SHORT ARTICLE

Tourism Developments Increase Tsunami Disaster Risk in Pangandaran, West Java, Indonesia

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Abstract On 17 July 2006, the tourist resort of Pangandaran on Java's south coast was hit by a tsunami, resulting in 413 fatalities and severe damage to buildings. The tsunami resulted in major rebuilds with a focus on mass tourism. Assessments of the impact of a future tsunami focussed on building development and suggest limited change since 2006. This article presents a case study on the development of (largely domestic) tourism in Pangandaran and how this has increased the tsunami disaster risk. Tourist numbers were stable at about 900,000 visitors a year prior to the tsunami, down to slightly over 250,000 visitors a year in its aftermath, and from 2007 onwards numbers are doubling every three years to about 4 million visitors in 2019. The increase has been most pronounced during weekends. Prior to 2006, Pangandaran was characterized by wooden structures and one- and two-story buildings of clay-brick masonry; by 2019, 14 three to six-story hotels have been erected along the waterfront. With many more visitors, most of whom are unfamiliar with tsunami risks, and shelter facilities for less than a quarter of visitors during peak times, future impacts and the potential cost to life are considerably higher now than in 2006, especially if a tsunami were to hit over a weekend. All tourists upon arrival and throughout their stay should be better informed about the risks of tsunamis, and of the location of tsunami shelters and evacuation routes.

Keywords Disaster resilience · Effective warning · Indonesia · Risk mitigation · Tourism · Tsunami

1 Introduction

The tourist resort of Pangandaran (7°41'S, 108°39'E) on the Indonesian island of Java is situated on a small, narrow (200 m at its narrowest) 2 km long isthmus leading to a larger rotund island firmly anchored in the Indian Ocean. On the afternoon of Monday 17 July 2006, after a 7.7 magnitude earthquake in the Indian Ocean some 200 km off Pangandaran, the isthmus as part of a 300 km long stretch of southern coastline was hit by a tsunami. Of the 668 confirmed fatalities, 413 (130 men, 205 women, and 78 children) were in and around the tourist resort (Fritz et al. 2007; Mori et al. 2007; Reese et al. 2007). The up to 5-m high waves flooded Pangandaran up to 400 m inland. The wooden or bamboo cafes, shops, and homestay facilities along the waterfront and up to 20 or 30 m inland were washed away (Mori et al. 2007). There was severe damage to almost all structures within several hundred meters of the waterfront, where the construction was predominantly one- and two-story buildings of unreinforced clay-brick masonry. Damage consisted of collapsed walls, walls with large holes where windows and doorway once existed, and large piles of debris consisting of building material and small boats (Mori et al. 2007). The main objective of this article is to provide a case study of the development trajectory of Pangandaran following the tsunami, with an emphasis on growth of domestic tourism and how this has increased the future tsunami risk potential.

The tsunami resulted in a major rebuild of Pangandaran with a focus on mass tourism (Hidayat 2011; Nijman et al.

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2016). Pre-tsunami Pangandaran was characterized by small hotels and hostels catering to individual tourists and small parties; now it is dominated by high-rise, three- and four-star hotels that cater for large groups and organized tours. The new hotels were initially erected predominantly on the western beachfront, but now they are a feature throughout the peninsula (Fig. 1).

Several assessments have been made of the future tsunami risk potential in Pangandaran (Bisri 2011; Faiqoh et al. 2013; Husrin et al. 2015; Mardiatno et al. 2020; Windupranata et al. 2020). Bisri (2011) found that the areas of local governance, disaster recovery, and the emergency response were weak. Husrin et al. (2015) assessed how well tree cover could mitigate the effects of a tsunami. Immediately following the 2006 tsunami the central government and local institutions launched a replantation project of Java's south coast, with different species planted and arranged in various configurations to provide protection against the tsunami flow. On the Pangandaran peninsula, the distance between individual trees was quite large to start with because of tourism needs, but in 2013, six years after replanting, most trees in the frontline had died because of lack of maintenance and the area that had been set aside for the new coastal forest was occupied by vendors (Husrin et al. 2015). Combining data on elevation, slope, land use, rivers, and so on, it was concluded that the

peninsula had a very high (East Beach, northern part of the West Beach) or a high (the remainder of the peninsula) level of vulnerability to a future tsunami (Faiqoh et al. 2013).

Most of the recent assessments of the future tsunami risk potential focused on building expansion in Pangandaran (Mardiatno et al. 2020), inundation ranges (Windupranata et al. 2020), and where best to position tsunami shelters (Ningrum et al. 2020). It was found that the development of buildings in the coastal strip after the 2006 tsunami was rather slow; and that buildings destroyed by the tsunami were reconstructed at the same location. Mardiatno et al. (2020) noted that the number of hotels had increased from 57 in 2006 to 110 in 2017, but the overall increase in the number of buildings was less—from 921 in 2006 to 1,054 in 2017, suggesting that two-fifth of the new buildings were hotels. Figure 6 of Mardiatno et al. shows an aerial map where they superimpose the new buildings on the build-up area from 2006 and illustrate that very little had changed (Mardiatno et al. 2020, p. 6). Mardianto et al. (2020) found that the density of people in Pangandaran increased, and that this increased the potential risk, but they did not include this in their assessment.

In order to assess future tsunami risks properly, data on the physical geography of the area and construction activities are important, but so is the social and cultural

Fig. 1 Clockwise from top left: View of several high-rise hotels at the southernmost end of the peninsula in 2018 (photograph by Hotel Biru Laut, used under CC BY); Pangandaran's West Beach on New Year's Day 2020 when close to 100,000 people visited the peninsula

(photograph by MyPangandaran, used under CC BY); one of the smaller side streets in Pangandaran in December 2015 (photograph by V. Nijman); Pangandaran in August 2004 (photograph by E. Goverse, with permission)

context of the area under consideration. Information is needed not just on the number of buildings and the build-up area, but also on the type of buildings, the people that are present, and the origin of these people. In most villages, towns, and cities, the build-up area and number of people are linked, but this is different where tourists or visitors outnumber local residents. Vital information is needed on the size of the local resident population, the number of tourists that arrive, their origin, the duration of their stay and their temporal distribution. Entry to the Pangandaran peninsula is controlled by the local government and all visitors have to pay an entry ticket (currently USD 0.45 per person and USD 2.44–4.67 for a car, depending on its size), thus allowing for accurate records of the flow of visitors. At the beginning of each year these data are released by the regional government and reported in the local press.

I have visited Pangandaran 12 times over the last 25 years, first in 1995 and most recently in 2019 (Nijman 2012, 2019) and as such I am thoroughly familiar with the layout of Pangandaran. Over this period, I have kept track of the annual number of visitors, both domestic and international, that have visited Pangandaran as these figures are announced at the beginning of each year in the local press. I have observed first-hand how the area was affected by the tsunami and how it has been rebuilt. The number one aspect that has been largely overlooked by previous assessments of tsunami risks and risk mitigation (Bisri 2011; Faiqoh et al. 2013; Husrin et al. 2015; Mardiatno et al. 2020) is how much Pangandaran has changed in terms of the type of tourism, the type of hotels (above and beyond their footprint), and, most importantly, the number of visitors the peninsular attracts. Using a combination of first-hand data previously collected during my visits, discussions with local residents and government staff working in the village, and literature review, I provide an overview of the layout of Pangandaran prior to the 2006 tsunami, identify what has changed in terms of visitor numbers over the last 25 years as well as their background, and quantify the number of multistory buildings that have been erected on the beach fronts. Crucially, I explore how these development changes have affected the potential risks of and risk mitigation following a future tsunami.

2 Changes in the Nature of Tourism

Based on research conducted in 1992, Wilkinson and Pratiwi (1995) noted that despite the growing number of tourists, Pangandaran still had the feel of being a village—but perhaps not for long. This is how Pangandaran was when I first visited it and it had not changed very much during my last pre tsunami visit in 2004. The number of

permanent residents in Pangandaran has increased only slowly over the last decades. From 7400 in 1992, this had increased to 7500 by 2012, and in 2015 to 8400. In the 1990s and early 2000s there was no specific strategy to increase the number of tourists to Pangandaran, or, if there was, it was not very effective. For more than a decade the numbers remained relatively stable at around 900,000 visitors a year (Fig. 2). Following the tsunami tourist numbers, understandably, dropped considerably, to 263,000 and 258,000 for 2006 and 2007, respectively. Since 2007, Pangandaran has seen an exponential increase in the number of tourists, with numbers doubling every three to four years. In December 2018 another tsunami hit Java, this time following a major lateral collapse of the Anak Krakatau volcano in the Sunda Strait between Java and Sumatra, some 400 km from Pangandaran. In the months following this event, the number of tourists visiting Pangandaran dropped significantly, resulting in an overall lower than expected number of tourists in 2019 (Enceng 2020).

Notwithstanding the dip in 2019, the year-by-year increase in tourists visiting Pangandaran was achieved in part by a sustained campaign targeting mainly domestic tourists. This has been especially the case since in 2012 when Pangandaran became its own regency (*kabupaten*) with tourism on the Pangandaran peninsula as one of the regency's main economic drivers. Domestic tourists arriving in the 1990s were mostly from the cities of Bandung (60%), Jakarta (10%), and other cities in the western and central Java (Wilkinson and Pratiwi 1995); these same two cities, in addition to Yogyakarta (central Java) and Surabaya (eastern Java), have made up the majority of visitors in recent years (Nugroho et al. 2013; Nijman 2019). None of these cities are situated along Java's southern coast and their inhabitants are not familiar with the risks of tsunamis. In the 1990s, the number of foreign

Fig. 2 Tourist numbers in Pangandaran, showing total annual numbers (blue line) and the percentage of foreign tourists (red bars) and some significant events (Figure credit: V. Nijman)

tourists in Pangandaran was around 16,000 or 2% of the total. In the aftermath of the economic crisis of 1998 and 1999, the number of foreign tourists dropped significantly to around 4000 a year or less than 0.5% of the total. Following the tsunami, the number of foreign tourists has remained more or less stable in terms of absolute numbers (about 7000 a year) but proportionally they represent a much smaller number (Fig. 2). While in the 1990s foreign tourists originated mainly from Europe (Wilkinson and Prawiti 1995), in recent years most have come from other Asian countries such as Malaysia, Singapore, and China (Nijman 2019).

Data from 2019 show that during Lebaran (or *Idul Fitri* / *Eid al-Fitr*), the annual International Kite Festival, and New Year about three times as many visitors come to Pangandaran as on an average day (Rachman 2019, 2020). Weekends are more crowded than weekdays (Nijman 2019). Trips from domestic visitors are shorter than those of foreign tourists—two and four days on average, respectively (Wilkinson and Prawiti 1995).

Table 1 shows that the number of tourists present in Pangandaran has changed considerably and on weekdays there are now about two and a half times the number of people and the increase over the weekend is even larger. During the various holidays, peak numbers can be considerably higher: on 31 December 2019 92,811 visitors were present to see in the New Year on New Year's Eve and Day, bringing with them 17,783 vehicles (Rachman 2020).

3 Changes in Infrastructure Following the 2006 Tsunami

The main road infrastructure and layout of Pangandaran have not fundamentally changed since the 1990s—much of this is due to the geographic constraints of it being situated on a narrow peninsula. The only exception to this is at the southernmost end where a small 250 m long road (*Jl Pamugaran Bulak Laut*) linking the West Beach and the East Beach has been created. In the event of a future tsunami these narrow roads—most are 6 m wide at their widest—inevitably will lead to blockage of the evacuation routes Table 2.

Table 1 Estimates of the number of people present on any given day in Pangandaran (residents and tourists) at various times

Year	Weekdays	Saturdays or Sundays	Holidays
2006	9500	12,000	22,000
2019	23,000	44,000	59,000

Note: Holidays refer to Lebaran, the International Kite Festival, and New Year's Day. The 2006 tsunami hit Pangandaran on a Monday

Table 2 Number of high-rise hotels in Pangandaran in 2019

Type of Hotel	West Beach	East Beach	Total Rooms
3-story	6	1	337
4-story	2	1	289
5-story or above	2	2	605

Prior to the tsunami, much of the peninsula was characterized by single-story bamboo, timber, and traditional brick structures. To the best of my knowledge there were no three-story buildings. In 2019 at least 14 three to six-story structures, all hotels, have been erected on the West Beach, the East Beach, and roads immediately adjacent to these amenities, with a total capacity of 1231 rooms. Most of these hotels have been erected on land that was previously already built on, with single-story buildings making way for tall multistory buildings. In the event of a tsunami, these high-rise hotels may provide shelter for some of the visitors, but peak numbers exceed the hotel's capacity to provide shelter by an order of magnitude. In addition, the hotels tend to be at full capacity during weekends thus making them less capable of hosting a large number of additional persons seeking refuge from a tsunami. With most high-rise hotels at highly exposed locations at the south end of Pangandaran, a tsunami would funnel water along these buildings, accumulating debris as the surge proceeds, with no reduction in height or destructive force. The relatively small gaps that are present between the high-rise hotels do not allow the water to sufficiently dissipate. While hotels do have the potential to act as shelters, there is the real risk that high-rise buildings might collapse in a future tsunami.

Muntasib et al. (2018) assessed the level of knowledge of potential hazards in Pangandaran among tourist and local residents and, while for both groups tsunamis ranked first, overall awareness was low with only about 20% of the respondents mentioning tsunamis as a potential risk. Evacuation behavior is determined in part by response capability. This response is influenced by a number of factors: (1) geography and infrastructure (slope, population density, evacuation bottlenecks, critical facilities); (2) population demographics (with women and children among the more vulnerable groups); and (3) policy and planning (community preparedness, land use planning, decreasing settlements close to the sea, adhering to building standards). It is also determined by knowledge levels, with some evidence suggesting that communities previously affected by tsunamis in the past, or ones that are of known high risk, are better informed than communities that live in tsunami-safe areas (Hall et al. 2017).

In places such as Pangandaran, where residents are present alongside large numbers of tourists from cities where tsunamis are not part of the landscape, a more practical approach to tsunami disaster mitigation efforts is needed. Upon arrival, tourists (both domestic and international) need to be provided with basic disaster awareness information. This can be included in hotel rooms (Kelman et al. 2008), but it could also be handed out alongside the entry ticket upon arrival. This should be made available in Indonesian and English, but it may be prudent, additionally, to include versions in Arabic (to cater for halal tourism) and Sundanese (the language of western Java where the majority of domestic tourists live). In 2018 a tsunami shelter was opened near the central tourism market (about 600 m from the coast) with a capacity of 5100. Unfortunately, it is situated largely hidden from view, and many tourists may leave Pangandaran without ever having noted its presence. It is vital that the existence and the location of the tsunami shelter are much better signposted, both within the town itself and as part of the basic disaster awareness information. The mosque near the main entrance gate (about 1.2 km from the coast), with a capacity of 682, has been identified as another tsunami shelter (Husa and Damayanti 2019). Furthermore, two schools (*Sekolah Menengah Pertama Negeri 1* and *Sekolah Menengah Kejuruan Negeri 1*), with capacities of 3221 and 2872 have been suggested as alternative tsunami shelters (Husa and Damayanti 2019), but both are some 3 to 4 km from the main tourist area (running 3 m/s covers this distance in 17 to 22 minutes). Combined the tsunami shelter, the mosque, and the schools, when used optimally and to full capacity, can shelter about 12,000 people, which equates to about a quarter of the people present in Pangandaran at an average day over the weekend.

After 2006 a large number of yellow metal signs were erected along the East Beach and West Beach roads with a pictorial representation of a tsunami (warning the visitors of the existence of tsunami). At strategic sites, for instance near junctions, similar signs were erected pointing to evacuation routes (*jalur evakuasi*). Over time, however, these signs are hardly noticeable anymore among the thousands of advertising signs, billboards, and newly erected stalls, or may simply have disappeared (used for scrap metal). It is vital that these signs are maintained, replaced when necessary, and kept visible.

4 Future Tsunamis

It has been noted that if the 2006 tsunami had occurred one or two days earlier on the weekend, there probably would have been many more deaths on the crowded beaches (Mori et al. 2007). If the number of fatalities as a result of a

tsunami is related to the number of people that are present in an area, and knowing that the 2006 tsunami that hit on a weekday resulted in 413 deaths (Fritz et al. 2007; Reese et al. 2007), then we can make some cautious estimates about the impact of future tsunamis. With on average more than twice the number of people present on any given weekday in 2019 compared to 2006, all other conditions being equal, the potential number of fatalities may conceivably be close to a thousand; if a 2006 scale tsunami event happened over a weekend, the number of fatalities could be in the low thousands. The impact of a future tsunami has the potential to be even more severe during the New Year or Lebaran holidays or the International Kite Festival. The risk level is much greater now than it was in 2006, because the majority of people present in Pangandaran at any given time are tourists, visiting the areas for one, two, or three days, and many of them are not familiar with the layout, escape routes, and tsunami shelters, or indeed the risk of a tsunami. This greatly elevated risk level will enhance the negative impacts of a future tsunami.

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