

# Climate Change Study on Coastal Settlements and Traditional Architecture in Madura Island, Indonesia

Ispurwono Soemarno<sup>1</sup>, Muhammad Faqih<sup>2</sup>, Wahyu Setiawan<sup>3</sup>

## Abstract

Various studies on the phenomenon of global warming and climate change have been done. The results among other things are the rise of sea water levels and the change of air temperature. Such conditions would supposedly affect coastal settlements and its socio-economic as well as cultural future of the Madurese. The influence may also arise against existing Madurese traditional architecture. This study is aimed to understand the effects mentioned above.

The method used in this study is a series of field observations and interviews conducted in four regencies in Madura Island. Changes observed are the natural phenomena associated with climate change, including the indication of sea level rise and preventive actions as well as the current condition of Madurese traditional architecture.

This paper is a preliminary result of the overall study. The indication of sea level rise are found in three observed areas. Meanwhile, the changes of Madurese traditional architecture found in this study are mainly due to densification process. All the results are expected to be the subject of further studies to gain the anticipation of possible negative impacts through adaptation efforts.

**Keywords:** climate change, coastal settlements, Madurese traditional architecture

## 1. Background

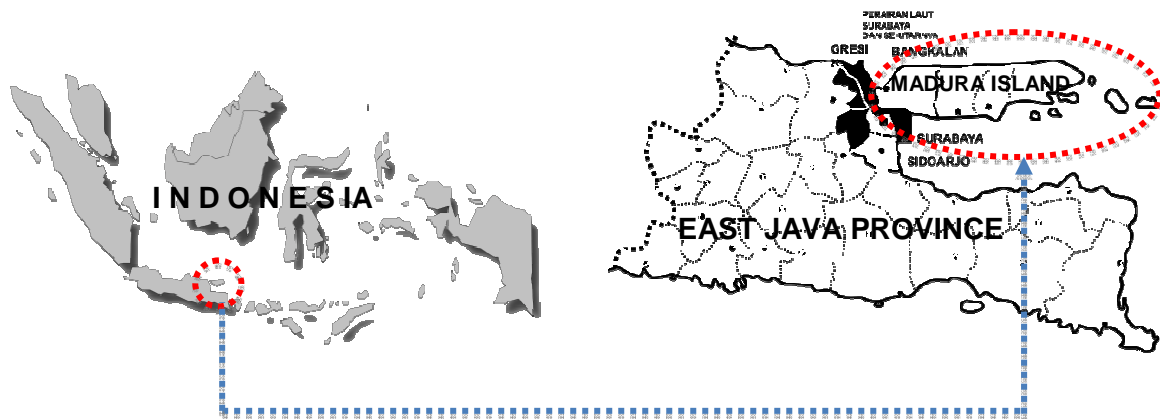
Madura Island is situated on the north of East Java, separated by Madura Straits. The majority of Madurese is devout Moslem society, while the main livelihood of Madurese is fishing. Fishermen settlements are scattered along the coast of this island. Other livelihoods are trader, tobacco farmer and salt maker.

---

<sup>1</sup> Senior Lecturer; Architecture Department; Sepuluh Nopember Institute of Technology; Jl. Tenggilis Utara 2/22, Surabaya 60292, Indonesia; [isp4251@yahoo.com](mailto:isp4251@yahoo.com)

<sup>2</sup> Senior Lecturer; Architecture Department; Sepuluh Nopember Institute of Technology; Jl. Ilmu Pasti Alam C-1, Kompleks ITS, Sukolilo, Surabaya, Indonesia; [faqih@arch.its.ac.id](mailto:faqih@arch.its.ac.id)

<sup>3</sup> Lecturer, Architecture Department; Sepuluh Nopember Institute of Technology; Jl. Sidoyoso IX/22, Surabaya, Indonesia; [wahyu9san@yahoo.com](mailto:wahyu9san@yahoo.com)



**Figure 1: Indonesia and Madura Island**

Administratively, Madura Island consists of four regencies, from west to east respectively: Bangkalan, Sampang, Pamekasan and Sumenep.

The Madurese has its own traditional architecture that is slightly different compared to Javanese architecture. In order to boost Madurese socio-economic development, the Indonesian government built Suramadu Bridge, which connects Surabaya in East Java and Madura Island. This 5.438 meter long bridge is completed in 2009.

This study is conducted in relation to the climate change phenomenon. It is an observation process aimed if Madurese clearly comprehends such phenomenon and whether it affects Madurese built environment, especially its traditional architecture. Interviews were conducted with related stakeholders. The questions raised to the staff of local environmental authority office among other things are whether they aware and comprehend the climate changes basic issues and their implication in Madurese context. Other information obtained include the locations of the Madurese traditional architecture that still can be found within the regencies in Madurese island. The next step is visiting the sites and comparing them with the theory of traditional architecture based on existing literatures. Furthermore, information related to climate change research results are also used to analyze the existing conditions in the study areas.

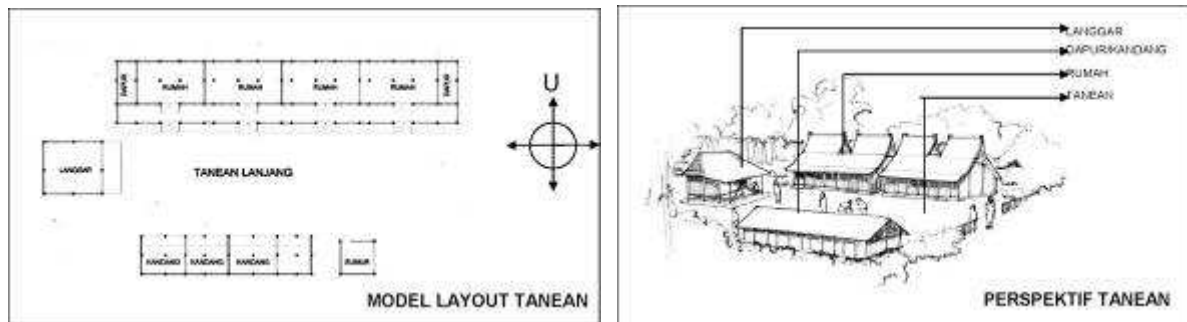
## **2. The Literatures and Field Findings**

### **2.1 The Madurese Architecture**

In 1986, Wiryoprawiro carried out a study on traditional architecture in Sumenep, Madura. Historically, Sumenep Kingdom existed in Madura Island in the past. This explains a variety of old kingdom buildings in Sumenep.

Tulistyantoro (2005) described his study on aspects and significance of the Madurese settlement. He explains that in the case of residential home extended family is adherent. The house is located on the North side, with *langgar* or *mushala* (a small mosque) located at the West end, while cattle sheds are located on the South. The layout of the kitchen was

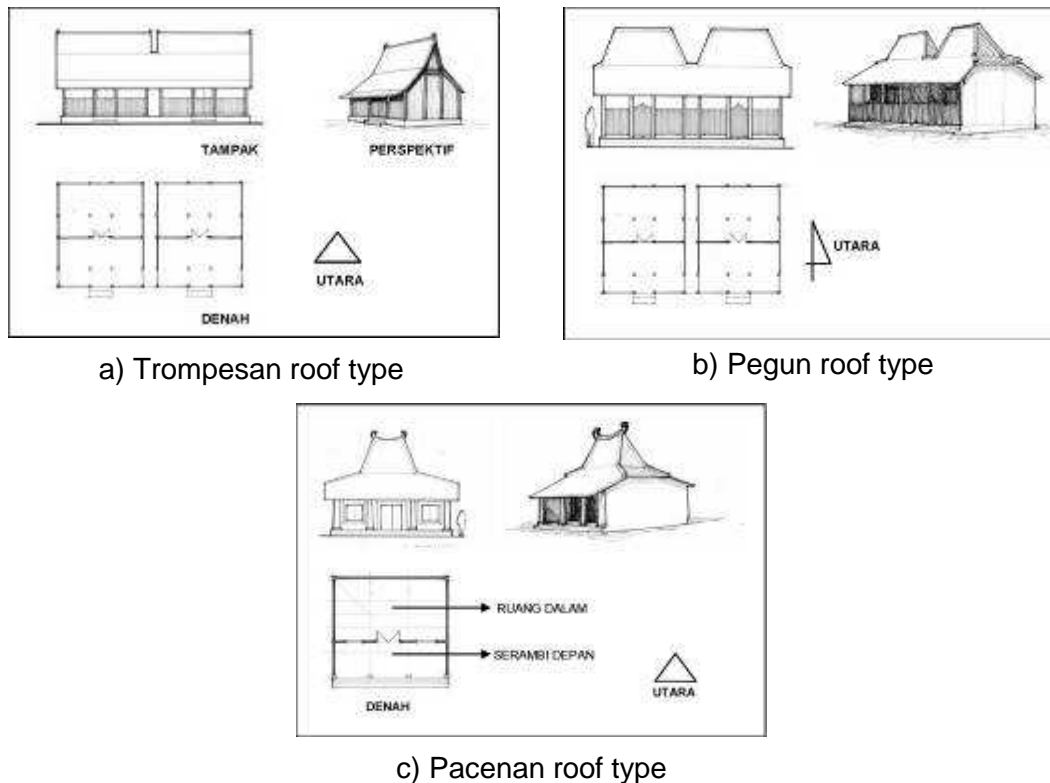
originally adjacent to the cattle sheds, but many kitchen layouts then shifted to the side or back of the house. In addition to cooking activities, the kitchen is also functioned as a place to store crops or agricultural products. The courtyard, which is formed and located in the middle of these buildings, is called *tanean*. A long courtyard is called *tanean lanjang*.



**Figure 2: A courtyard is formed and situated among buildings within a Madurese settlement**

Dwelling is the main residence, usually only has one door toward the front. This building is a space to sleep with a full wall on four sides. In addition, there is an open porch with a half-wall that serves well as a sitting room or area to receive guests for women. Dwelling floor height is around 40 cm above the surrounding land. Ground floor material is earth, plaster or other materials such as terracotta. The doors are generally made of wood, and roof materials are palm leaves, thatch or tiles depending on the economic viability of its inhabitants. The form of floor plans, location of the main mast, and shape of the roof can distinguish building form. Based on the floor plan, the building is divided into *slodoran* and *sedana*. *Slodoran* consists of one room with two doors and a porch with one exit. *Sedana* has two rooms and two doors but only has one porch with one exit. Based on its main column, a building can be divided into *bangsai* and *pegun*. *Bangsai* has similar shape of Javanese *joglo* beheaded on either side, while *pegun* is shaped pyramid-like that has overhang on the front and rear part. Both types have the same structure of four main columns, but *bangsai* always has ridge with dragon tails shape.

From its form, roof can be differentiate into *pacenan*, *jadrih*, or *trompesan*. A roofed shed house is called *pacenan* (derived from the words 'pa-china-an'). *Jadrih* is a roof type on a house with two ridges; while *trompesan* is a roof type that consists of three segments.



**Figure 3: Trompesan, pegun and pacenan roof types**

## 2.2 The Climate Change factors

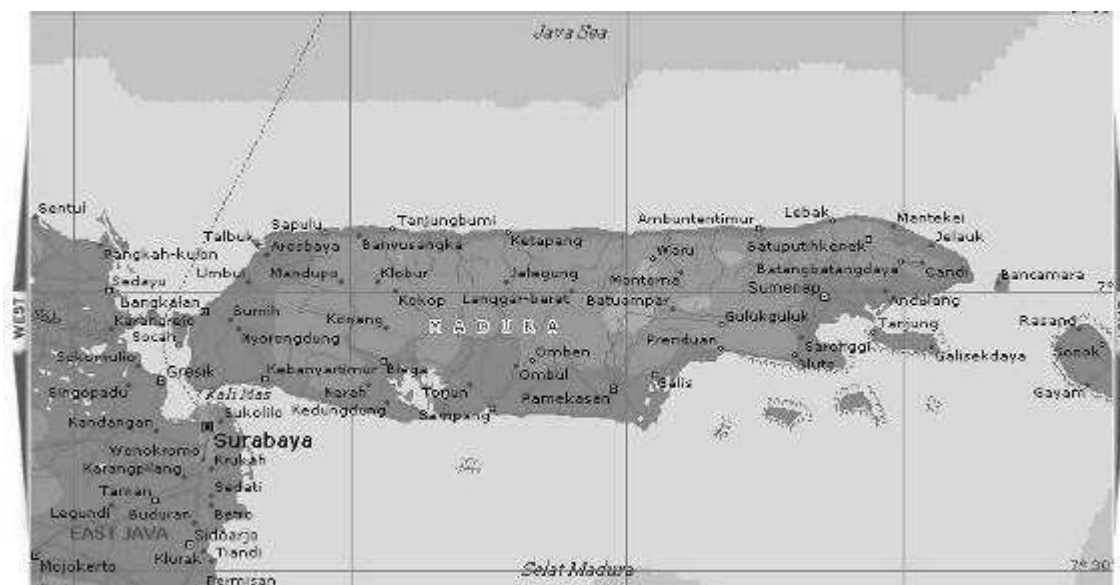
Climate change is a term refers to large changes in temperature, precipitation snow, or wind patterns lasting for decades or more. It is believed as real and urgent challenges that are affecting people and the environment worldwide. Climate change generates significant change on earth, including air and ocean temperatures rise, snow and ice melt, and the rise of sea levels. In this study, the observation on sea level rise is chosen as a method used in detecting the climate change at the study areas. Other climate change indicators indicated above require a long time to measure; especially air and ocean temperature rises, in order to acquire significant results. Declining in fish catches by the fishermen could also be resulted by the climate change phenomenon. However, several other factors have to be taken into account to get valid study results.

The study of Bappenas RI (Indonesian National Development Planning Agency) in 2010(b), pointed out that land temperature increase only  $0.5^{\circ}\text{C}$  in wet months (December to February) for the period between 1904-1994 (with Jakarta as the sample), while during the dry months (June to August) there is an increase of  $1.5^{\circ}\text{C}$ . In terms of sea level rise due to climate change in Indonesia, Bappenas RI (2010a) stated that the result in comparing the average of sea level during the period 2001 to 2008 and the period 1992 to 2000 shows a sea level rise between 2 - 12 cm with an average increase of 6 cm in a period of 7 years.

In architectural aspects, change in building material used or comfort in building interior might also be the results of the climate change. These cases also need several factors to be considered valid as climate change implication. In this study, change in building floor level or building relocation are due to the rise of sea levels.

### 2.3 The Field Findings

The interviews and discussions are carried out with related parties in four environment regencies (Bangkalan, Sampang, Pamekasan and Sumenep) offices in Madura Island. The results of these actions are mostly having none or barely related directly to climate change implication. The awareness of climate change consequences is still somewhat limited among staff in the environmental offices in all regencies in Madura Island.



**Figure 4: Madura Island**

There are four locations in northern coast of Madura and one in southern coast surveyed in this study. They are Sepulu and Tanjungbumi in northern Bangkalan regency, Ambunten and Pasongsongan in northern Sumenep regency, and Camplong in southern Sampang regency. The findings in those field survey areas are described below.

The observations, associated with the presence of Madurese traditional architecture conducted in Bangkalan regency, are barely found any group of buildings that form a complete residential area with its *tanean lanjang*. This fact is consistent with the study results conducted by Sharvina (2012) in Labang district, southern part of Bangkalan. She has not found any Madurese settlement completed with *tanean lanjang* pattern there. However, some Madurese traditional buildings still exist in Sepulu, a small district at coastal area in northern part of Bangkalan.



a)



b)

**Figure 5: a) Fishermen village at Sepulu district; b) A traditional house found at Sepulu**

From Figure 5b) above, clearly seen that one traditional house has been surrounded by other, relatively, new buildings. This densely populated village resulted on the need of more land to build their dwelling. This need is also shown in the following figure 6 a) & b) which showed an attempt to enlarge the coastal area through reclamation efforts.



a)



b)

**Figure 6 a) & b): A reclamation effort to get 'new' land for dwelling**

On the other hand, it is clearly seen that tidal water level has increased in this area. This is demonstrated by the construction of embankments to protect the area from high waves. A broken house located right on the beach is also found. The information from the field stated that the inhabitants moved to another place that is considered as 'safer place' from the threat of rising sea level at this beach. These situations are shown in Figure 7 a), b) and c).



a)

**Figure 7a): The embankment, which gives protection from waves**



b)



c)

**Figure 7b) & c): The broken & abandoned house**

Furthermore, at this survey area, a wall was built with the purpose of a protection from the ocean tides. It is apparently made several times in different times. This can be indicated from the different materials used for that wall. This fact indicates the increase of tidal waves from time to time at this survey area.



**Figure 8: A protection wall against tidal waves that was built in different phases**

In addition to the circumstances above, it has been found two buildings with Madurese traditional architecture character at this survey area. One building stands next to a new building. There is an open space in front of the second building. This space might be part of *tanean lanjang* in the past. (Figure 9a) and 9b)).



a)



b)

**Figure 9a) & b): Two buildings with traditional architecture character at the surveyed area**

In Camplong district, part of Sampang regency, at the southern coast of Madura Island, a protection wall was also found. However, it is not as high as the one in Sepulu, northern part of Bangkalan regency. The coast settlement situation in Camplong and the waves protection wall can be seen in the following Figure 10.



a)



b)

**Figure 10 a): Fishermen settlement at Camplong coast; b) The waves protection wall**

In Camplong study area, some Madurese traditional architecture buildings are found. Some of these traditional buildings are situated at the same site. The existence of *tanean lanjang* still can be seen here, even though some buildings have changed their function. It is shown in the following Figure 11a) & b). Both figures were taken at the same location and from the opposite direction.





**Figure 11 a) & b): Both figures show the existence of *tanean lanjang* as described above**

In Sumenep regency, two locations are chosen as the survey study areas, namely Ambunten and Pasongsongan. Both districts are situated at the northern coast of Madura Island. At Ambunten, local inhabitants describe the increase in sea level. They showed their graveyard that has been eroded underneath due to the reason above. They also explained that within the last five years, the level of tides is increased. They supported their story by showing the sign of previous water level tide.



**Figure 12: Eroded graveyard land at Ambunten**



**Figure 13 a), b) & c): All three figures above show the gradations of sea level rise points at Ambunten coast**

At Pasongsongan district, the sea level rise was very clear. During the interview phase, a staff of Local Government Development Board explained that in Pasongsongan district, the Public Works Department was in the process of building a wall protection against the tidal waves. During the field survey, some parts of the protection wall were being prepared. Moulding of these reinforced concrete walls were also in forming process. Some of the preparation works can be seen in the following figures.



a)



b)



c)



d)

**Figure 14 a), b), c) & d): The tidal waves retaining wall preparation process**

### **3. Conclusion**

From all the discussions described and figures presented above, some conclusions of this climate change study on coastal settlements and Madurese traditional architecture can be drawn as follows:

- The sea level rise is clear in all Madura coastal areas. This is evident with the construction of retaining walls in some places in the survey areas.
- The shifting of buildings to a higher location and the erosion happened on a cemetery site at the study areas also proved the sea level rise.

- The sea level rise on the northern coast of Madura, however, is higher than the south coast. The large area of Java Sea in compare to Madura Straits might be the reason of these differences.
- Some Madurese traditional architecture buildings are still exist throughout the island. Meanwhile, the concept of *tanean lanjang* is barely found. It might be in the extinction process. The main reason of this process is the scarcity of land while the population is always increased over the years throughout the island.

In light of the findings above, some task actions that could be carried out by the government including:

- Provide periodic explanation to the public about a variety of negative consequences that may arise due to the phenomenon of climate change, and efforts to address them.
- Continue to take necessary actions against disasters caused by the sea level rise and protect the coastal settlements from the risen tidal waves.
- Preservation the remaining Madurese traditional architecture buildings and encourage Madurese society to rebuild the building compound with *tanean lanjang* concept. It might not be an easy process. Some government incentives in the form of property tax might be needed to preserve the traditional architecture treasures.

## References

Aldrian, Edwin; Mimin Karmini & Budiman (2011) "*Perubahan Iklim di Indonesia*", ICCTF, BMKG, Jakarta.

AR4-IPCC-Climate Change (2007) "*Synthesis Report, An Assessment of the Intergovernmental Panel on Climate Change*", Velencia, Spain.

Bappenas RI (2010a) "*Indonesia Climate Change Sectoral Roadmap – ICCSR, Basis Saintifik: Analisis dan Proyeksi Kenaikan Muka Air Laut dan Cuaca Ekstrim*", Bappenas RI, Jakarta.

Bappenas RI (2010b) "*Indonesia Climate Change Sectoral Roadmap – ICCSR, Basis Saintifik: Analisis dan Proyeksi Suhu dan Curah Hujan*", Bappenas RI, Jakarta.

Bappenas RI (2010c) "*Indonesia Climate Change Sectoral Roadmap- ICCSR, Synthesis Report*", Bappenas RI, Jakarta

Kementerian Negara Lingkungan Hidup RI (2007) "*Rencana Aksi Nasional dalam Menghadapi Perubahan Iklim*", Kementerian Negara Lingkungan Hidup, Jakarta.

Rapoport, Amos (1969) *“House Form and Culture”*, Prentice-Hall, Inc. Englewood – New York.

Sharvina, Ainun Nurin (2012) *“Perancangan Kawasan Pariwisata Kaki Jembatan Suramadu sisi Madura”*, unpublished Master Thesis at Architecture Department, Sepuluh Nopember Institute of Technology (ITS), Surabaya.

Tulistyantoro, Lintu (2005) *“Makna Ruang pada Tanean Lanjang di Madura”*, Dimensi Interior Journal, Vol. 3, No. 2. December 2005, p.137-152, Petra Christian University, Surabaya.

Wirjoprawiro, Zein Mudjiono (1989) *“Arsitektur Tradisional Sumenep, Madura”*, Bina Ilmu, Surabaya.

Yusuf, Arief Anshory dan Herminia Francisco (2009) *“Climate Change Vulnerability Mapping for Southeast Asia”*, EEPSEA, Singapore.