

# CHANGES OF PEMALI RIVER DELTA IN BREBES CENTRAL JAVA, INDONESIA

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## I. INTRODUCTION

Indonesia is a tropical country with high rainfall intensity that often cause erosions in many watersheds in Indonesia. Arsyad (2000) in his book mentioned that the force of water that flow on the earth surface is the main cause of erosions. Erosions that happen in a watershed will produce sedimentations and causing intensive changes in the delta area. Erosion is one of the destructive forces that included in the process of forming earth surface (Ludiro, 1985). Changes in the earth surface not only caused by the physical factor, but also caused by human factor. These factors also cause the changes in the delta areas.

The north coast of Java has the characteristic of sloping beach and a sediment deposition region. Many primary rivers in Java empty into the north coast and bring sediment material caused by erosion in the headwaters. Pemali River is one of the rivers that empty to north coast of Java. Pemali River estuary located in Brebes Regent and the large number of material that deposited in the delta caused this delta categorized as prograded coastal.

Pemali River Watershed is one of critical watershed in erosion and become the priority in conservation program (Arsyad, 2000). The condition of headwaters will affect the condition of the watersheds estuary and the river sediment will also affect the changes of shape and delta areas.

Previous research about Pemali River has been conducted by Hollerwoger which describe the changes of Pemali River delta in 1863-1865, 1920, 1964. Hermawan (1995) also mention Pemali River in his research of Stadia Delta in Ci Manuk watershed within period of 1984-1994. This resesearch tries to continue the previous research by analyzing the delta of Pemali River from 1971 to 2004.

## II. METHOD

This research uses time series data acquired from various source and institution such as:

- ◆ Field survey to investigate the delta location and gathering information related to Pemali River delta.
- ◆ Sea current bathymetry maps from Hydro-Oceanographic Service of the Indonesian National Navy (Dishidros TNI-AL)
- ◆ Time series landuse map (1971-2004) from Directorate of Landuse, Department of Home Affairs, National Land Agency (BPN), and National Coordinating Agency for Survey and Mapping (BAKOSURTANAL)
- ◆ Rainfall and Pemali River Debit data from Water Resource Management Office Pemali-Comal
- ◆ Sedimentation data from Brebes Regent Irrigation Office

The data were groups into two groups that explained the delta characteristic and the landuse change in the Pemali River Watershed. All spatial data then processed using GIS software to get the changes in the delta. The time series data were overlaid each other and give result of the difference in each period.

The result from landuse change then analyzed to see the relationship between the landuse conversion and the changing of delta in Pemali River.

### III. RESULT & DISCUSSION

#### 3.1 Landuse Change in Pemali River Watershed

Time series data is use to detect the landuse change in Pemali River Watershed. Based on the available data, the landuse change is divided into two periods, between 1971-1994 and 1994-2004. In the first period plantation/farm area, swamp, rice field, and bare land experienced an area reduction, while moor areas are increasing. In the second period there is a reduction in forest, grassland, bare land and moor, but there is an area increase in swamp forest, plantation/farm area, rice fields, bushes, and fish pond.

#### 3.2 Changes in Pemali River Delta

By focusing the research on the Pemali River Delta, it can be seen that since 1971 until 2004 the delta area is increasing starting from 4.373,69 ha in 1971 to 5.071,46 ha in 1994, and 5.136,56 ha in 2004. In the Pemali Delta there are seven small rivers that empty to the Java North Sea, and the changes for each river estuary can be seen in the table and maps below.

No.	Delta	Period of 1971-1994	Period of 1994-2004
1.	Kali Beting Delta	Abrasion	Accretion
2.	Kali Bonggol Delta	Accretion	Abrasion
3.	Kali Nipon Delta	Accretion	Accretion
4.	Kali Pemali Delta	Accretion	Accretion
5.	Kali Pemuda Delta	Accretion	Abrasion
6.	Kali Pulo Delta	Abrasion	Abrasion
7.	Kali Sitruntung Delta	Accretion	Abrasion

Fig. 1. Pemali River Delta change in 1971 - 2004

### IV. FACTORS CAUSING THE CHANGES IN PEMALI RIVER DELTA

#### Sea Current

Sea current around the Pemali River Delta very related to wind direction in Java Sea. The wind speed reaches 2 m/s in the east monsoon, and 8 m/s in west monsoon when the wind blows from west to east. This condition explains why the river sediment in Pemali River Delta dominantly moving towards east. The sedimentation of material carried by the rivers were then directed by the sea current causing delta accretion towards east of the delta.

#### Beach Morphology

The coast in Pemali River Delta is considered as muddy beaches. Muddy beach is a coast where there are many river empties their large amount of sediment material to the sea. The calm wave and flat beach in the area were not able to transfer sediment to the ocean deep causing sediment material deposits along the coast and keep adding the delta area.

The coast in north and east of Pemali River Delta has the characteristic of sloping beach compare to the west coast of the delta. With the addition of strong sea current from the west, these conditions apply the situation where sedimentation is always occurring in the east coast of the delta.

#### Sediment Material

High rain intensity will produce also high sediment material transferred by the rivers. The sediment then deposited in the river delta and causing the changes in the shape of delta. Based on the measurement in 2003,

it is recorded that Pemali River contributes 975.000 m<sup>3</sup> of sediment deposit in the delta. The high sedimentation of Pemali River is the result of erosion in the headwaters of Pemali River watershed.

### **Changing of Streamline**

River streamline can change naturally or manmade. Naturally the changing of streamline is caused by the nature of water that always flows to the lower area, and sometimes also depends on the geologic condition of the area. Since 1971 to 2004, the streamline of Pemali River is still the same, always flowing towards east. The water debit of a stream can become low if there is a silting of the river that caused the inability of river to transfer its sediment material. If the condition continuously to apply, the delta area will decreased and the streamline will flow to other direction. Pemuda River is the sample of what happen caused by silting of the river. In the dry season Pemuda River use to be a small stream that flow to the Pemali Delta, but nowadays the river only filled with mud and cannot be passed by boat.

### **Landuse Change**

The volume of sediment that keeps on increasing in Pemali River delta is related to the forest logging in the upper watershed. The lost of forest in the 1994 – 2004 period reaches 192,74 Ha and located at the headwater of the watershed causing erosions. In Ci Gunung headwater, forests are converted to rice fields and mixed plantation. This condition also applied in Rambatan river upper area where forests are converted to moor land. Landuse of mixed plantation and moor land tend to become easily eroded compare to forest landuse. The forest logging in the headwater area plus high intensity of rain will caused erosion.

In the Pemali River delta, landuse conversion also happens by converting mangrove forest into embankment for shrimp which causing abrasion to the beach. In the 1994-2004 periods, the area of embankment reaches 3.253,62 Ha.

## **V. CONCLUSION**

Based on the result, it can be concluded that the changes of Pemali river delta is moving towards east in the same direction with the Pemali River stream direction because of the effect of sea current, coastal morphology, sediment material, the changing of streamline, and landuse change in the headwater area. In the period of 1971-1994, the Pemali River Delta expanded by 698 Ha where in the west part experienced accretion, the mid part experienced abrasion, and the east part experienced both. While in the period Of 1994-2004 the delta expanded by 65 Ha where the accretion and abrasion area still the same with the previous period.

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