchi and of Sri Lanka to suggest that there could have been exchange of technical expertise between the two areas, which were of course in touch during the period of Buddhist evangelism.


22. Dimensionless flood frequency curves for northern Sri Lanka and Indravati (Madhya Pradesh): floods as multiples of mean annual flood.
Comparisons of climate and hydrology

While it is useful to compare the dams in the Sanchi area with contemporary developments in Gujarat and Sri Lanka, it is important to note the contrasts in climate, especially rainfall, between these three areas, which affect the design and the role of the reservoirs. The Sanchi area contains hills of moderate elevation, and lies on the boundary between sandstone hills to the southeast and plains of black cotton soil derived from basalt; the annual rainfall averages about 1350 mm, which is concentrated between mid-June and October. Once the soil moisture deficit has been eliminated by the early monsoon rainfall, the surplus of rainfall over evaporation gives rise to about 500 mm of runoff; also the moisture stored in the soil is adequate to cultivate a wheat crop between the end of the monsoon until harvesting in February or March. The potential evaporation is related to temperature, which varies between a hot summer and a relatively cool winter; thus the crop evaporation is relatively low during the winter.

At Junagadh, where the Sonrekh stream drains an area of some 20.5 km² on the steep slopes of Girnar Hill, which rises up to 1100 m, the effect of the hill is to create an area of relatively high rainfall in a dry area where it would be difficult to grow crops in the absence of irrigation. The average annual rainfall at Junagadh is 844 mm, which itself is higher than adjacent stations like Rajkot where the average is 670 mm; this suggests that the influence of the hills extends as far as the town itself. According to Rao (1981), discussing the effect of topography on rainfall, “the effect of the Vindhyas and the rest of the Satpuras is not so marked, but the Gir Hills in Kathiawar have more rainfall than their surroundings”. The rainfall at Junagadh is even more concentrated than in the Sanchi area; Figure 20 shows that the rainfall peak in July is particularly marked. In the absence of direct rainfall measurements over the hills, one could assume that the rainfall over Girnar Hill might reach about 1200-1400 mm, which would result in an average rainfall over the stream leading to Junagadh of about 1000-1100 mm, and bearing in mind the concentrated rainfall season, the thin soils and the steep catchment, a runoff of about 250-300 mm.

In the northern plains of the so-called ‘Dry Zone’ of Sri Lanka, there are significant differences in climate from the Sanchi area. Comparisons of mean monthly temperatures between Bhopal and Anuradhapura show that, although the mean annual temperatures are similar, the daily and seasonal ranges at Bhopal are much larger than at Anuradhapura, where the lower range enables rice to be grown throughout the year. The average annual rainfall at Anuradhapura of 1447 mm is of the same order as Sanchi. However, the seasonal distribution is quite different, with wet seasons in March /May and October/January. The contrast with Vidisha, near Sanchi, is illustrated in Figure 20. The water balances, including the runoff depths, of the two areas are determined by the comparison of rainfall and potential evaporation; the difference in seasonal patterns results in a much higher runoff at Sanchi than in northern Sri Lanka. The annual runoff in the Sanchi area is about 500 mm, compared with only about 170 mm at Anuradhapura. However, there are within a short distance of the irrigated areas near Anuradhapura rivers, draining the Central Highlands of Sri Lanka, which carry runoff up to 1000 mm, so there are useful water resources which can be tapped within short distances of the flat plains.

The influence of seasonal distribution on rainfall/runoff relations is demonstrated by Figure 21, where annual records of the Betwa basin, including Sanchi, are compared with average records from stations in northern Sri Lanka; where rainfall is concentrated, runoff is much higher than where rainfall is spread over a longer period. Thus the hydrological backgrounds to the three areas differ widely.

There are also key differences in the flood regimes of the three areas, which could affect flood control and the history of the dams. The flood potential is clearly controlled by storm rainfall magnitude and percentage runoff, but can also be described by a regional flood frequency curve based on flow records, which illustrates the flood potential of an region by a graph relating the flood of a given frequency to the mean or average annual flood. This curve illustrates the ratio of rare floods to normal floods, and the shape of this curve is largely controlled by climate. It has been shown (Sutcliffe and Farquharson 1998) that they are much steeper in dry climates like Botswana than in monsoon climates like West Africa. The curves are surprisingly steep in northern Sri Lanka for a relatively wet climate, and are compared in Figure 22 with a curve based on the Indravati basin to the southeast of Sanchi; in other words a rare flood of 500 year return period is particularly high as a multiple of the mean annual flood, the average of the annual floods at a site. Although the mean annual flood at Sanchi will be greater than the equivalent in Sri Lanka, rare floods however in Sri Lanka will be a far greater multiple of the mean annual flood than at Sanchi. This means that someone basing spillway designs on experience of normal floods, occurring every 5 years, in Sri Lanka, could find them grossly inadequate for rare floods, occurring once in 500 years, which could be 7 times as high. By contrast, at Sanchi a spillway designed on experience of normal floods would experience a rare flood only about twice as large, and might well survive. Without flow records from Junagadh, a similar comparison is not possible, but the relatively dry climate suggests that an intermediate curve is probable. These differences in flood regime are discussed further when
dealing with the individual areas.

The difference in climate between the Sanchi sites and Junagadh is important. The mean rainfall at Junagadh is only 840 mm, though the rainfall must be higher in the hills above the dam site. The annual runoff has been assumed to be about 250 mm; from a basin of 20.5 km², this would be just adequate to fill a reservoir of 5 m³x10⁶ in an average year. On the other hand, while the 24-hour storm of 50 year return period is 240 mm for the Sanchi sites, it is about 360 mm at Junagadh near the coast, and the “probable maximum storm” is estimated as 750 mm (SDS Abbi, pers. comm.). In other words, while the Saurashtra catchment would receive a lower average runoff depth, it is more liable to extreme storm depths and the 50-year daily runoff is likely to exceed the reservoir volume. Severe floods are likely to damage the embankment by overtopping in the absence of adequate spillway capacity. The risk is illustrated by a recent dam breaching tragedy on the Machhu river about 120 km north of Junagadh; in August 1972, the basin of 1460 km² received a 24 hour storm averaging 500 mm, equal to the mean annual rainfall, resulting in a flood of twice the spillway design, which washed away 1800 m of embankment and caused considerable loss of life downstream (Water Power & Dam Construction, October 1979, p.3). It is not surprising that the history of the Junagadh dam and lake is dominated by damage to the embankment and subsequent repair.

It is of some interest to note the dates given in the Rudradāman and Skandagupta inscriptions for the breaching of the dam. The latter states the devastation occurred in the month of Prauṣṭhapada, which appears to correspond to August (Fleet 1888, p. 58, vs 2-3). This would place the storm in the middle of the monsoon, when such storms might be expected. The date given in the Rudradāman inscription, however, is less credible. It places the storm during the first of the dark half of Mārgaśīrsha which according to Kielhorn, corresponds to either mid October or November (Kielhorn 1905-6, lines 4-5, 41). Mārgaśīrsha is more commonly placed in December. Either way, it is an unlikely time for a storm of the magnitude described in the inscription, given the very limited normal rainfall season at Junagadh (Fig. 20). We are either dealing with an extraordinary event, or else a misunderstanding.⁵¹

As already discussed, the rock edicts of Asoka are situated near the upstream limit of the Sudarsana lake, and these are accompanied by the Rudradāman and Skandagupta inscriptions which throw light on the history of the reservoir. Mehta deduces that the Mauryan earthwork existed without damage for about 450 years, thanks to its broad base and sound construction. Rudradāman’s repairs in c. 150 AD gave it a subsequent life of three centuries until the repairs under Skandagupta in c. 450 AD; if one assumes, following Mehta (1968, p. 27), that the latter’s repairs would have lasted a similar period to earlier repairs, then the dam would have finally breached in about 8th/9th century and not been repaired again.

This inscription record throws some light on the likely history of the Sanchi dams. As mentioned earlier, they have all been destroyed by breaching near the river courses through the deepest part of the valleys. In the case of the larger dams, there remains evidence of spillways excavated in the rock abutments; comparison of the spillway capacity at Devrajpur with storm depths suggested that the spillway would pass the 50 year flood. Further, there is evidence that rare floods would not be so extreme in this area. However, there is no remaining evidence of spillways at a number of the Sanchi dams, though natural rock outlets might have been used in some cases. It is therefore not surprising that the Sanchi dams suffered damage from flooding over a period of two millennia.

Conclusion

In this paper, we have presented new archaeological evidence relating to the ancient dam complexes in Sanchi and Junagadh, and suggested technical exchange between these two politically interconnected areas with their varying hydrological environments. While the patronage base in Junagadh is well attested by the Girnar rock inscriptions, there is a lack of such evidence in the Sanchi area. We have argued, however, that the local Nāga dynasty, who are clearly represented in coins and inscriptions, were major patrons of dams and monastic sites in the area. Both their role as facilitators of agrarian expansion, and their identification with a totemic deity are features more commonly associated with the Guptas, who from the 4th century AD appear to have usurped the Nāga’s authority in the area. Further, hydrological data at Junagadh and Sri Lanka have helped to place the Sanchi dams in their physical context. Finally, we have discussed the relationship between water-management and religion. Scholarship on monastic landlordism in Sri Lanka, and observations regarding the ostentatious display of water harvesting facilities at rock-cut monasteries in western India are helpful for building an integrated model of religious and economic change in ancient India.
WATER MANAGEMENT, PATRONAGE NETWORKS AND RELIGIOUS CHANGE

NOTES

1. Grateful thanks to Archaeological Survey India for support of this project, and to the British Academy, and the Society for South Asian Studies for funding. The first author would like to thank Stanford University (Archaeology Center, and Center for Buddhist Studies), Oxford University (Merton College, and Institute of Archaeology) for support while working on this paper. In Sri Lanka, thanks are due to Yvonne and Ian Makin for arranging discussion at the International Water Management Institute, Colombo, and for hospitality; also to C.R. Panabokke and D.L.O. Mendis for useful discussion. In Madhya Pradesh, we are grateful for the help of Meera Das, G.K. Dev Burman, Santosh Kumar Dwivedi, and in Delhi to Johan Grijsen, S.D.S. Abbi and H. Chowdary. We are indebted to Hans Bakker, Dilip K. Chakrabarti, Emma Tate and Michael Willis who read earlier drafts of the paper and offered valuable suggestions for its improvement; and to Alison Wilkins who adapted figures 1, 12 and 15 for publication.

2. These hypotheses will be tested further using, amongst other methods, intensive survey, satellite imaging, and excavation. Ongoing work is being carried out in collaboration with other members of the Vidisha Research Group, set up in 2001 to provide an interdisciplinary setting for research in the area. See Shaw and Sutcliffe Forthcoming; Willis Forthcoming.

3. More detailed discussion of this argument is given in Shaw Forthcoming.

4. This is demonstrated in recent text books on Indian history. E.g., John Keay (2000, p. 130) refers to “an irrigation system in the vicinity of Junagadh which has long since disappeared”.

5. Labelled nos. 6 and 16, in Shaw and Sutcliffe 2001, Fig. 2.

6. Grateful thanks to Michael Willis for helping to understand this material.

7. Future remote sensing and geoarchaeological work will help to determine whether current ground levels are the result of “natural” elevation or human agency.

8. This was verified during the regional survey by the high archaeological visibility of archaeological mounds in alluvial areas.

9. The Bhojpur lake covered about 650 km² according to one estimate (Kincaid 1888, p. 352). Local tradition attests to it having led to the aridification of the Betwa river and the need for well and tank storage during the hot season. With the destruction of the lake, the flow returned to the Betwa, rendering the use of tanks at Vidisha unnecessary. The area draining to the Bhojpur lake would have been about 1400 km², compared with a total area of 2500 km² above Vidisha, draining to the Bhojpur lake would have been about 1400 km². Unfortunately the excavations carried out in the 1960s and 70s were never published beyond summary form, but the presence of Northern Black Polished Ware in the city ramparts indicates a Mauryan date.

10. As attested by studies in Bengal, south India and Sri Lanka, the obvious advantage of fish is their high nutritional value, but they have also been shown to be a crucial factor in the control of malaria, because they feed on the larvae of mosquitoes (Davison-Jenkins 1997; Agarwal and Narain 1997, pp. 93-4; Willcocks 1930).

11. For a detailed discussion of the impact of irrigated rice cultivation in ancient South East Asia, and south India, see Stargardt 1990, especially chapter III.

12. While a distinction between minor ritual use and large-scale production needs to be made, the argument here is that sustained use of rice within a monastic context would require rice cultivation becoming embedded in the local agrarian infrastructure.

13. The assumption behind such claims is of course that there was a pan Indian nāga cult which was assimilated by Buddhism. As discussed elsewhere (Shaw Forthcoming), this is open to debate. However, the iconographic representation, of nāgas is another matter, and may well have come as part of the cultural ‘package’ that accompanied Buddhism during its spread from the Gangetic valley area.

14. Parallels may be drawn here with “religion as technique” models such as Peel’s (1968) study of Christianisation in west Nigeria. Peel uses a medical analogy to understand Yoruba attitudes towards religion, whereby each religious “technique” is viewed as an independent means of reaching certain spiritual or social goals, just as a new cough medicine may be used alongside a traditional flu remedy (Ibid., 124-5). Similarly, Goody (1975) found that for the Lo Daga people of west Africa, the acceptance of Christianity was not viewed as a “conversion” because belief in the older gods was still maintained.

15. See Shaw Forthcoming for detailed descriptions of these sculptures and their position within the archaeological landscape.

16. An examination of 19th century accounts strongly suggests that the two nāgas now stored in the Sanchi Museum (Williams 1976, 174, fig. 6; Harle 1974, fig. 40), and their female counterparts, one of which stands outside Sanchi temple 31, were originally housed in independent shrines to the east of stūpa 1. (Shaw Forthcoming).

17. E.g. Vāsudeva would have been represented by the Garuḍa standard mentioned in the Heliodorus pillar inscription while Saṅkaraṇa probably took the form of the fan-palm capitals found at the same site (Hārtel 1987).

18. It is important to note however that suggestions for a pre-Mauryan, “pre-monumental” phase of Buddhism in the area are provided by the high occurrence of prehistoric shelters at Buddhist sites which show evidence of having been re-used as monastic dwellings.

19. Unfortunately the excavations carried out in the 1960s and 70s were never published beyond summary form, but the presence of Northern Black Polished Ware in the city ramparts indicates a Mauryan date.

20. Vidisha belongs to a larger group of sites in central India, including Eran, Tumain, and Pawwaya, whose adoption of an urban status appears to have been linked to the expansion of the Mauryan empire.

21. This link is also attested by textual passages which inform us that Vidisha was the native town of Devi the wife of Asoka, who was based as viceroy in Ujjain (Mahāvīra, 13:7; Dipavaliśka 12-14). Sanchi is described in these texts as Cetiya orir or Vedisagiri, the setting of the “beautiful monastery” to which Queen Devi accompanied her son, Mahinda, during his visit to Vidisha. Asoka’s marriage to a local woman demonstrates Vidisha’s prominence within the Pan-Indian political scene, but also alludes to its importance in the pre-Mauryan period: the character of Vidisha during the pre-Mauryan period remains largely unknown. This stems primarily from
uncertainties over the chronology of NBPW, but also because the nature of the transition between the Chalcolithic and early-historic period, has not yet been understood.


23. The temple is described as the “excellent temple” (prāksādotattanā) of the Bhāgavat, the latter being thought to correspond to Vāsudeva-Kṛṣṇa, the principal deity of the Bhāgavata tradition (Chanda 1920, 152).

24. Marshall (1940, p. 23) was of the view that the damage to the earliest phase of stūpa 1 and temple 40 at Sanchi was a direct result of Śunga intolerance to Buddhism.

25. A recent revision of Sātavāhana chronology is given in Cribb 2000.

26. Numismatists are now in general agreement that the king in question is Satakarni I, who ruled in the Malwa area from c. AD 25, and not Satakarni II, or the later Gautampiṭa Satakarni (Cribb 2000).

27. Now stored in the Sanchi Museum (Catalogue no. A82). Written in Kuṣāṇa Brāhmaṇī, the inscription records a gift from king Vāsiśka, during the year 28 (AD 228-253) (Willis 1999/2000).

28. One of these mentions a king called Vaskus, who according to Marshall belonged to the Kuṣāṇa dynasty (Marshall 1940, p. 386, inscrip. 829; pl. 105c). The inscription is dated to year 22 (c. AD 222-247). The image, of which only the feet and a lower panel remain, is now stored in the Sanchi Museum (Catalogue no. A83).

29. For two other Mathura images, one a Bodhisattva, and the other a Buddha, both of which were found deposited in post-Gupta stūpas (nos. 4 and 18), see Marshall 1940, p. 387, inscrip. 830; ibid., p. 47, pl. 105b).

30. The ancient settlement of Kanakhera is situated on the lower saddle of Sanchi hill. This date follows Majumdar’s reading of the Saka year given in the inscription as 241 (AD 318/19) (Majumdar and Pusalker 1954, p. 47). Banerji read it instead as 201 (AD 279) (Ep. Ind. XVI, pp. 230-33).

31. East Malwa is the old geographical designation, which roughly speaking, corresponds with the eastern part of Madhya Pradesh in which Sanchi is situated.

32. Sackfuls of Nāga coins continue to be collected from surrounding fields after the monsoon, and sold in the local market. Ironically, therefore, they continue to have some kind of currency in the Vidisha area (Willis, pers. comm.).

33. Scholars are divided, however, in their opinion as to whether in the Purāṇas the word nuna refers to the “nine” Nāga rulers (Trivedi 1957) or to the three “new” houses at Mathura, Kantipurya and Pawaya as opposed to the older, aforementioned lineage at Vidisha (Bhandarkar 1981a, pp. 20-21).

34. Grateful thanks to Shailendra Bhandare for alerting me to this inscription, which is also renowned for containing the earliest reference to Maharashtra as a geographical entity.

35. Such an approach illustrates the general dislocation between the study of religious and political history in south Asia. There are also suggestions that the Nandins kings who succeeded the so-called “Śurgas” had Nāga affiliations: (Bhandarkar 1981a, p. 10).

36. The nāga is part of a larger group of serpent sculptures originally studied by Joanna Williams (1976); their position on the bank of the now-dried up reservoir was only noted following the discovery of the dam there (Shaw and Sutcliffe 2001).

37. For an illustration of the larger of the two Cave 6 images, see Harle 1974, pl. 8.

38. This appears to be a pan-Indian trend, as commented upon by Joshi (1979, pp. 38-9).

39. A close parallel is the well-known Nāgarāja outside cave 19 at Ajanta, whose royal status is suggested by the lalitīṣāna pose and elaborate crown (Harle 1974, fig. 84). Interpretations of this figure are usually confined to a purely religious framework. E.g., R. S. Cohen (1998) following on from the associated inscription, views it as a local spirit “assimilated” into the complex as part of the saṅgha’s localization strategies. Consequently, the possibility for wider dynastic references has not been explored. Given the political and genealogical links between the Vākāṭaka and Nāga houses discussed earlier, some reference to a Nāga ruler would not have been out of place at Ajanta.

40. For a critical summary of these views, see Willis In press.

41. Grateful thanks to Michael Willis for raising this suggestion.

42. References here are to v. 7 and line 21.

43. According to Bakker (1997, p. 17), this probably took place between Candragupta’s death (AD 415) and Damodarasena’s succession to the throne (AD 419).

44. Ghataloka is known from the Tumain inscription of AD 435-6 and two gold coins (Bakker 1997, p. 26; CII III, pp. 276-279; 294-296).

45. This is not to be confused with a much larger stream of the same name shown on the Survey of India map about 15 km north-east of Junagadh.

46. It is significant that reservoirs mentioned in two more or less contemporary Vākāṭaka inscriptions at Ramtek and Vatsagulma in Maharashtra are both called Sudarsana, while the former inscription also begins with an invocation to Viṣṇu (Bakker 1997, pp. 30-33; n. 94).

47. For an account of the Girnara Mahatmya and the various temples on the hill, see Burgess 1876, pp. 154-76.

48. Described in detail in Burgess 1876, but for recent discussion of dates, see Meister et al. 1988, 16.

49. It should be noted that in same guidebook’s overall site plan, the Sudarsana lake is incorrectly indicated at the eastern base of the medieval fort area.

50. Although there have been claims to the contrary the shell-script has not yet been convincingly deciphered. For recent discussion of saṅkhaliṣa inscriptions at Udayagiri, see Willis In press.

51. For example, it is possible that because the calendrical system was not fully standardized until the Gupta period, that during the 2nd century AD, Mārgaśīra referred to a different month.

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