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Foreword

In many countries, its capital and major cities have been developed in low-lying area exposing to various stresses from nature and human treats. As a result, natural lowlands are turned into highly vulnerable area in safety, economic and environmental aspect. New record of the highest temperature and precipitation in many region of the world has challenged the knowledge and technology for protecting life, property, and ecological system in lowlands.

To achieve "Sustainability of Lowland to Climate Change and Natural Disaster", not only main themes as for previous ISLT like Geotechnical & Geo-environmental Engineering, Water & Environmental Engineering and City Planning and Management, but also new themes on Coastal Engineering and GIS Application for Lowland Management are concerned in the 8th International Symposium on Lowland Technology (ISLT2012).

In this year, the word "Lowlands" has brought together more than 100 researchers and engineers in related fields from 15 countries to share their great experience on coping with various problems in lowlands. Six outstanding speakers are invited to give one special lectures: Prof. D. T. Bergado (Miura Lecture); two invited lecture: Prof. D. A. Suriamihardja and Prof. W. Wangsadinata; and three keynote lectures: Prof. S. L. Shen, Prof. J. C. Chai and Dr. Olivier Hoes.

This symposium is organized by International Association of Lowland Technology (IALT) and Institute of Lowland and Marine Research (ILMR), Saga University with cooperation of Department of Civil Engineering, Hasanuddin University, Indonesia. I would like to extend my sincere appreciation to Prof. M. Madhav, the President of IALT, Prof. H. Araki the Chairman of the International Advisory Committee and Organizing Committee for their support.

I sincerely wish to express my gratitude to the International and Local organizing committee and all other staff of ILMR for their great contribution. Finally, I would like to thank all the authors for their participation. Without all of you, the symposium will never be successful.

Lawalenna Samang
Local Chairman of ISLT2012

President's Address

Institute of Lowland Technology (ILT) founded in 1991 and renamed as Institute of Lowland and Marine Research has come a long way. Apart from undertaking research and education in the specific areas relevant to problems and issues of lowlands all over the world but especially in the Asian Region, a major activity has been the conduct of International Symposia on Lowland Technology fondly referred to as ISLT. These Symposia offer a great opportunity for researchers, academics, policy makers, etc., who all are interested in studying the various issues of planning, development and management of lowlands to meet once in two years to exchange ideas and developments and to share knowledge for the common benefit of all. The need for interactions is felt continually with natural disasters striking almost all countries of the region. The saddest has been the catastrophic earthquake off the coast of Japan last year. The vulnerability of coastal areas has been once again exposed with the disastrous ten to twelve meter high Tsunami. Similar events in the other regions especially in Indonesia remind us all the need for continued research and study of coastal lowlands.

Following the successful conduct of ISLTs in Saga, Bangkok and Busan, the 8th Symposium in the series is a wonderful opportunity to meet in the picturesque island of Bali thanks to the great efforts of Prof. Samang, Dr Triharianto, Mr Abdurrahman, etc. The five major themes of „Geotechnical/Geo-environmental Engineering", „Water & Environmental Engineering", „City – Urban Planning & Management", „Coastal Environmental Science & Engineering" and „GIS Application for Lowland Management" with twenty seven subthemes would cover all or most of the relevant topics of interest to everyone. Prof. Bergado, the eminent researcher and personality has been invited to present the third Miura lecture. With several keynote and invited lectures the event promises to offer the best occasion to interact and get intellectually stimulated.

ILT and ISLT have been successful because of the foresight of the founders, in particular, Prof. Norihiko Miura. They have been fostered and nurtured by eminent personalities such as Prof. Poorooshasb, Prof. Hayashi, and the members of the Councils all these years. I would like to place on record the help, support and cooperation received from the Executive President Prof. Araki, Secretary General Dr Azizul Moqsud, Prof. Bergado, the conference organizers for the success of the symposium.

Wishing the Symposium a be great event to be remembered and cherished and looking forward to meet you all,

Madhav Madhira

President, IALT

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EVALUATION AND OPTIMIZATION OF HANDEEL AS PUBLIC WATER CANALS ON BANJARESE TRADITIONAL TIDAL PADDY RICE FIELD SYSTEM

M. A. Noor[1], N. Helda[2] and Y. F. Arifin[3]

ABSTRACT: Handeel is a Banjarese local term for public water canals, which actually came from dutch language "andeel", means a straight line canal made by a group of people/society/village community, had a function in delivering water from rivers to a paddy field. The system has established since the era of dutch colonialization, then treated and modernized by Indonesian government during 1970's. Unfortunately, even though the system has implemented for 40 years, the current development of this tidal irrigation system were stack or rise very slowly. Since then it is necessary to evaluate the base characteristics of the existing canal system, ie. Hydraulic capacity, tidal paddy field type, hydrotopography, and probability for implementing advanced methodology in farming system. After the basic problem found, then continued with the optimization on existing Handeel to improve the best benefit for farmers.The study area covers about 20 Handeel as secondary/tertiary canal system in anjir Tamban Primary System which supply water distribution to 3000 hectares paddy fields. The study gives the information about the lack of important water structures (levees, folders, control boxes, culverts, etc.) as the main cause of Handeel problem. The second problem is about the soil property which still poor even though the land has already washed and leached from the poisonous matter such as sulfate acid with tidal movement through paddy field. And the third is caused by poor water management as excess from the first reason.

Keywords: Handeel, canals, tidal paddy field

INTRODUCTION

The 3000 hectares of Survey, Investigation and Design (SID) for Public Handeel site plan in the tidal reclamation area is located on geographical coordinates of : $3^o13'$ to $3^o16'$ South Latitude and $114^o21'$ to 114^o25 East Longitude . The site plan of the net 3400 hectares lies at the southwest of the area which is known as Pulau Petak delta. It is river estuary lowland which covers about 240 thousand hectares of tidal swamp area, which is bounded by Barito River system in the east, Kapuas River in the west and the Java Sea in the South. Specifically, Public Handeel scheme area is located in the east of Kapuas River, with Anjir Tamban Canal as Primary System and some of secondary canals (North Secondary Canal and South Secondary Canal).

Traditional planting method are conducted by Banjarese people which take place in the area that extend out over the land 5 km far away from the edge of the tidal river. Initially, there were a lot of natural canals along the tidal river, which have interval ranging from 200-700 m.

Banjarese farmers, in the beginning, tried to upgrade the canal function (known as Handil) to be improved drainage canal as well as the supply canal to provide water for their farming land. This upgraded canal system has been reached 2 km effectively into the land. Unfortunately, in the next development, the water level limit was too high so that it is impossible to plant the crop in the rainy season.

Swamp Recclamation Project which was organized by the Dutch Government since 1910 (East Indies Government), was indicated by the construction of big connecting canal (known as Anjir Serapat) which connects Barito River and Kapuas River with two purposes: as a land drainage and transportation means, respectively. In 1955, Anjir Tamban was built by the Indonesian Goverment.

After that, Banjarese farmers made numerous small canals which lie vertically to that Anjir with the same interval as natural canals.

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Tabel 1:Dates of Construction of Swamp Recclamation Project.

Scheme	Year
Lahan Spontan	…….
Anjir Serapat	1915
Anjir Tamban	1955
Anjir Talaran	1969
Barambai	1969
Belawang	1975
Sei Muhur	1976
Tabunganen	1977
Sakalagun	1978
Seluang	1979
Puntik Terantang	1981
Puntik Danda Besar	1981

OBJECTIVES

The objective of SID project for Public Handeel is to make a detail design of Rehabilitation Plan of Swamp Recclamation Network which covers :

Indentify the potencies and the constraints appear on the location consist of technical, agriculture, social-economic and environmental aspect respectively. Then, try to formulate the development plan for supporting the farmers' welfare and to provide job opportunities in accordance with the neighbouring area.

Evaluate the existing canal network, whether natural or man made canals and to plan drainage/irrigation canal network for the development of the previous objective.

RESEARCH METHODOLOGY

For implementing the tidal swamp reclamation, it used abbreviation of SIDLACOM frequently. This abbreviation explains the stage of the swamp reclamation project in sequence as follows:

S - Survey
I - Investigation
D - Design
L - Land
A - Acquisition
C - Construction
O - Operation
M - Maintenance

For the swamp development projects, SID are the first 3 stages after the project identification. Usually, the project has been identified by government institute or private company. Project identification will explain the project space boundaries, goals and types of the planned areal development and also covers investigation of particular subject or established plan works. The project can be the opening of new areas, undeveloped areas or rehabilitation and upgrade the existing canal network.

The activity of SID with Government funding, usually, are the responsibility of the Department of Public Works. They can give it all or some of it to the private organizations which are the technical consultants or private institutions.

During the SID process, important decisions were made which include the targeted constructions and the type of planned physical work. The decisions were made by consulting with other institutions involved in the areal development, also with the community.

The order of the SID process are shown here:

Preliminary
Field Survey
Data Analysis
System Planing
Report

All the criteria and specification are in the correspodence with the hydraulic means.

RESULTS AND DISCUSSIONS

Public Consultation Meeting

Location:
Darul Mu'minin Mosque, Tamban Baru Tengah Village
The participants:
Coordinator of PPL BPP of Agriculture Department Tamban Catur District, Farmer Group Represntatives from 4 villages at Tamban Catur District.
The results of the meeting are written below:

1. Tamban Baru Mekar village

- Many of Handil canals are blocked and grass growth
- People reject the dredging of the canal
- People hope for worm canal to be built
- Most of water gates are not operated
- People are not use water transportation.

2. Tamban Baru Tengah village

- People want the dredging and worm canals made
- People want water gate to be built in the downstream of the canal.
- Irrigation canals are not exist
- Water channels are built under the farmer road.

3. Tamban Baru Timur village

- People want the dredging dan street hardening
- Many people use water transportation
- Irrigation canals and water gates are functioning properly

- People want the improvement of the farmer road
- People want the solution of the plant disease

4. Tamban Baru Selatan village

- People want the solution for the water acidity
- People want the solution of the plant disease
- People want the dredging and the improvement of the farmer road
- The head of the village hope to make the canal longer than before.

Water System Boundary

Based on the lay-out of water system, the Public Handeel Water System can be defined as some stages as follows:

Delta Water System: Delta Pulau Petak Water System
Macro Water System: Anjir Tamban Water System
Meso Water System: Public Handeel Water System
Micro Water System: Handil Rice Field Water System

The Public Handeel Macro Water System in the study area is boundary with Jelapat Fork-liked Water System, Tabunganen Fork-Liked Water System Lupak Primary Channel (A1-A4) as shown in Figure 1.

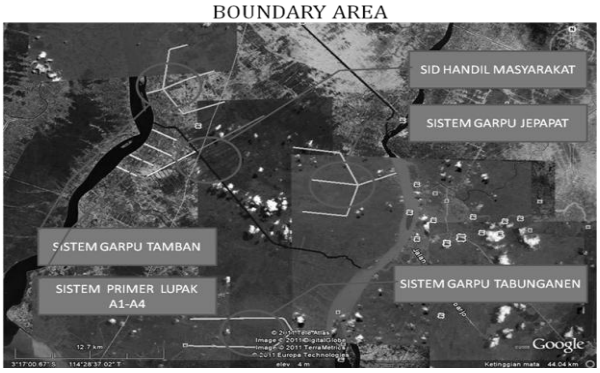

Fig. 1 Boundary Area of Field Study

Macro Water System

Handil Masyarakat Macro Water System which has 22 Handeels at the plan area is Anjir Tamban Primary Drainage System. Nevertheless, part of the drainage flow runs to neighbouring water system: to Lupak Primary Channel (A2 and A3) and Bukat Flow Water System.

On the stage of Anjir Tamban Primary Channel System, has experienced shallowness, primarily at the 1/5 from the mouth of Kapuas River (4/5 are empty into Barito River). The Major cause of the shallowness is dead flow zone, which has two river currents in the opposite direction. The total length of Anjir Tamban is approximately 25 kms.

The tidal movement predominantly in Anjir Tamban Ayunan is the inflow to the mouth of Barito River. The location of Public Handeel from the mouth of Kapuas River until the intersection of Anjir Tamban and Secondary Channel is about 5 Km, as can be seen in Figure 2.

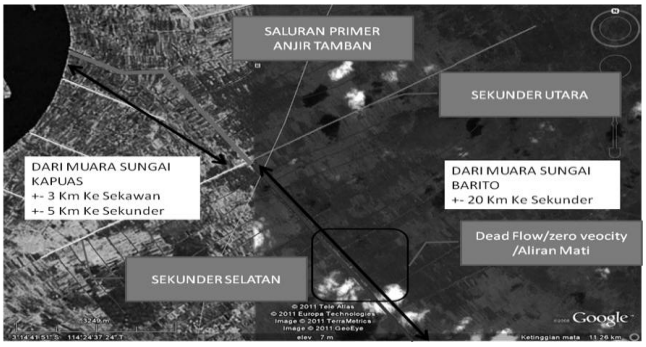

Fig. 2 Layout of Macro Water System

Micro Water System

Handeels at the plan location are in the stage of Meso/Micro Water System. The farmers' rice fields are usually water supplied from the handeels. Each of the paddy field has a tap channel directly into the handeel, and it is supplied at the right and the left of the handeel. Although the Handil Water System in Anjir Tamban ages more than 30 years, however, it has not shown the maturity stage and is not equipped with water control infrastructures. The solution of this peoblem is Controlled Water Management consists of some stages of design and plans. Solusi dari permasalahan ini adalah

Besides, the interval between two handeels is 200-300 in average, there are only two paddy fields between the two handeels which are only supplied by one handeel. In other words, the micro water systems are separated. Figure 3 shows the lay-out scheme of Meso/micro Water System at the edge between two handeels.

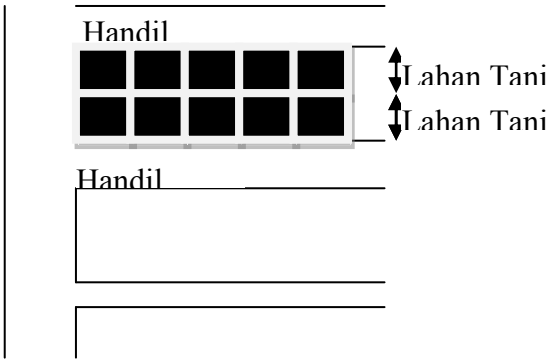

Figure 3: Meso / Micro Water System

Hydrotopography Analysis

The next two figures are the results of the hydrotopography analysis of the study area.

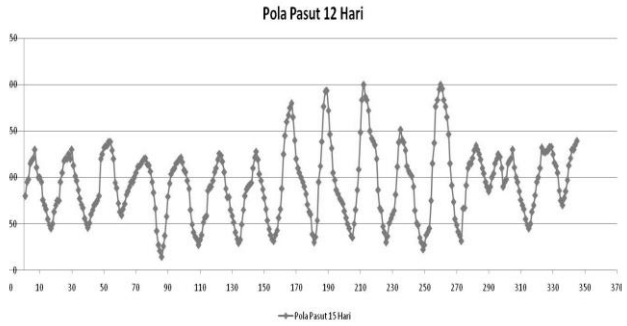

Fig. 4 Tidal Pattern from Field Study

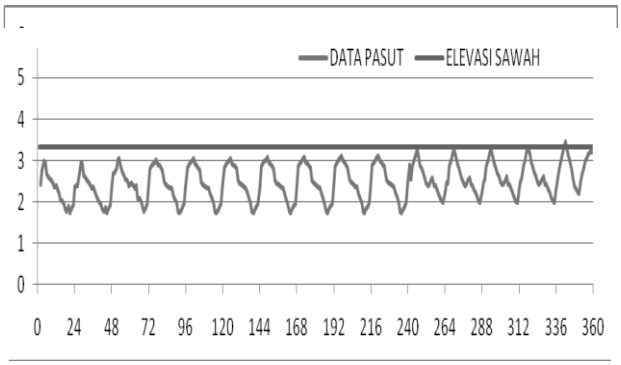

Fig. 5 Tidal Pattern from Field Study

From the overlay of the Tidal Data of some Handeel samples, it is known that based on the Class or the Land Type, the Handeels are in the Type A Class (± 4 times the land is influenced by the tidal, whether in the dry season or rainy season).

Hydrological Analysis

a. Climatological Data from Sungai Tabuk station are used, while Precipitation Data came from 3 stations: Anjir Pasar, Tamban, dan SMPK Kapuas Murung Palingkau.
b. Climatological data from Sungai Tabuk station consists of temperature, sunshine duration, wind speed, evaporation and relative humidity.
c. The average precipitation in Kapuas Regency is 174,6 mm. The highest average is 314.6 mm in January and the lowest is 43.0 mm in August respectively.
d. The Average Evapotranspiration (ET_0) is 6.217 mm/day. The highest ET_0 is 7.987 mm/day in August and the lowest is 5.285 mm/day in May respectively.
e. In deciding whether precipitation data from 3 stations can be used or not, Homogeneity test (t-test) was used. Homogeneity test was done in order to know whether the series data which came from two gage stations were coming from the same population or not. Finally, 3 pairs of precipitation stations will be obtained.
f. From t-test for precipitation data, for Anjir Pasar and Tamban Stations, t calculated = 1.0912 < t critic, where t kritis for two sides t-test distribution with α = 5% and dk = 18, was given t kritis = 1.734.
g. From t-test, for Anjir Pasar and SMPK Kapuas Murung Palingkau stations, t calculated = -0.3520 < t critic, where t kritis for two sides t-test distribution with α = 5% and dk = 18, was given t kritis = 1.734.
h. From t-test, for Tamban dan SMPK Kapuas Murung Palingkau stations, t calculated = -0.9633 < t critic, where t kritis for two sides t-test distribution with α = 5% and dk = 18, was given t kritis = 1.734.
i. Frequency Analysis was done in order to get design precivitation value with some of Probability Distribution as follows:

1. Gumbel Probability Distribution.
2. Normal Probability Distribution.
3. Log Normal Probability Distribution.
4. Log Pearson Type III Probability Distribution.

Based on all probability distributions, it can be summarized that all probability distributions can be accepted, however, Gumbel probability distribution is the best distribution to analyze precipitation data on the study area.

Kala Ulang T (tahun)	Reduce Variated (Yt)	Faktor Frekuensi (k)	Hujan Rancangan (X_T) mm
2	0.3665	-0.13550	95.017
5	1.4999	1.05796	114.451
10	2.2504	1.84813	127.318

Fig. 6 Gumbel Probability Results

Agriculture Soil Land Analysis

Agriculture Soil Survey is part of Public Handeel Survey, Investigation and Design for Kapuas Regency. This Survey is done to learn and to study about the potency and capability also land suitability in order to increase and develop farm enterprises for some selected commodity plants in the survey area. The outcomes of the survey were expected to give important suggestions that can be used for detail design of water system upgrading.

The method used in this survey referred to the technical guidance and relevant survey guidelines.

From the agriculture soil survey, it can be formulated the patterns of land use with always pay attention to the principle of land function conservation and regulations. This survey consists of some activities and methods as written below:

1. Inventory of soil characteristics, soil type and soil spreading with secondary data collection and direct observation in the field.
2. Inventory and localize exiting soil problems such as pyrite, acid sulphate soil, acidity, peat land (thickness and maturity stage)
3. Soil samples removal for analyzing in the laboratorium in order to get the description about soil characteristics, by seeing the components whether they can fertile or poison the soil. Finally, it can be used for soil classification and fertile soil analysis.
4. Problems identification in the survey area for agricultural cultivation and the suggestions to face them.
5. Table 2 presents the land suitability for plants as follows:

Table 2: Soil Properties

No	code	C	N	C/N	P_2O_5 Bray I
		%			ppm
1	0-30 cm	T	R	T	SR
	30-60 cm	T	R	T	SR
	60-90 cm	ST	R	ST	SR
	90-120 cm	ST	R	T	SR
2	0-30 cm	ST	R	T	SR
	30-60 cm	ST	R	ST	SR
	60-90 cm	ST	R	ST	SR
	90-120 cm	ST	R	ST	SR
3	0-30 cm	S	R	T	SR
	30-60 cm	S	R	T	SR
	60-90 cm	T	SR	ST	SR
	90-120 cm	T	SR	ST	SR
4	0-30 cm	ST	R	ST	SR
	30-60 cm	T	SR	ST	SR
	60-90 cm	ST	R	ST	SR
	90-120 cm	ST	R	ST	SR

Continued, Table 2

No	KTK	K-dd	Mg-dd	Ca-dd	pH
	me/100 gr				
1	R	SR	R	R	SM
	R	SR	S	SR	SM
	S	SR	R	S	SM
	R	SR	R	R	SM
2	R	SR	SR	SR	SM
	R	SR	R	R	SM
	R	SR	R	R	SM
	S	SR	SR	R	SM
3	R	SR	SR	R	SM
	R	SR	SR	R	SM
	R	SR	R	R	SM
	R	SR	R	R	SM
4	R	SR	R	R	SM
	R	SR	R	R	SM
	R	SR	R	R	SM
	R	SR	R	R	SM

Land Suitability

Land suitability evaluation reffered to the Frame Work of Land Evaluation (FAO, 1976) with 4 categories: order, class, sub-class, and unit. In this work, the land suitability evaluation was done until only sub-class category which can be explained below:

Order	:	Reflecting kinds of suitability which are divided into two orders:
Order S	:	Suitable for long term and special use
Order N	:	Not suitable for special use
Classes	:	Reflecting degrees of suitability, with five classes of suitability, as follows:
	Class S1	: Highly suitable
	Class S2	: Moderately suitable
	Class S3	: Marginally suitable
	Class N1	: Currently not suitable
	Class N2	: Permanently not suitable
Sub-classes	:	Reflecting kinds of limitations. In each sub-class can have more than one limitation factor. Therefore, the dominant limitation factor has to be written in the front.

Land characteristics which will be used for land suitability evaluation are the average value that represents the land quality which is used by plant and crop for food. Some commodities that are going to

evaluate for the suitability covers: rice, pineapple, banana, sweet potato, cassava, orange, peanut, pumpkin, chili, watermelon, tomato, eggplant and spinach. Land suitability Classes were determinate by using Technical Guidance for Land Evaluation of Agricultural Commodity from Soil Research Agency 2003.

Based on the test, it can be summarized that for each of rice field has the same land suitability for some plants and crops for food. Although according to land suitability analysis, the location in the study area are in class S3 (marginally suitable), however, they still can be managed by giving them organic and non-organic fertilizer and by selecting local variety that can face hard environment.

In particular, for Handil Indragiri, Handil Sumber Jaya and Handil Sekawan, not only the fertility problem but also the thickness of pyrite (FeS2) that can poison the plants. The making of drainage canals can cause the land dry faster so that it can accelerate pyrite oxidation process. Combination of water management by using water gate with lime addition can help in the farming development on the area with high pyrite content.

Based on the soil analysis on all SID rice field locations in Kapuas Regency, the results show low soil fertility. The major cause is relatively low base content, especially element of K, Mg and Ca. Low base content will tend to decrease the base saturation which is one of the variable that determines soil fertility status. The additional fertilizer which content element of K (KCl) and Ca/Mg (Dolomite) will increase the mineral for plants. Lime addition to the soil can increase the soil pH. Organic fertilizer which combines with microba such as bokashi is recommended since it is environmental friendly and support the government programme "Go Green".

Based on the soil analysis, it can be summarized as given below:.

- From the Land Suitability Evaluation, in general, all location points are in Class S3 (marginally suitable), but they still can be managed not only by giving organic and non organic fertilizer but also by selecting local variety that can face the surrounding environment.
- The agricultural land problems for 3 locations (handil indra giri, handil sumber jaya & handil sekawan) are:
  1. Low soil fertility (relatively low base content)
  2. The thickness of Pyrite that is less than 1 meter from soil surface.
- The solutions to answer the problems mentioned before are :
  1. Combination of water management with controlled water gates and lime addition to decrease the pyrite content.
  2. Giving combination of organic fertilizer micro-organisme since it is environmental friendly and supporting government programme.

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