Erosion on the Secondary Canal of Reclaimed Agriculture Tidal Lowlands Telang I Banyuasin Regency

A. Syarifudin, M. S. Imanudin, A. S. Moerwanto, M. Yazid, and F. X. Suryadi

***Abstract*—Canal erosion is one of the technical issues in tidal lowland agriculture. It is influenced by water flow in the canal under a designated water network system. This study aims at exploring several aspects related to the erosion at the secondary canal in tidal lowlands of Delta Telang I, Banyuasin District, South Sumatra. A survey was conducted to measure canal profiles related to water flow, observe grain size and sediment transport in secondary canal and its implication on the operation and maintenance of water infrastructures. Results indicate that majority of secondary canals are unstable in relation to water flow. Sediment size in both SPD and SDU canals is categorized as non-cohesive. Operation and maintenance should be directed towards achieving stable canal to fulfil crop water requirement.**

***Index Terms*—Erosion and sedimentation, secondary canal, Opreation and Maintenance**

I. INTRODUCTION

Indonesia has reclaimed approximately 1.8 million ha of its tidal lowlands. Inventory conducted by the Directorate General of Water Resources, million ha of the reclaimed lowland were abandoned or unused [1].

Tidal lowlands are generally areas that have relatively flat topography, located near the beach at the mouth of river, formed naturally and periodically influenced by tides. Water management in tidal lowlands is uniqe compared to that in technical irrigation since water is always available in this area. Soil in tidal lowland has unique properties which are acidic, containing pyrite and peat. In addition, salt water intrusion is commonly found during the dry season.

Water availability for agriculture in tidal lowlands is technically influenced by existing water network system, canal and gate profile and conditions, and existing flow. In addition, it is also affected by the status of operation and maintenance caused, among others, by erosion.

This research aims at measuring the profile of secondary canals and its relationships with the erosion and implication on the operation and maintenance requirements for agricultural activities.

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A. Syarifudin, M.S Imanudin and M. Yazid are with Sriwijaya University, Indonesia (e-mail: syarifachmad6080@yahoo.co.id; momon2001hk@yahoo.com; yazid_ppmal@yahoo.com)

A. S Moerwanto is with Water Resources, Ministry of Public Works, Indonesia (e-mail: ariemoerwanto@yahoo.com)

F. X. Suryadi is with IHE-Unesco, Delft, The Netherlands (e-mail: f.suryadi@unesco-ihe.org)

II. RESEARCH METHODOLOGY

A. Research Sites

The research was conducted in Delta Telang I, one of the reclaimed tidal lowland areas in South Sumatra Province . The research location is shown in Fig. 1. Delta Telang I was reclaimed following the double-grid system (Rib System) along with Delta Telang II, Delta Saleh and Sugihan . The initial design (an open canal system) was prepared by the team from Bandung Institute of Technology (ITB). The system consists of main canals (also used for navigation), secondary and tertiary canals.

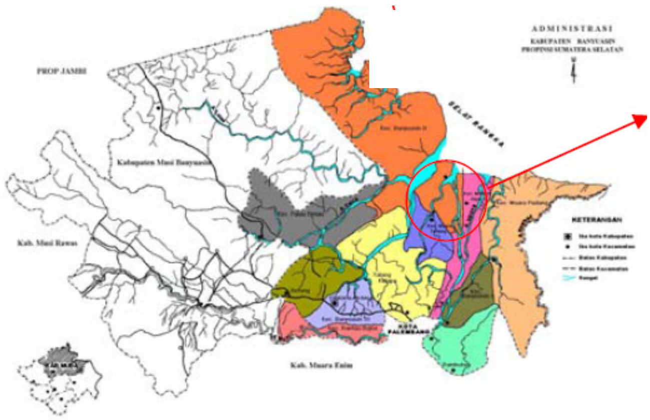

Fig. 1. Research location

Geographically, Delta Telang I lies between 2^0 29' to 2^0 48' South Latitude and 104^0 30' to 104^0 52' East Longitude. It is located in the North of Bangka Strait and South of the Musi river estuary. Delta Telang I is surrounded by Musi River in the East and Telang River in the West is shown in Fig. 2. The hydro-topographical layout of Delta Telang I (see Fig. 3). Hydrology of the block is determined by the condition of the adjacent canals, the status of water in each canal, the operation of gates, the influence of tidal and climatic conditions such as rainfall and evapo-transpiration [2].

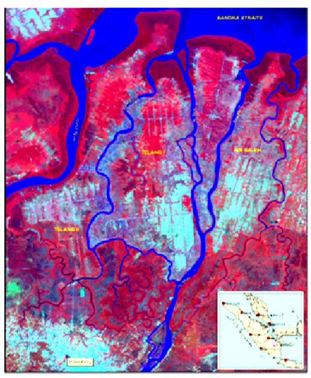

Fig. 2. Geographic location

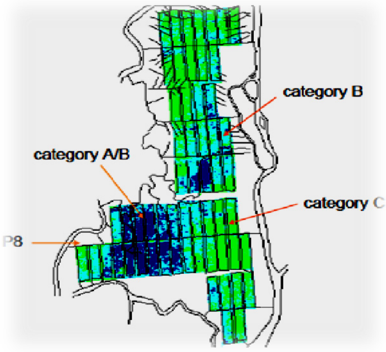

Fig. 3. Hydro-topographic conditions of DeltaTelang I

B. The Instruments of Mike-21 FM Model

Erosion modeling process began with the collection of data as input. For bathymetric condition, a digitized ocean map and bathymetric measurement data were used. Configuration was then developed by setting up the mesh and bathymetric modeling.

The next stage was the preparation of input data for large hydrodynamic (HD) domain module (global) and spectral wave (SW) module using the medium domain. Data prepared for HD module included the boundary conditions in the form of tides data.

Data for SW module included heights and periods of significant waves from hind casting analysis and output data from the large HD in the form of water elevation data. Prior to using the large HD data for SW and small HD, calibration must be made using tide and flow data.

The next step was modeling the medium domain of SW module and small HD module. The following step was verification of tide data measurement in the study area and performing the analysis on the medium domain of SW module and small HD module. Subsequently, Sand Sediment Transport (ST) was modeled using small domain of HD module.

Operation and maintenance scenario consisted of 3 approaches as shown in Fig. 4, Fig. 5 and Fig. 6.

Fig. 4. Scenario I (O&M 25%)

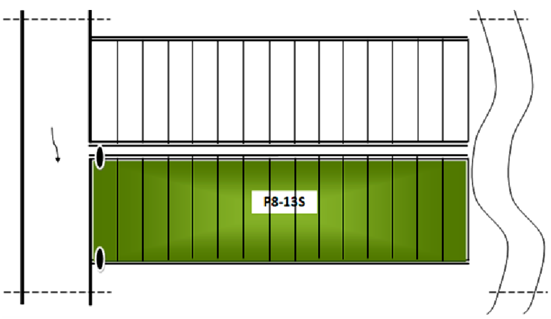

Fig. 5. Scenario II (O&M 50%)

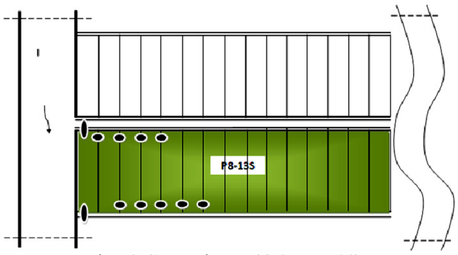

Fig. 6. Scenario III (O&M 75%):

III. Data Collection

A. The Data

Primary data were collected through field observation and direct measurement. In addition, other relevant data were also inventoried from the office of the relevant agencies in the form of secondary data.

Indicators of canal instability include internal factors and external factors. Internal factors such as canal hydraulic parameters are discharge and flow velocity and height of the tide and low tide, canal shape and dimensions (length, width, height of the water, as well as canal materials and diameter coefficient granules). External factors such as operation and maintenance activities, ship movement and water user participation were also collected.

B. Surveys and Line Profile Measurement

Survey of canal network used hydraulic simulation to determine the profile of the canals. In addition, the survey also collected information on canal structure such as structure type, hydraulic conditions, threshold peak, and crest length. From the above information, "*n*" Manning Coefficient was derived. This coefficient was then used to simulate sand transport model using softwares.

C. Soil Data

Soil samples were collected at several points on a secondary canal to represent different soil types along the canal. Disturbed soil samples from the canal were analyzed in soil mechanical laboratory using sieve to obtain grain diameters of d_{35}, d_{50}, and d_{90}.

IV. Results and Discussion

A. Canal Profile

The schematic profiles of primary and secondary canals and Based on the measurement, the dimensions of the secondary canal were 10 m in surface width, 2 m in bottom width, and 1.50 m in average depth .

All seconadry canals were generally unstable, except SPD canals in P6 and P8 and SDU canals in P10 and P12.

B. Sediment Materials Due to Erosion

Sediment smaller than 2µm (clay) is generally considered as cohesive sediment, whereas coarse sediment with the size greater than 60µm is considered as non-cohesive sediment and the mud (silt) which size is 2 - 60µm is considered among the cohesive and non-cohesive sediment [3].

Results indicated that grain size distributed in SPD canal has the average diameter of 797µm which was considered as non-cohesive sediment. In SDU canal, the average grain size was 793µm which was also considered as non-cohesive sediment. Grain size distribution in SPD canal is shown in

Fig. 7. and Grain size distribution in SDU canal is shown in Fig. 8.

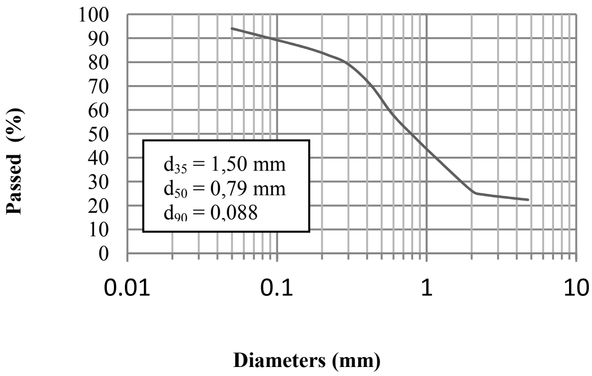

Fig. 7. Grain size distribution in SPD canal

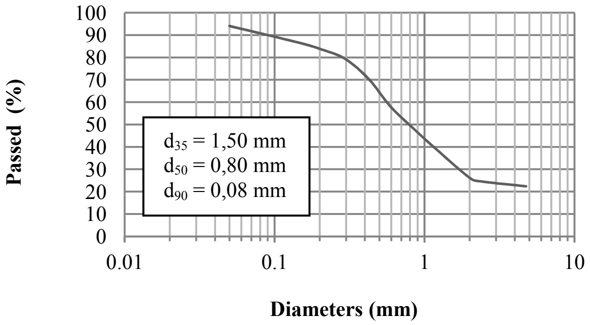

Fig. 8. Grain size distribution in SDU canal

C. *Implication on OM for Agriculture*

Operation and maintenance (OM) of water infrastructures are intended towards fulfilment of crop water needs. Proper OM can be achieved if canal flow is in good capacity. This requires stable canal both in static and dynamic conditions.

In order to achieve stable canal, erosion must be controlled by considering canal dimensions and structures, proper operations of gates to obtain proper flow and the specific characteristics of tidal lowlands. [4]- [6].

V. Conclusions and Recommendations

A. *Conclusions*

From this research, the following are concluded:

1) All secondary canals were generally unstable, except SPDs at canal section 6 (P6) and P8 and SDUs at P10 and P12.
2) Sediment grains in both SPDs and SDUs were categorized non-cohesive sediment.Erosion occured in SPDs at P0, P2, P4 and P6 and in SDUs at P0, P2, and P4.

B. *Recommendations*

Different scenarios should be made on the basis of n-Manning coefficient, sluice gates and flow velocity.

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A. Syarifudin was born in Palembang (South-Sumatra, Indonesia) in November 19 1960. He is an candidate doctor Environmental Science of Sriwijaya University, Palembang, South Sumatra. His areas of interest are Hydraulic Enviromental Engineering.

M. S. Imanuddin was born in Kuningan (West-Java, Indonesia) on October, 31 1971. He is a Lecture of Agriculture Science Sriwijaya University. His area of interest is Agriculture and Environment.

A. S. Moerwanto is a Director of Directorate General of Water Resources, Ministry of Public Works Ministry of Public Works. His area of Interest is Hydraulic and Coastal Engineering.

M. Yazid was born in Palembang, Indonesia on May 10, 1962. He is a Senior Lecture in Agricultural Resource and Environmental Economics, Faculty of Agriculture, Sriwijaya University.

F. X. Suryadi is a Lecture of IHE, Unesco Delft, Netherlands. His areas of interest are hydraulics Engineering, especially infrastructure Hydraulic Engineering including Environmental Science.