MONITORING THE DYNAMICS OF COASTAL SAND DUNES IN PARANGTRITIS AS A CONSERVATION EFFORT OF SCARCE LANDSCAPE IN INDONESIA *

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Abstrack

Sand dunes in Parangtritis are the only sand dune landform in Indonesia. The sand dunes are formed by the activity of Merapi volcano that continuously erupt pyroclastic material. The sand dunes are formed by marine power and strong wind, occurred in the southern coastal of Java toward the Indian Ocean.

The 1974 aerial photograph shows the total 456 ha areas are covered by sand dunes. In the early 1990s the government held a coastal reforestation to prevent the movement of sand dunes so that the rice field areas are not covered. Coastal reforestation is more intensified in 2005 after the tsunami in Aceh. Today, the current area of undisturbed sand dune from vegetation or buildings is only 41 ha.

The dynamics of sand dunes movement and extent change has been occurred continuously, so it needs to be monitored. Monitoring the changes of sand dune area is done by aerial photographs and satellite imagery in 1974, 2002, 2009, 2011, 2012, and 2013. The dynamics of sand movement are observed visually and GPS measurement, by making control point that is placed in the observed sand dune. Anemometer is used to determine the wind direction and speed.

Speed of the moving sand at Parangtritis sand dunes in dry season up to 25 km/h with an average flying height 15 cm. This lead to the formation of sand dunes occurred continuously. The 56 m/s wind speed can blow the sand grain sized 23 micron.

Formation of the sand dune types is determined by wind direction and type of the barriers, the most common type is barchan.

Key word: sand dune, Parangtritis coastal area, sand dune dynamics

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Background

Sand dunes Parangtritis the only landscape in Indonesia. It is very unique, because the presence of sand dunes usually found in the middle latitudes of the continent, but Parangtritis sand dunes in the area of tropical islands. Mount Merapi in Central Java, is one of hundreds of volcanoes that exist in the path of the fire ring in Indonesia. Known to be very active volcano Merapi pyroclastic material issued from the bowels of the earth. Parangtritis sand dunes material believed to have originated from pyroclastic material igneous suffered due to rounding and shrinkage rolled grain transported by two major rivers namely Opak and Progo.

Reached the mouth of the river, pyroclastic material has been selected into fine sand. The sand is then entered into the Indian Ocean which has the character of big waves and deep seafloor topography. Grains of sand washed in sea water and float in the water body. Alongshore current flow eastwards bringing sand smooth moves and partially restored by the waves towards the shore.

The intensity of sunlight throughout the day causing sedimented grains of sand on the beach to dry quickly. Grains of fine sand (diamater 0.2 micron) will be transported by strong southeast winds moving toward the northwest. Process that occurs continuously this causes the formation of small mounds of hills known as the sand dune.

By local communities, with sand dunes known as the sand moves. That's because the location of these sand dunes are always shifting. Parangtritis village communities have coexisted for decades with sand dunes. They feel that the movement of sand dunes is considered active enough quite disturbing. This is due to their farmland on the wane since buried by sand. The houses were built near the beach interrupted by gusts of wind that brings sand material. Simple steps undertaken by the community is to create a green belt, which is by planting a variety of crops to curb the movement of sand dunes.

The high rainfall in the region, the plant is able to adapt to the material of sand and sun pretty good strong growth. Along the coastal afforestation program, start planting in many areas of sand dunes, which are mostly not a native coastal plants. This affects the shrinking sand dunes in Parangtritis.

Landscape of sand dunes Parangtritis

Landscape of sand dune stretches of craggy limestone hills on the east side to the mouth of the Opak river on the west side. The area of distribution of the sand dunes approximately 500 ha. Distribution of the sand dunes spread in the form of a triangle. In the eastern part of the development of sand dunes hampered by dense settlements. East side of the village known Parangtritis is a very famous beach in Yogyakarta.



Figure 1 . Landscape of Sand dune Parangtritis

Parang Kusumo beach known as the Java community do the ritual tradition of giving alms sea. This beach is also found in the attractive natural appearance that is the igneous rock outcrops, and hot springs. When the new year arrives Javanese calendar, the beach is visited by thousands of people.

Parangtritis sandbanks known as barchan sand dunes. This is due to the formation of sand dunes that are often found resembles a crescent moon. The formation and dynamics of sand dunes occur in the dry months (May to October) at which time the wind was blowing southeast. In the rainy season, in some places in the area of sand dunes formed lake will be dry when the dry season arrives. At this time the landscape of sand dunes Parangtritis often used for movies and photo shoots. Development of sand dunes in the western part of this area has been hampered because many plants overgrown greenery beach. Most of this area is used by people for farming onions and peppers on a domestic scale. Communities also use dry wood to be used as household fuel.

At the west end of the area known as the sand dune Depok Beach. In the last 10 years this beach is known as the culinary center of the fish. Often found migrating from Cilacap fishermen live here to look for fish. In Depok beach also has built the foundation for sport aviation aircraft. Jogja Airshow Festival held every year at this place.



Sand dunes in the north is an area of dry land rice fields and residential areas. The main agricultural commodities were red onions and peppers. Parangtritis village inhabited by about 7,200 people, who have the primary livelihood as farmers, fishermen, civil servants and some work in the tourism sector.

Depreciation of land area sand dunes

Sand dunes in Parangtritis is formed by aeolian marine. Continuously sedimented winds bring sand from the sea to form sand dunes. From 1974 aerial photographs show that at that time distribution of sand along the coast to reach an area of about 456 hectares stretching from the east to the mouth of the Opak river.



Figure 3. Sand Dune in 1974



Movement of sand dunes continually reduce the area of agricultural land of farmers. Rice fields in the southern part slowly covered by sand dunes. So at that time encouraged tree planting activities at the beach with the aim to curb sand dunes into agricultural areas. Coastal afforestation activities are still going on until now, where the coastal afforestation program into routine activities of the forestry ministry especially after the terrible tsunami disaster in Aceh, which occurred in 2004.

Constriction area gumukpasir apart due to the widespread greening coastal area is also influenced by socio-economic changes in environmental conditions. Before the bridge was built connecting Yogyakarta, Parangtritis a poor and remote villages. The existence of the bridge over

the Opak river has changed significantly village Parangtritis especially from the tourism sector. Society has additional income from the tourism sector by selling fish, kiosks, parking and rent a vehicle tour.





Figure 4. Sand Dunes in 2009

The impact of the growth in the economic sector especially tourism is increasing illegal buildings that are not expected. The location of the building disrupt the movement of sand dunes. Building which functioned for most of the entertainment facilities built by people from outside the village Parangtritis.

Now this, from the mapping using high-resolution imagery, land undisturbed sand dunes lives about 41 ha. Constriction area effectively sandbanks will occur during the rainy season, which at that beach vegetation growth vertically or horizontally. In contrast to the dry season, with a gust of wind, the growth and movement of sand dunes will be widespread.

Geospatial approach to save and protect of sand dunes

As the landscape only in Indonesia, sandbanks Parangtritis an object is very important coastal space. Geospatial approach to be an effective means to maintain, and monitor the dynamics of sand dunes. One of the efforts of the Coastal Geospatial Laboratory Parangtritis is to construct a spatial geo database sand dune area. In collaboration with aerospace sports federations Jogjakarta, shooting aerial photographs of sand dunes area is done periodically in order to obtain image data multiple times. The existence of a light aircraft runway is very helpful in the acquisition of aerial photography in the sand dunes area.

Aerial photographs produced through the use of a vehicle shooting micro light aircraft (trike). Furthermore, the data is processed in the laboratory for correction and rectification. Field checks made to take the points with GPS coordinates so that the resulting corrected photographs. Appearance of small format aerial photographs provide detailed enough information objects. The boundaries of the sand dune area of the map to do this photo. Shape and pattern of movement of the sand dunes can be monitored from aerial photographs.



Figure 5. Small Format Aerial Photo Sand Dunes Parangtritis

Measuring changes sandbanks also conducted terrestrial field. As it is known that sand movement occurs through the process of crawling, jumping and floating (Susmayadi I, 2009). Measurements of wind speed in the area of sand dunes done during the day and night. From the results of measurements with anemometer made by Willy Sihotang (2013), the wind speed during the day more than at night. Recorded on May 14, 2013 the average daytime speed of 12 meters / sec and at night was recorded 1.4 m / sec.



Figure 6. Measurement and monitoring of Sand Dune

Measurement of the shape of the sand dunes were calculated using two camera developed by Nyoman Jelun (2012). Measurements were performed using two cameras mounted on the front of a series of balls. The ball has a position relative to a reference point. The result is a 3-dimensional sand dune formations. With regular monitoring is done, then the change in shape of the sand dunes can be measured.

Various forms of sand dunes that are still found in Parangtritis are as follows:



Barchan - Sand Dune



Parabolic – Sand Dune



Ripple Mark - Aeolian Process

Figure 7. Type of Sand Dune Parangtritis



Barchan - Sand Dune



Parabolic – Sand Dune



Ripple Mark - Aeolian Process

Sand Dunes Parangtritis in Future

Parangtritis sand dunes, a unique landscape and rare islands found in the tropics. For that we all need to maintain and preserve the existence of sand dunes. Local government as a policy maker, is expected to soon issue a policy supporting the various local communities in order to keep the preservation of the sand dunes. People in the village Parangtritis fully aware they live with their sand dunes and thankful and ready to keep. Village community spirit fully deserves our support by all lovers of the environment through a variety of capabilities that we have.

Reference :

- Laboratorium Geospasial Pesisir Parangtritis 2013. Gumuk Pasir Barchan itu masih ada, Upaya penyelamatan Bentang Alam Gumuk Pasir di Pesisir Laut Selatan Yogyakarta.
- Sunarto, 2009, Penaksiran Multirisiko Bencana di Wilayah Kepesisiran Parangtritis. Pusat Studi Bencana Universitas Gadjah Mada Yogyakarta