Chapter 3
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Assessment and Prediction of Canal Erosion on Tidal Swamp Delta Telang I, Banyuasin Regency, South Sumatra

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ABSTRACT

Surface water dynamics at swamp region either in tertiary compartment also at canals very influenced by several conditions, among others: total rainfall, hydro-topography, potential high water overflow, potential drainage, water order network condition, and water order building operation. Tidal swamp region characteristics very unique in comparison with technical irrigation region because the water availability ebb swamp region always supply from high water and lessened sea water has special character that is has acidity, contain pyrites, peat and met existence intrusion brine at the (time) of dry season. For that entire components must be evaluated and at analysis to support plants amount of water required fulfillment efforts. The canals need observation data directly at field so that can accurate observation data. In the manner likes this need time, energy and cost big enough. Therefore, computer model use to guess and evaluate network performance is a correct solution. Related to troubleshoot above, so necessary existence to watchfulness besides to evaluate existing drainage system performance in water face control at also necessary channel stability analysis in the effort support operation and channel maintenance. Supposed to this watchfulness can describe according to intact process the happening of erosion and sedimentation at channel, environment service aspect and qualitatively model constructively SOBEK software can explain sedimentation dynamics in canals at tidal swamp region. This System monitoring also recommend where and what is total minimal water face observation at canals and farming tune with climate data observation.

Keywords: Swamp region; Canal in wetland; SOBEK program; Sedimentation dynamics

1. INTRODUCTION

Usually, tidal swamps are the region that has flat topography relatively, situated near coast at river estuary and formed naturally also influenced by sea water periodical. Tidal swamp region characteristics very unique in comparison with technical irrigation region because the water availability ebb swamp region always supply from high water and lessened sea water has special character that is has acidity, contain pyrites, peat and met existence intrusion brine at the (time) of dry season.

Based on data collection result that done by swamp and coastal directorate of water resource 2006, pass area swamp region data stock taking studies west and east area, got conclusion that from total area swamp region that reclaims 1,8 million ha found 0,8 million ha neglected swamp area or area sleeps. Swamplands have great potential to be used as an integrated farming system (food crops, estate crops, and animal husbandry). The challenge is to do so both profitably and sustainably [1,2]. Neglected is caused by matters among others existing water order network less optimal in gives the function in water management, because existing current system not yet appropriate. The canals condition and also long hasn't rehabilitation and so also not yet the optimal in the case of canals maintenance.

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In these case of canals maintenance, one of them necessary water order network enhanced existence passes channel maintenance connecting with self canals stability. this troubleshoot concerns besides related technical problem, field condition, also still the weak institution to managed in wide level.

For that be need exit so that all problems can success be solved comprehensively. beside that must understand also that water/irrigation order system development at tidal swamp region up to in this time a large part present in first level stage, where is new come up with network development completion. Temporary to supported tool development (water building) still not yet many done.

Surface water control in course of swamp reclamation is key process that must be done well and true. In this hook, the swamp reclamation should use concept "shallow-intensive drainage" [3] and not "intensive-deep drainage". second this concept is properly combining with exile control and water restraint [4]. But such follow [5], when connecting with water management and design criteria can be done with two approach, that is minimum reclamation (minimum disturbance), and reclamation total (maximum disturbance). For condition in Indonesia, approaching minimum disturbance still best [4,5]. Reclamation is the first step in developing swamps for agriculture. This reclamation process plans for water management to accelerate the ripeness of soil, so that crops and land management can be established [6].

Surface water dynamics at swamp region either in tertiary compartment also at canals influenced by several conditions, among others: total rainfall, hydro-topography tune, potential high water overflow, potential drainage, water order network condition and water order building operation. For that entire components must be evaluated and at analysis to support plants amount of water required fulfillment efforts. at the channel self be need observation data directly at field so that can accurate observation data. but manner likes this need time, energy and cost big enough. Therefore, computer model use to guess and evaluate network performance is a correct solution.

Mean while for water order network condition evaluation in capacity as supply and exile has been developed model computer DUFLOW [5]. Model simulation result DUFLOW can to give practically recommendation in the case of network enhanced efforts and water management operating system [6].

In simulation program use besides can be using hydraulic numeric model program 1 dimension model SOBEK, the program carries out one-dimensional hydraulic calculations of denunciated area that is schematized by a network of open water canals. The all calculated quantities acres cross section averaged values. A network can consist of several branches with bifurcations, cross sections can vary within a branch. SOBEK can handle:

- water flow;
- salt intrusion;
- sediment transport and morphology;
- water quality

Because SOBEK is 1D model, the calculation of times acres low, but the usability is restricted to problems without importantly 2D or 3D effects. It can for example be used for flood protection studies, design of canal systems, determination of dredging strategies for a river, salt intrusion in lower reaches of rivers.

SOBEK model is used for:

- support in decision taking about large new river programs like 'room for the river, or a new control regime of the sluices at haringvliet;
- daily prediction of water levels along the rivers;
- calculation of representative high water levels to check the safety of the;
- calculation of salt intrusion during dry periods.

Related to troubleshoot above, so necessary existence a watchfulness besides to evaluate existing drainage system performance in water face control at also necessary channel stability analysis in the effort support operation and canals maintenance. A computer models use necessary at test and be developed because can save time, energy and cost. Such, process calibrates necessary done to get good result equally that result from model, it is almost equals with measurement result at field [6].

2. MATERIALS AND METHODS

2.1 Description Area

Telang I is one of the so-called second generation type of swamp reclamation schemes in South Sumatera which followed the double-grid layout design ((Rib System) together with Telang II, Saleh and Air Sugihan schemes. Surveys were carried out in 1976 by Bogor Institute of Agriculture (IPB). Subsequent designs for the open canal systems were prepared by Bandung Institute of Technology (ITB). The system comprises main canals (also called primary canals, also used for navigation), secondary canals and tertiary canals [7].

Geographically region telang I lay in 02°29' until 02°48' LS and 104°30' until 104°52' BT in general telang I is located in north on Bangka strait, half south abut on Sebalik river, eastside with Musi river and westside abut on river Telang I (see Fig. 1).

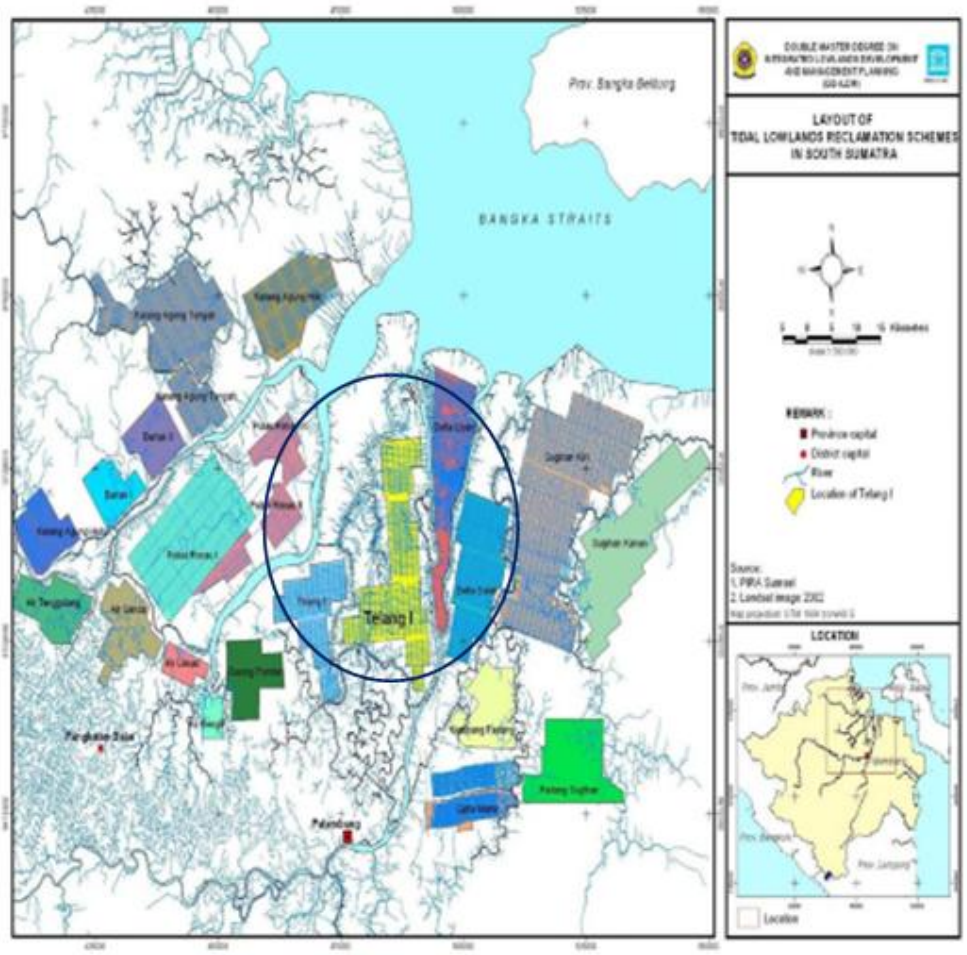

Fig. 1. Location research [7]

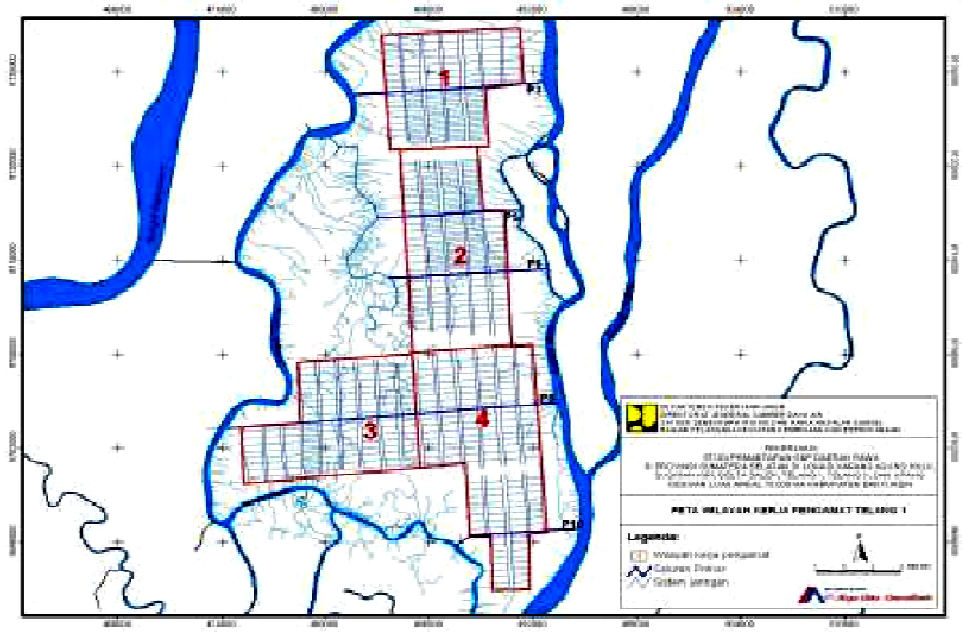

Fig. 2. Tidal swamp recalamation network map delta Telang I [4]

According to hydrological, tidal region Telang I that surrounded by rivers. The area eastside abut on Musi river, westside abut on river Telang river, half south with Bangka strait and borthside abut on Sebalik river.

Fig. 3 show lay out secondary block and tertiary at Telang I. hydrology from block is determined by canals condition that border on, water status at each canals, operation from gate, tidal influence, and climate condition likes: rainfall and evapo-transpiration [8, 9].

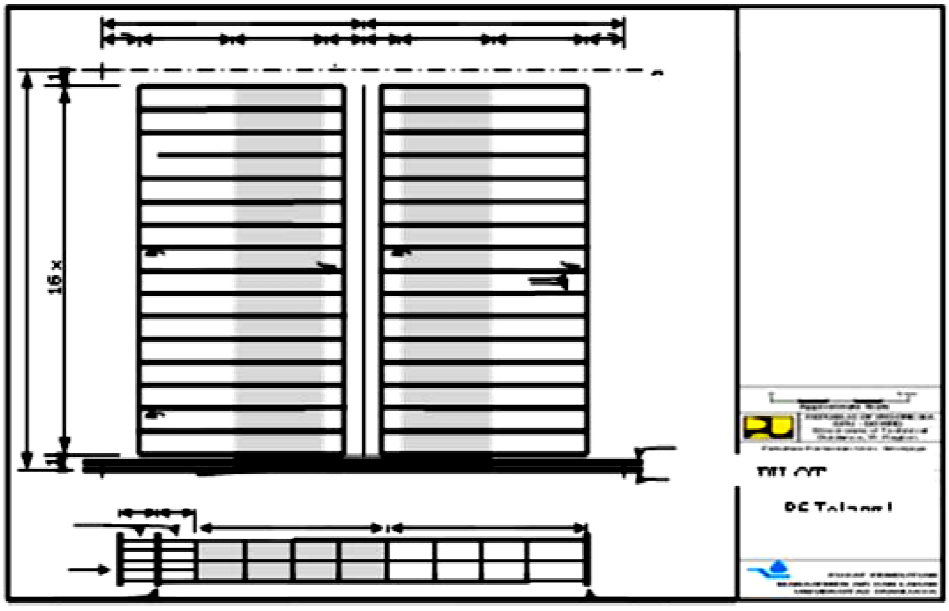

Fig. 3. Lay out secondary and tertiary block at Telang I [8,9]

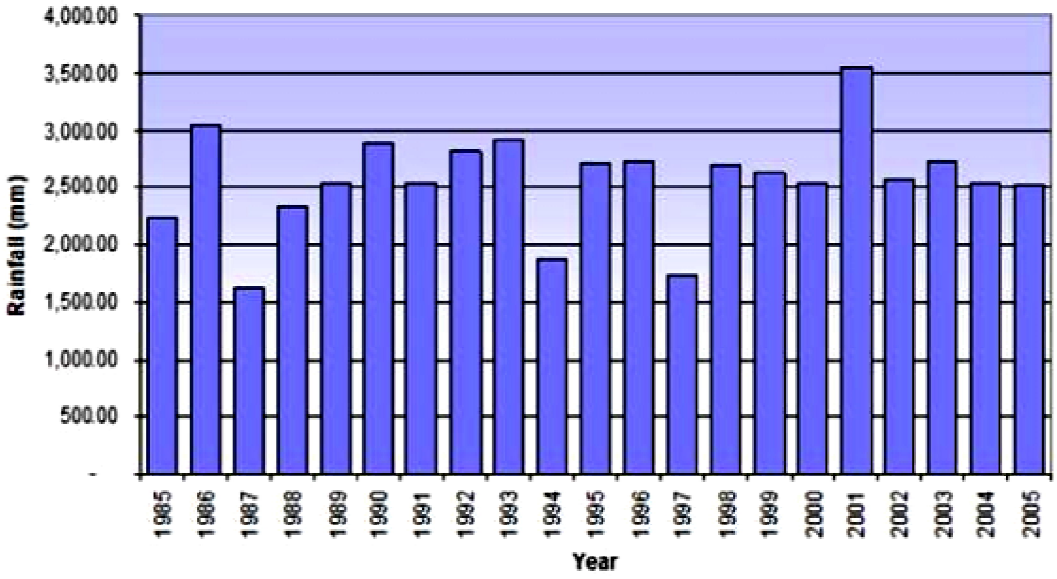

Fig. 4. Annual rainfall telang I from 1985-2005 [10]

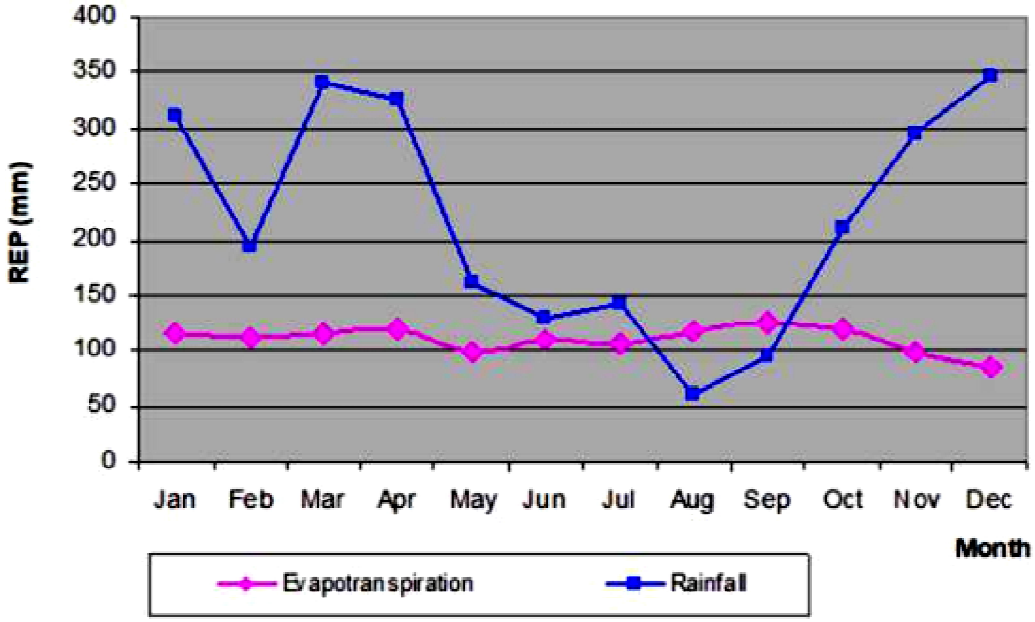

Fig. 5. Montly rainfall and potential evapo-transpiration of telang I from 1996- 2005 [10]

2.2 Climate

Climate at region Telang I is tropical rain, hot and moist during the year with maximum temperature between 29-32°C, temperature minimum 21-22°C and humidity between 84-89%. Wet months (rain fall more than 200 mm per month) happens during period on November-April and August average dry month (rainfall less than 100 mm per month). average annual rainfall around 2.400 mm. follow classification Oldeman, climate agro-ada c-1, with 5 until 6 successive wet months (rainfall more than 200 mm) and 0 - 1 dry month (rainfall less than 100 mm) [11].

2.3 Rainfall

This region free from tropical storm although local storm can causes damage. Climate and rainfall supports various plants [12]. Fig. 4 above show annual rainfall Telang I and Fig. 5 show monthly rainfall and evapo-transpiration Telang I.

3. RESULTS AND DISCUSSION

3.1 Operation and Maintenance

According to visual, existing canals in this time stills not yet at do maintenance routinely. this matter can be seen that canals although done "dredging" or digging, but happen ledge erosion and grass so that make for remain to happen erosion and channel sedimentation in base and ledge/erosion landslide in channel side. Also at watchfulness location that is at P8-13S not yet enough available waterworks (automatic valve door), although available but in character still simple and necessary enhanced existence technically.

Operation troubleshoot and irrigation network maintenance at ebb swamp region is function from soil condition, water, climate, water order (network), flood gate building, human resources, institute, farmer, and production tool. Therefore beginning step in this watchfulness with identifies condition existing and all related variables each component later be analyzed and studied dependability one same another so that got stable canals form to supports operation activity and maintenance at certain area. Data source is got from principal physical data, and tune environment with do survey field and secondary data with method desk study.

In the execution, operation and maintenance is divided to be two activities, that is operation activity and maintenance, and especially for activity operation rule execution the aim appropriate water management for plants need. Operation execution and maintenance must be done concurrent with monitoring. Monitoring will give information that need to restrain and when needed change rule and operation activity and maintenance. Besides, monitoring can give information for long-range development planning at region concerned.

3.2 Water Management

In new paradigm, operation activity development and maintenance to the fore done to pass to approach operation and maintenance participation and water user farmer club strength enhanced (P3A) with be a society self-supporting institution as facility and colleague energy.

Usually water management at tidal swamp reclamation region is done dual stage, that is:

"Water management rice field (tertiary compartment). This water management determines directly environment condition for plants growth;

"Water management network or at the principal system. The main aim restrains water face standard and water quality as good as may be to fulfill agricultural activity need. system or principal network divisible into primary network, secondary and tertiary.

Water management option basically determined by soil condition and hydro-topography factors. Water management option is base deliberation then spelled out to into existing waterworks operation rule. matter this means that is after first development stage where the channel network stills shaped open system to facilitated the happening of soil maturation and throw away water exile that over do out from tune, so furthermore in development stage next increase water management system with equip water regulator building in existing canals network.

As to peculiarly aim from water management: (i) guarantee water sufficiency for plants; (ii) throw away superlative water out from tune; (iii) prevent plants weeds growth (with defend water field); (iv) prevent to deteriorate it water quality; and (v) prevent intrusion brine.

In sour sulphats soil case, water management rules must calculate as possible need for prevention the happening of soil acidity during plants growth. but such, it is important to know also that acidity will lost after several time periods and after that period can applied operation with normal rule.

4. CONCLUSION

This study shows that to achieve desirable target in operation development and maintenance at tidal swamp reclamation region, so necessary done activity step by step, one another must be done inwrought, can not be done apart. Stage that meant:

1. Farmer resource enhanced, expert and this observer is done with training and direct assistance at field
2. Practical instruction maker for farmer to make activity time-table in operation and existing water order system maintenance and along with waterworks; and also farmer is supplied erudition enough in managed tune and water belongs the hook with flood gate building operation to create plants desirable water status. This model must be accustom with development condition in this time, and condition hydro-topography area (A; B; C/D). A models manual operation and this maintenance also divided in tertiary level (field level) and principal system (secondary and primary);
3. A food plants farming system repair in location that studied;
4. Operating expenses planning and to maintenance, must be done with approach participation, especially for secondary level. Temporary at secondary level and primary very influenced by local tune environment physical condition; and
5. Monitoring and evaluation; this activity aims to see how far program success and model at application at field. This System monitoring also recommend where and what is total minimal water face observation at canals and farming tune with climate data observation. Climate data that watched minimal rainfall and air temperature around location.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Biography of author(s)

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He was born in Palembang, South Sumatra, Indonesia on November 19, 1960. He has completed Bachelor of Civil Engineering, Faculty of Engineering, Sriwijaya University, Master of Civil Engineering at the Gadjahmada University Yogyakarta Postgraduate Program and Doctoral Education (Doctoral) at the Palembang Sriwijaya University Postgraduate Program. He is an associate Professor in Civil and Environmental Engineering on Post Graduate Program Study Universitas Bina Darma Palembang, Indonesia. During his doctoral education, he received a scholarship program from the Ministry of Higher Education at the Sandwich Program at IHE-UNESCO, Delft, The Netherlands in 2011. In 2000, he joined Bina Darma University in the Faculty of Engineering and served as Head of the Civil Engineering Study Program (2000-2004). He has been the Head Lector functional positions in the courses of Fluid Mechanics & Hydraulics, Irrigation & Water Building, Hydrology Engineering, River Engineering and Urban Drainage. He is working as the Team Leader in the PUPT HIBAH research project from Ministry of Higher Education (2012 - present). Apart from teaching, he is also active in various professional organizations, including HATHI (Indonesian Hydraulic Engineering Expert Association), KNI-ICID, PII (Indonesian Engineers Association) and LPJK (Indonesian Construction Services Development Board), South Sumatra Province. He has been team leader in several strategic water projects including flood control for the city of Palembang (1997), flood control for the Lempuing river (2005), strengthening of the cliffs for flood control over the Musi river (2016), Expert of River Restoration in Palembag City, Indonesia (2019-Present), Ministry of Public Works Road and Tunnel Road Safety Commission (2020-present).

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