BUKTI KORESPONDENSI

ARTIKEL INTERNATIONAL SEMINAR TERINDEX SCOPUS

Judul Makalah : INTEGRATION OF DUFLOW-DRAINMOD MODELS FOR DEVELOPING NETWORK IMPROVEMENT RECOMMENDATIONS AND WATER TABLE CONTROL OPERATIONS IN TIDAL LOWLAND RECLAMATION AREAS"

Seminar Internasional : The Second International Seminar on Civil and Environmental Engineering (2st ISCEE) 2021 Bogor, Indonesia, September 6– 8th, 2021

Daftar korespondensi :

No	Tanggal Korespondensi	Kegiatan
01	8 April 2021	Penyerahan Abstrak
02	11 Mei 2021	Surat Penerimaan Abstrak
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04	15 Agustus 2021	Makalah Diterima
05	12 Juli 2021	Penerimaan Pembayaran
06	17 Agustus 2021	Hasil Review Makalah
07	18 Agustus 2021	Revisi Pertama Makalah
08	28 Agustus 2021	Surat Penerimaan
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Kepada: MOMON SODIK IMANUDIN

Kam, 8 Apr 2021 jam 09.33

The 2nd International Seminar on Civil and Environmental Engineering
"Sustainable Infrastructure and Environmental Development"

ISCEE 2021

Bogor, Indonesia, September 6th - 8th 2021

MOMON SODIK IMANUDIN.

successfully received your abstract, "INTEGRATION OF DUFLOW-DRAINMOD MODELS FOR DEVE
RK IMPROVEMENT RECOMMENDATIONS AND WATER TABLE CONTROL OPERATIONS IN TIDAL
D RECLAMATION AREAS'. The accepted abstract will be announced at June 1st 2021.

regards,
21

LETTER OF ACCEPTANCE

ISCEE IPB <iscee@apps.ipb.ac.id>
Kepada: MOMON SODIK IMANUDIN
Sel, 11 Mei 2021 jam 16.27
May 10th, 2021

LETTER OF ACCEPTANCE

Dear Author: Momon Sodik Imanudin

We are pleased to inform you that your abstract entitled:
"INTEGRATION OF DUFLOW-DRAINMOD MODELS FOR DEVELOPING NETWORK IMPROVEMENT RECOMMENDATIONS AND WATER TABLE CONTROL OPERATIONS IN TIDAL LOWLAND RECLAMATION AREAS"

Has been **reviewed** and **accepted** for presentation at 2nd ISCEE 2021 to be held on September 6th – 8th, 2021.

Please submit your full paper for further publication process and make payment for the registration fee as the presenter before the deadline through our website at ipb.link-iscee-fullpaper-submission and ipb.link-iscee-registration, respectively. Author guideline and template of full paper available at ipb.link-iscee-fullpaper-template. For more information, please visit our website or contact the organizing committee at iscee@apps.ipb.ac.id.

On behalf of the 2nd ISCEE 2021 Committee, we greatly appreciate your kind contribution and cooperation in advance, looking forward to meeting you in September this year.

Best regards,

Heriansyah Putra
Chairman of Organizing Committee of 2nd ISCEE 2021

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The 2nd International Seminar on Civil and Environmental Engineering
ISCEE 2021, Bogor, Indonesia

May 10th, 2021

LETTER OF ACCEPTANCE

Dear Authors: Momon Sodik Imanudin

We are pleased to inform you that your abstract entitled:

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On behalf of the 2nd ISCEE 2021 Committee, we greatly appreciate your kind contribution and cooperation in advance, looking forward to meeting you in September this year.

Best regards,

Hariansyah Putra
Chairman of Organizing Committee of 2nd ISCEE 2021

IPB University

paper submission and conference registration

ISCEE 2021 <iscee@apps.ipb.ac.id>

Kepada: Momon Unsri

Sel, 15 Jun 2021 jam 13.52

Dear MOMON SODIK IMANUDIN,

The Organizing Committee would like to warmly thank you as we are receiving such a great interest in the 2nd International Seminar on Civil and Environmental Engineering (ISCEE) 2021 from all over the world.

This is a friendly reminder that the deadline for full paper submission and conference registration fee payment is July 15th, 2021 for your paper entitled: "INTEGRATION OF DUFLOW-DRAINMOD MODELS FOR DEVELOPING NETWORK IMPROVEMENT RECOMMENDATIONS AND WATER TABLE CONTROL OPERATIONS IN TIDAL LOWLAND RECLAMATION AREAS". The accepted and presented papers will be submitted for publication to the IOP Conference Series – Earth and Environmental Science, which is indexed by Scopus.

Please submit your full paper for further publication process and make payment for the **registration fee** as the presenter before the deadline through our website at ipb.link/fullpaper-submission and ipb.link/registration-and-payment, respectively. Author guideline and template of full paper are available at ipb.link/iscee-author-guideline-and-full-paper-template.

Conference registration fee payment can be made with a bank transfer to:
Bank : BNI Branch Bogor
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Please be noted that the payment for publication fee is available following the review process and after your paper are ready to be submitted for publication

Further details are available at our conference website https://iscee.ipb.ac.id/., or you can contact the organizing committee of 2nd ISCEE 2021 at iscee@apps.ipb.ac.id. Take advantage of this exciting opportunity to present your research, talk to leading experts in the field, and extend your networks.

We look forward to seeing you soon in the 2nd ISCEE 2021 and stay safe.

Sincerely Yours,

Heriansyah Putra
Chairman of Organizing Committee of 2nd ISCEE 2021

The 2nd International Seminar on Civil and Environmental Engineering

ISCEE 2021, Bogor, Indonesia

Your Revised paper submission received succesfully

Yahoo/Email Masuk

ISCEE 2021 <iscee@apps.ipb.ac.id>

Kepada: Momon Sodik Imanudin

Min, 15 Agu 2021 jam 21.22

ISCEE 2021

Bogor, Indonesia, September 6th - 8th 2021

The 2nd International Seminar on Civil and Environmental Engineering

"Sustainable Infrastructure and Environmental Development"

non Sodik Imanudin.

successfully received your revised paper, "Integrated Duflow-Drainmod Model For Planning Of Water ient Operation In Tidal Lowland Reclamation Areas '. Camera ready submission at 25th August 2021.

regards,
21

ISCEE 2021 <iscee@apps.ipb.ac.id>
Kepada: Momon Unsri
Sen, 12 Jul 2021 jam 15.27
Dear **Momon Sodik Imanudin**

Sriwijaya University

Thank you for your registration as Presenter on the 2nd ISCEE 2021. Your payment has been recorded in our system. Please kindly find your receipt in the attachment.

Once again, we appreciate your kind contribution to this event and see you soon at ISCEE 2021 in September this year.

Best regards,

ISCEE 2021 Committee

RECEIPT

The 2nd International Seminar on Civil and Environmental Engineering

"Sustainable Infrastructure and Environmental Development"

Name	*Momon Sodik Imanudin*
Receipt Number	*ISCEE-E.013*
Description	*Registration - Indonesian Presenter*
Amount	*Rp 1.000.000,-*
Payment Method	*Transfer Bank BNI*
Paid Date	*01/07/2021*
Paper Title	*INTEGRATION OF DUFLOW-DRAINMOD MODELS FOR DEVELOPING NETWORK IMPROVEMENT RECOMMENDATIONS AND WATER TABLE CONTROL OPERATIONS IN TIDAL LOWLAND RECLAMATION AREAS*

Financial Chair

Joana Febrita, S.T., M.T.

REVISED PAPER

ISCEE IPB <iscee@apps.ipb.ac.id>

Kepada:MOMON SODIK IMANUDIN

Cc:Andik Pribadi

Sel, 17 Agu 2021 jam 17.17

Dear **Momon Sodik Imanudin**

Sriwijaya University

On behalf of the 2nd ISCEE 2021 Committee, we would like to inform you that your revised paper **ISCEE_3 002** entitled **'Integrated Duflow-Drainmod Model For Planning Of Water Management Operation In Tidal Lowland Reclamation Areas'** has been evaluated by experts in the related field and editors. Therefore, we again request you to make **a revision** before it is processed further. Please find the comment and suggestion in the attachment. Please revise your manuscript according to the comments and suggestions, and re-submit your revised manuscript through https://iscee.ipb.ac.id/2nd-revision/ before **August 20th, 2021**. Please mark all modifications in the manuscript with the other color or track changes function in Microsoft Word to be easily visible to the editor. The entire comments should be addressed, as acceptance is conditional on an appropriate response to the requirements and comments.

In addition, please recheck the IOP conference template, the example was attached. Make sure that your paper follows the format.

If you have any questions regarding the reviews of your paper, please do not hesitate to contact us.

See you on the 2nd ISCEE 2021
Best regards,

Heriansyah Putra

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The 2nd International Seminar on Civil and Environmental Engineering

ISCEE 2021, Bogor, Indonesia

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The Second International Sem[...]nmental Engineering (2st ISCEE) 2021
Bogor, Indonesia, September [...]

especially the space between paragraphs.

Integrated Duflow-Drainmod Model For Planning Of Water Management Operation In Tidal Lowland Reclamation Areas

M S Imanudin[1], S J Priatna[1], M.Edi Armanto[1] and M.B Prayitno[1]

[1]Department of Soil Science, Sriwijaya University, Indralaya South Sumatra, Indonesia 30138

E-mail: momonsodikimanudin@fp.unsri.ac.id

Abstract. The research objective was to develop field operational model to control water table level at reclaimed area of tidal lowland for food crop cultivation. The research site is reclaimed tidal lowland area in Delta Saleh primer 10 of South Sumatera Indonesia as representative of C typology land. Komputer model DUFLOW computer model is used to evaluate the perfomance of water management network at secondary and tertiary levels, whereas DRAINMOD computer model is used to evaluate soil water status at tertiary block. Results of DUFLOW model simulation can be used to improve water management by passing the Secondary Irrigation Chanel (SPD) and Secondary Drainage Chanel (SDU) through tertiary channels, water gate installation of stop-log type and weir construction in Drainage Secondary Channel

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Integrated Duflow-Drainmod Model For Planning Of Water Management Operation In Tidal Lowland Reclamation Areas

M S Imanudin[1], S J Priatna[1], M.Edi Armanto[1] and M.B Prayitno[1]

[1]Department of S [...] umatra, Indonesia 30138

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Abstract. The research objective was to develop field operational model to control water table level at reclaimed area of tidal lowland for food crop cultivation. The research site is reclaimed tidal lowland area in Delta Saleh primer 10 of South Sumatera Indonesia as representative of C typology land. Komputer model DUFLOW computer model is used to evaluate the perfomance of water management network at secondary and tertiary levels, whereas DRAINMOD computer model is used to evaluate soil water status at tertiary block. Results of DUFLOW model simulation can be used to improve water management by passing the Secondary Irrigation Chanel (SPD) and Secondary Drainage Chanel (SDU) through tertiary channels, water gate installation of stop-log type and weir construction in Drainage Secondary Channel (SDU). The weir construction has function as long storage and capable to control or maintain soil water level in land not quickly drawdown. Drainmod simulation model is acceptable, this is indicated by the results of statistical analysis where the correlation coefficient value reaches

0.89. Analysis of DUFLOW-DRAINMOD computer model software showed mutually supportive results in which DUFLOW simulation results can provide water potential information in channel for supply purpose (irrigation). This water level condition is an important part in DRAINMOD model because it has effect on soil water level dynamics as targeted on tertiary block as well as on capacity to applied drainage operation system.

1. Introduction

In General the tidal lowland reclaimed area in Indonesia to date is could not optimally function in controlling water status. This condition is proved by the variety of water status and land productivity although located on the same land typology [1]. The existing design system is made with the same concept without considering land hydro-topography resulting in excessive soil water level drawdown on one side and excessive water (logged condition) on other side [2]. Therefore, evaluation of the existing drainage system is urgently needed to obtain proper information related to how and where the proper system design that is still suitable for agricultural purpose, especially for food crops cultivation

[3]. Operation of drainage in wet land is mainly to control soil water level in order to create soil water depth condition that capable to supply crop water requirement which in turns reduce the irrigation water requirement [4][5].

Water management is one of the most important factors in managing agricultural land at tidal lowland area. The objective of this water management is not only to reduce or add surface water availability, but also to decrease soil acidity, prevent soil acidity due to oxidized pyrite layer, to prevent salinity and flooding hazards as well as to leach toxic elements accumulated in crop root zone [6][7]. In order to achieve the above objectives, water management operation is directed to aspect of soil water level detention that should be always kept above pyrite layer and land leaching through controlled drainage system [8][9]. Therefore, effort of water level control is important in management of tidal lowland area. The expected condition water level is highly depend on crop types, soil and hydrological condition of local area [10][11].

The computer model had been made and developed in order to examine drainage system effectiveness at micro level. This model is well known as DRAINMOD [12][13]. It is developed to evaluate water balance at shallow soil water level so that it is very acceptable to be us[illegible] model can also be adapted to variety of land characteristics in accordance with local agro-climate characteristics. It is successfully tested in some states such as America [illegible] [15]; Europe [16]; China [17], and [illegible]

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Meanwhile, DUFLOW computer model had been developed to evaluate condition of water management network in the capacity as supply and drain [20][21]. This model is capable to predict how far the the reach of high tidal water that can be utilized for water supply. This model can also be adapted to variety of land conditions in accordance with local agro-climate characteristics and water level of low tidal effect for drainage potential [22]. Simulation results ~~DUFLOW model can provide~~ practical recommendation for effort of water network improvement and operational system of water management [23][24][25]. Integration of the DUFLOW-DRAINMOD models are expected capable to answer the problem of water level control from tertiary block to water network level so that operational design of water level control can be developed to provide condition of soil water status as required by crops. DRAINMOD model is very good to be used to predict the depth of soil water level [26][27]. Estimation value of soil water level prediction resulting from simulation and modelling was $r^2 = 0.93$ [27].

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Research ~~aimed is to develop field operational model of water~~ management on tertiary block in effort to control water [illegible] in accordance with water requirement for corn and rice. The use of DUFLOW-DRAINMOD computer model is [illegible] as auxiliary equipment in operational plan composing of water level co[illegible]

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2. Methodology

2.1. Place and Time

This reserach was conducted at tidal lowland reclaimed area of Delta Saleh, South Sumatra Province. Two tertiary blocks were chosen as representative (1 in the end and 1 in the middle) within one secondary block for each sample locations. Sample location of adaptation model was located at primer 10 Delta Saleh (Figure 1). The observation period (ground water level monitoring) was carried out from November 2008-2009. For model simulation required, field data has been used since 2005 to 2016.

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2.2 Material and Equipment

The equipments used in this study were consisted of soil samples, corn seeds, rice seeds, fertilizers, pesticides, plant protection plastic and chemical materials for soil analysis in laboratory. Materials used in this study were consisted of piezometer, wells (perforated paralon pipe), metering board, water pass, tape measure, soil augers, disposal tube (*bailer*), stopwatch, GPS (*Global Positioning System*), digital camera and farm equipments. Computer simulation is conducted by using DRAINMOD 5.1 software [28]) to evaluate water status at tertiary block. DUFLOW software [29] was used to analyze water network perfomance..

2.2. Method

Some stages are required to compose the recommended design for water level control at each land hydro-topography class. The first stage is primary data compilation to conduct physical characteristics identification of land environment and scenario composing of water management. The second stage is design testing (simulation model) and field testing (model validation). The third stage is composing of the recommended management for each sample areas and the last stage is information presentation of management operation at micro level.

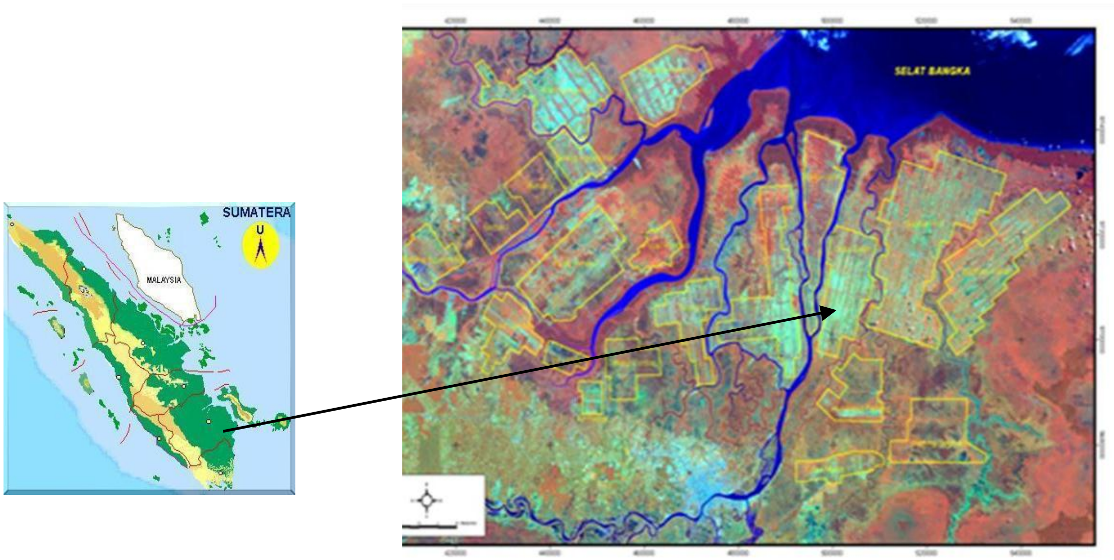

Figure 1. Research area situation map at Delta Saleh

Operational design of water management that will be developed in model adaptation of water management at tertiary block is as follows:

- Water disposal concept *(drainage)* and soil leaching
- Controlled drainage concept (*control drainage)*
- Channel water seepage concept *(sub irrigation),* and
- Tidal irrigation concept *(tidal irrigation),*

For simulation of computer model, one unit of water management system is taken as the boundary condition, i.e. one secondary block consisting of 17 tertiary channels. Tie points for borderline of modeling is estuary of supply and drainage secondary channels at upstream and downstream sites. Tertiary block is used as monitoring block for validation.

The scenarios to be developed for water network improvement at Delta Saleh Area with land typology C/D (dry) are as follows:

Scenario 1: Tertiary network of grid system, connected in two directions toward village secondary channel (SPD) and drainage secondary channel (SDU), channels are equipped with valve gates and secondary water gates only available at SPD level ,

Scenario 2: Tertiary network of grid system, connected in two directions toward village secondary channel (SPD) and drainage secondary channel (SDU), channels are equipped with stop-log gates, secondary water gates are available at SPD level and weir is built at drainage secondary channel (SDU).

These two scenarios will be combined with objective to be used for rice and corn crops with variation of dry, normal and wet rainfall conditions (probability of 20, 50 and 100%).

DRAINMOD model simulation is conducted to determine soil water status as a results of water operation in tertiary channel. There are three management scenario plans consisting of controlled drainage through water retention combined with land leaching, maximum water disposal as long as crop is unavailable in order to leach hazardous substances, and pump irrigation opportunity for short live plants.

Condition of tidal water and daily rainfall will also be analyzed to obtain opportunity of planting pattern that probably be implemented at two types of land. Meanwhle, value of water level status will be related to availablity of acid sulphate layer in order to determine how long the land experience oxidation and when land leaching operation can be implemented. These combination will be used as a basis for composing of water management scenario.

Calibration will be conducted on the use of DRAINMODD computer model prior to evaluation of some scenarios of selected water management. Some data input farticularly soil and drainage system parameters will be simulated in order to obtain simulation results data that is close to field measurement data [30]. If this condition is met, then DRAINMODD computer model can be used as a means to evaluate the perfomance from each selected scenarios and it is already proven that model results can be adapted to field condition [31] [32]. Data input that should be available for the purpose of calibration and DRAINMODD computer model simulation can be seen in Table 1.

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Table 1. Water management objective for rice and corn cultivation at tidal lowland for each crop growth phases.

Crop growth phase	Water management objective for rice crop	Water management objective for corn crop
Land tillage	Plowing: soil is below field saturation capacity Flooding: puddle 0 – 5 cm Levelling: puddle 5 cm	Water table elevation is dropped up to 40-50 cm so that soil is in field capacity condition which suitable for land tillage operation
Seedling	Water saturated soil/no flooding	Water table elevation control at depth of 30-40 cm. Soil should be at field capacity, not in saturation condition.
Vegetative growth	puddle 5 – 10 cm, water replacement, drain water during fertilizing time	Water table elevation is dropped up to 40-50 cm, except for area in which phyrite layer is located below 50 cm
Reproductive growth	puddle 5 – 10 cm, water replacement replacement, drain water during fertilizing time	Water table elevation is dropped up to 40-50 cm
Maturing phase	Soil in saturation condition up to field capacity.	Water table elevation control is not neccessary, it will dropped naturally

Source: [20]

Adaptation model of water management for each scenarios was conducted through expermental plot in the field with farmers group. The main observation indicator is monitoring of daily water level fluctuation and crop growth performance. Field water management operation model covers tertiary water gate operation and develop of micro water management network. Illustration of water table control operation in tertiary canal through water gate operation can be seen in Figure 2.

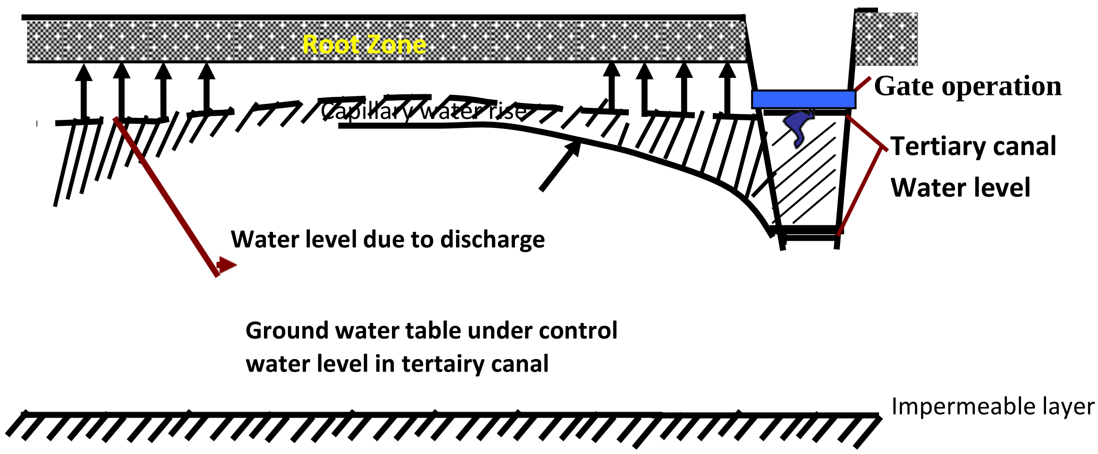

Figure 2. Water table profile between two tertiary channels due to water gate operation.

3. Results and Discussion

3.1. Water Management Objective

Water management aims to fulfill crop water requirement at tertiary block. Suplay water in tidal lowland is highly affeted by crop growth phase, and rainfall [33]. This condition cause different water management objective plan on respective phase and land type (Tabel 2). For second crop such as corn, the main objective in water management on farm land area is retained water in tertiary canal and maintened ground water table control by gete operation..

Water management objective is also highly depend on land hydro-topography classes. For tidal lowland area with C-type (high tide water is unable to enter the land), then water management aims to retain rainfall water and to maintain water level in tertiary channel at depth of 40-50 cm below the canal dike [34]. Water pump sometimes is still needed for crops during long dry season [35] It was commonly famer done in generatif growing phase on July-August-September period.

Table 2. Water management objective for rice and corn cultivation at tidal lowland for each crop growth phases.

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Maturing phase	Soil in saturation condition up to field capacity.	Water table elevation control is not neccessary, it will dropped naturally

Source: [20].

3.2. DUFLOW Model Adaptation in Composing Operation and Improvement of Water Management Network at Tidal Lowland Area with Dry Land Typology(C/D Type).

Analysis of wáter network perfomance is also conducted for dry área of C/D land tipology. As borderline within computer simulation model, one secondary block is used as simulation borderline (boundary condition). Some basic data of measurement used in this simulation are average soil surface level of 2.07 m (msl), average tidal water level of 1.7 m (msl). Crop evapotranspiration is made constant with average value of 5-7 mm/day [36] and rainfall condition is divided into three categories of dry (0 mm), normal (50 mm) and extremely wet (100 mm).

Scenario which is composed in DUFLOW simulation at the study area can be seen in Table 3. Variation of rainfall condition with and without waterworks at tertiary level is observed at this dry tipology land as well as water gate construction to maintain water level in SDU channel. The choice of waterworks at tertiary level is water gate of stoplog type and water level control is conducted by setting water gate height. Water retention with height of 50-60 cm in tertiary channel will capable to keep the ground water table under 40-50 cm below soil surface. [34].

DUFLOW simulation as water supply and water retention is an effort to maintain stable soil water level in order to prevent quick water losses into tertiary channel which subsequently wasted into secondary channel. This can be done by installing water gate of simple stoplog type and by restraining water with weir in drainage secondary channel (SDU). The objective of restraining water with weir in drainage secondary channel (SDU) is to obtain fixed water level in drainage secondary channel (SDU) which in turn can maintain water level in tertiary channel. Drainage channel has function as long storage in order to prevent drop of soil water level because there is strong correlation between fluctuation of water level in channel and soil water level [37].

Table 3. Scenario of DUFLOW program simulation for land type of C/D.

Water management scenario	Simulation treatment
Current condition evaluation, no water gate in secondary channel Networking improvement evaluation with wáter retention in drainage secondary channel (SDU) through wáter gate installation	• Dry rainfall (0) mm • Normal rainfall (50) mm • Wet rainfall (100) mm

Simulation results of computer model in which secondary channel is retained with weir and land had normal raifall (50mm) are presented as initial phase. Duflow gives an overview that water retention in secondary channel is capable to increase water level in tertiary channel (Figure 3). Water level in tertiary channel during initial water intake is relatively high close to 2 m msl, but subsequently drop and water level in the middle of tertiary channel is close to 1.5 m msl. Application of water retention in tertiary channel is difficult to be applied on the last period of wet season or dry season due to high soil porosity. Thus, effort to develop drainage secondary channel as long storage is highly appropriate so that water losses can be reduced.

DUFLOW model is incapable to respond the effect of high hydraulic conductivity of soil in the field. DUFLOW only capable to evaluate flow capacity of channel as supply and disposal. The increase of water level in tertiary channel as results of weir development effect in SDU ca be seen in Figure 4. This is due to the increase of water level in secondary channel which capable to supply water for tertiary channel. Water level in tertiary channel has increase and finally can be maintained at height of 1.5 m msl. It means that tertiary channel receive constant water supply at height of 50-60 cm from soil surface. But what is more important is that the available of water level in tertiary channel is to maintain soil water balance at tertiary block so that water is not quickly drop.

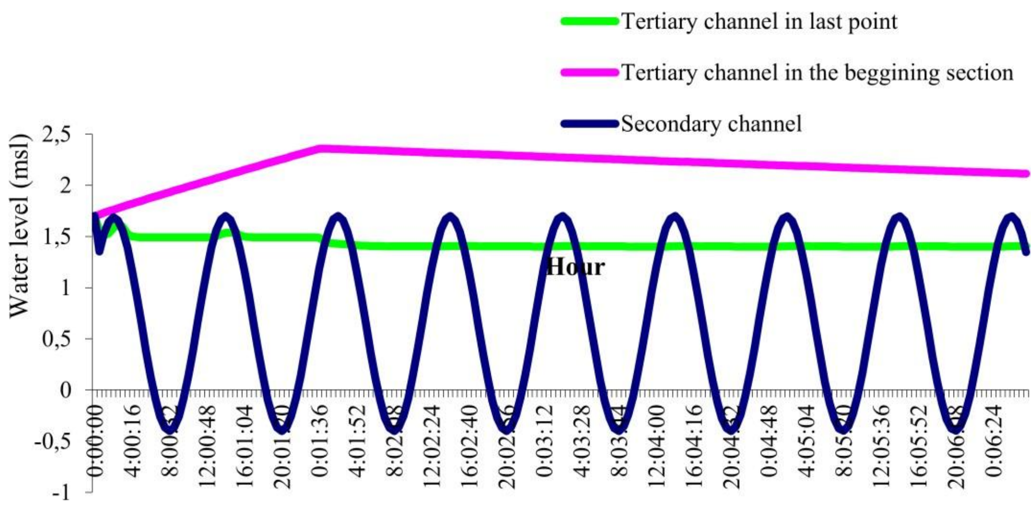

Figure 3. The effect of supply operation combined with water retention in tertiary channel at minimum rainfall condition

If water depth in tertiary depth is maintained at 50-60 cm height, then soil water level at tertiary block is still at safe level for rice crop or it is above 15 cm zone. Water level condition at depth of 10-15 cm for long period can significantly reduce production [38].This condition is similar to study result by [39] which show that rice crop will experience water stress if soil water depth is drop below 20 cm zone. Optimum water depth for rice crop is 5 cm above soil surface [40]. According to [41] production of 1 kg rice requires 1,432 liter water to fulfill crop evapotranspiration requirement.

According to [25] Duflow computer model is very good to evaluate the flow and disposal potential at network system of tidal lo[illegible]udy result in which Duflow computer model capable to give an overview of water level rise due to waterworks operation. One of important operation that should be conducted is channel flushing to dispose poor water quality due to water retention for long time in secondary and tertiary channels. The increase of water level in SDU

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can be flown into tertiary channel and to dispose water from tertiary channel into SPD which is subsequently flown into primary channel. This water operation can also be arranged based on simulation of DUFLOW model and one of them is used to decrease sedimentation effect in channel [42].

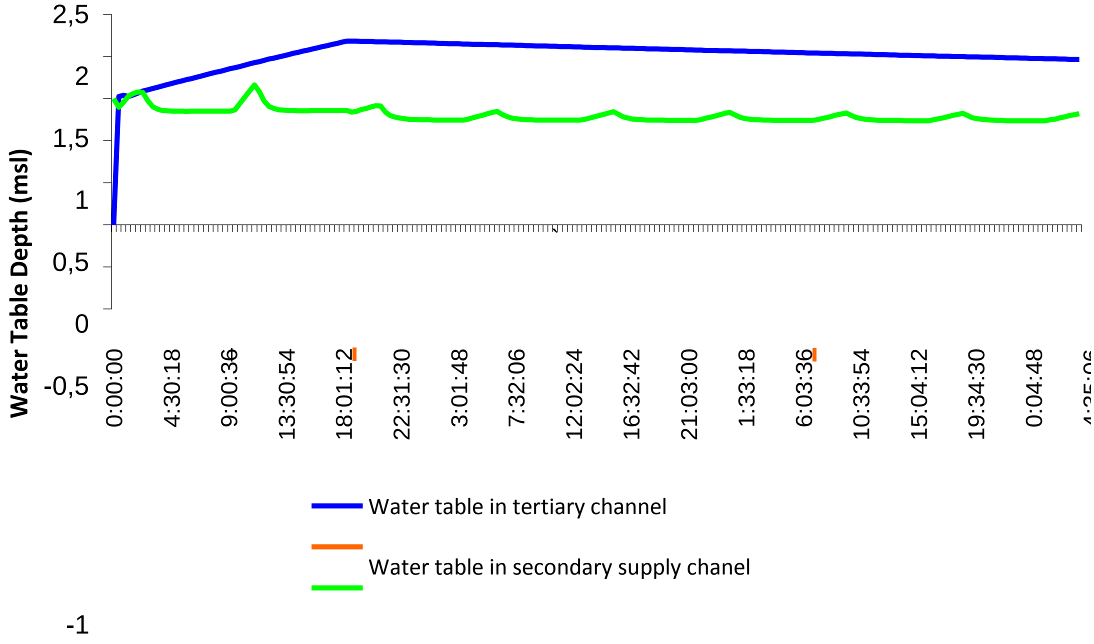

Figure 4. Results of DUFLOW simulation at SDU (main drainage channel) condition as longstorage and water table elevation in tertiary channel is elevated at 70 cm.

Leaching and flushing activties can only be done at the end of rainy season after rice planting. Water in tertiary channel can be disposed into secondary channel which subsequently flow into primary channel. Observation of soil water level at tertiary channel before and after the existence of waterworks at SDU secondary channel can be seen in Figure 5.

Figure 5 shows that there is an increase of ground water table during the growing period (MT1) of rice crop. Soil water level never drop beyond -30 cm so that soil water status stays in saturation condition. Meanwhile, previously soil water level drop to -60 cm resulting in water stress experience by rice crop, especially during initial period of the flowering stage.

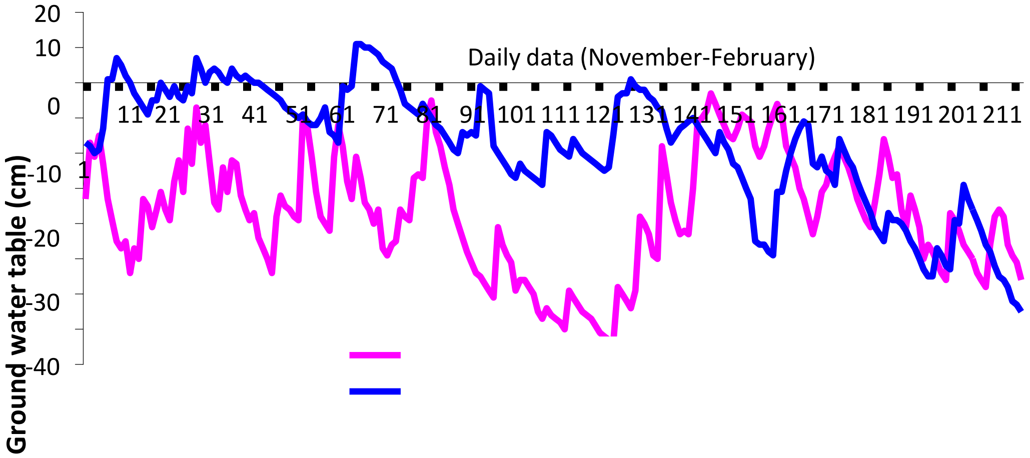

Figure 5 . Water table elevation at tertiary block for first planting season 2005 before and after weir construction in 2008-2009 at P10-2S delta Saleh.

The disadvantage of weir construction in SDU is the difficulty in water management system operation because it is not equipped with operational water gate. At least a culvert is needed in combination with fiberglass flap gate.

3.3. DRAINMOD Model Adaptation for constructing field operation model

DRAINMOD simulation had been done at dry land (Saleh). This simulation use several assumptions such as *steady state condition*, crop water requirement use empirical approach in which potential evapotranspiration is calculated by using Thornwhite equation [43]. The drainage system had distance between channel of 200 m and the depth of impermeable layer is located 1.5 m below soil surface.

Water management scenario is based on land utilization pattern potential and farmer socioecomic aspect in which the proposed planting pattern is rice-corn. Based on water status in land, the main objective of water management at Saleh area is water retention and water leaching.

The results of statistical analysis of the DRAINMOD simulation using one year of data (rainy and dry conditions) showed good performance where the results of modeling and observations had the same trend of water level fluctuation patterns. This means the model is acceptable, with high reliability. This condition is strengthened from the results of statistical analysis where the correlation coefficient value reaches 0.89; the efficiency model has a positive value and is close to one, namely 0.97, and the root mean error (Root Mean Square Error) is 1.45 cm. With these results, it can be concluded that the performance of the model is said to be very good, and the DRAINMOD model can be used to evaluate the status of shallow groundwater levels.

The recommended water management scenario is to cultivate land with planting pattern system of rice-corn in which rice is planted at first planting season of November-January/February and corn is planted at April up to June/July. The problem for corn cultivation is that soil is still in water saturation condition in February, March and April so that drainage is required. Entering the month of May, soil water level drops below 30 cm so that corn crop experience water stress. Water retention in channel is required during this condition and whenever possible irrigation can also be given. Water level dynamics resulting from DRAINMOD simulation can be seen in Figure 6.

Model adaptation in the field is conducted in 2009-planting season and showed good result in which the effect of water gate retainer and water gate retainer in secondary channel showed the significant increase of soil water level (Figure 6). Soil water can be maintained due to the existence of water in tertiary channel and water can be stored in land in case of rainfall occurence. This condition causes the land to be flooded resulting in increase of production. Production for 2005 year in average is 2.5 ton/ha, whereas production is increase in average of 4 ton/ha for 2009 year.

Monthly operation of water gate according to crop growth phase can be seen in Table 4. Soil tillage for rice crop is started since November. The main objective of water management at initial soil tillage is disposal. This drainage process had been started since September- Oktober. Its objective is to leach hazardous substances and soil acidity out of the root zone of the plant. Water retention process is started since soil puddling up to seeds sowing phase. Water disposal is done at seeds sowing phase in which quarterly channel gate is opened so that water in land can be disposed through quarterly channel into tertiary channel.

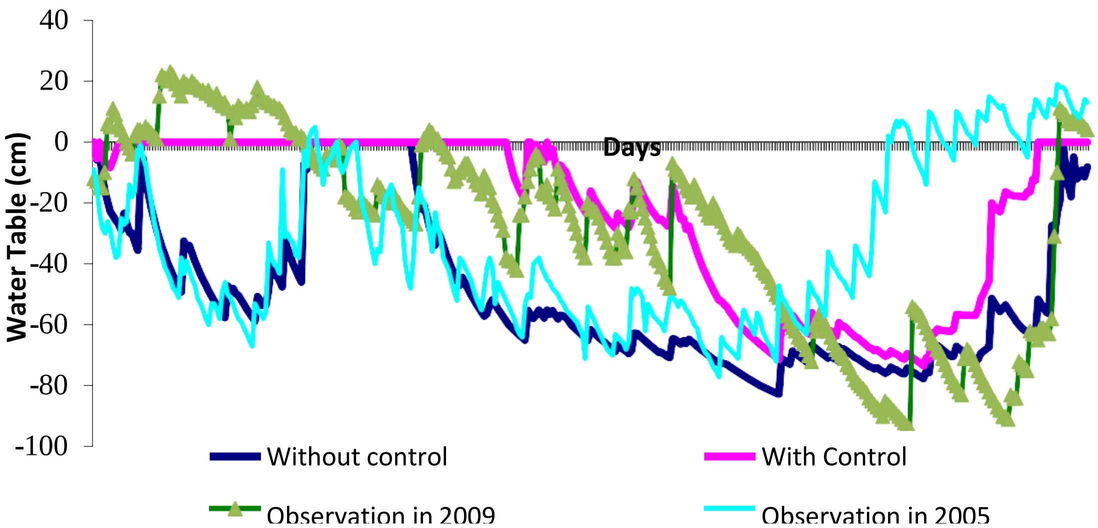

Figure 6. Daily water dynamics resulting from computer simulation of DRAINMOD model at location of P10-2S Delta Saleh.

Table 4. Field Operation on farm for first planting season of rice during December- February 2009) at Location of P10-2S Delta Saleh (dry type).

Crop growth phase	Activity period	Tertiary canal operation system	
		Modeled by Drainmod simulation	Farmer done for model adaptation
Land preparation	September-October	Open	Open
Land tillage	October-November	Close/water retention	Close/water retention at 50 cm
Planting, direct seedling (Tabela)	November	Close/water retention	Close/water retention at 50 cm
Vegetative growth	December-January	Close/water retention at 50 cm	Close/water retention at 50 cm
Reproductive phase	January-February	Close/water retention at 50 cm	Close/water retention at 50 cm
Maturing phase	February	Close/water retention at 50 cm	Close/water retention at 50 cm

It is obvious that without operation of water level control, water deficit will occur at Delta Saleh (Figure 7). Water level drops far beyond acid sulphate layer and land can not be cultivated for the whole year. DRAINMOD simulation results showed that ground water table is drop below root zone of 0 cm without water retention in tertiary channel although at rainy season condition. Therefore, farmers in the field are strongly agree that water retention is done during rainy season, especially during rice growing period.

Option for water gate in tertiary channel is closed during rice crop growth in December up to February. Water gate is not fully closed at this operation, only about 40-50 cm. It is expected that suplay water is possible during high tide water and water in tertiary channel is not all discharge because it is retained by the gate at height of 40-50 cm during low tide water.

The proposed planting pattern is rice-corn based on field study and input from farmers. Gate operation is mostly in retaining condition during rice crop cultivation which is started from October-December and January-February. Water retention is done at height of 50 cm. Gate operational is by retaining water at depth of 50 cm. It is expected that water in tertiary channel can be retained at height of 50 cm by this gate operation and water level at estuary of tertiary channel can increase to 60 cm during high tide water so that high tide water can fill tertiary channel. The entering of high tide water is also to maintain water quality.

3.4. Model Adaptation in Composing Water Control Operation for Rice and Corn Crops at C/D Typology Land (Dry Condition)

In tidal lowland corn cultivation can be started if soil water drops below root zone of 30 cm. This activity can be done directly after rice harvesting. This is due to the fact that soil water level is still high so that soil layer in the root zone is still saturate with water. Therefore, water gate is totally opened at March period and at the same time flushing acid substances is done that are accumulate during water retention period at rice cultivation season. Computer simulatin of DRAINMOD had succeed in composing seasonal operational plan for water table control. The results of desired water level for corn as impact of water level control can be seen in Figure 7.

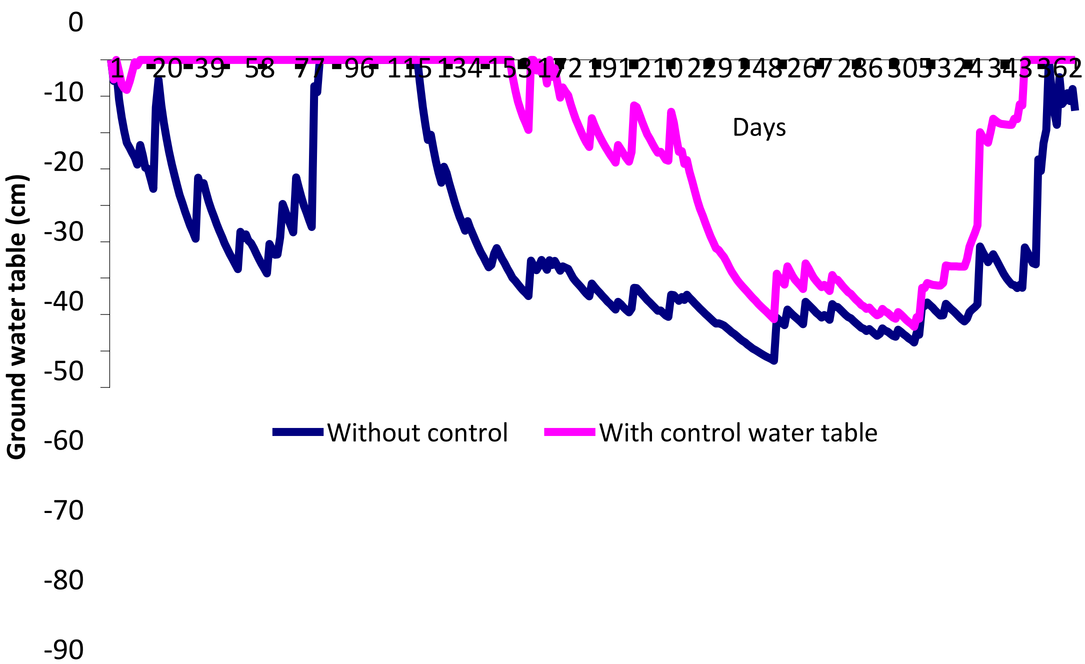

Figure 7. Simulation result of DRAINMOD under two option water management.

Field operation should include water retention effort entering the dry season. Water level condition drops close to 60-70 cm below soil surface during generative phase of crop (August). This condition is vulnerable if no rainfall occurrence because crop will experience water stress [35]. Therefore, water supply from surface is needed. Water addition should be given to fulfill crop evapotraspiration requirement especially when entering the generative phase. Pump irrigation with output or discharge diameter of 8 ich can be operated with interval once in 10 days. Pump operation is done during high tide water. Gate operation after rice harvesting in March is by total disposal to flush acid substances and to lower soil water level for corn planting preparation.

IV. Conclusion And Recommendation

4.4. Conclusion

The best cropping patern in C typology land class of tidal lowland is rice-corn based on water availability analysis in tertiay block. Water gate construction is needed to apply water control

operational system at tertiary block. Stop log type gate is the best compared to flap gate type on C typology land (dry).

Computer simulation showed good result in which soil water level dynamics from simulation result tend to be similar with field measurement results. It was stated that the root mean square value of error is 1.45 cm, model efficiency value is 0.97 and strong correlation value is 0.84.

Network improvement effort can be composed through adaptation of DUFLOW model for C typology land (dry). Network improvement is conducted by connecting tertiary channel SPD and SDU, water gate installation of stop-log type, and weir construction at drainage secondary channel (SDU).

Analysis to computer model software of DUFLOW-DRAINMOD showed the mutually supportive results in which DUFLOW simulation results can provide water potential information in channel for supply objective (irrigation)..

Field operation model of water management for corn was achieved by control drainage in which all water gates at all corn growth phase are operated as water retention and supply when salt water is not entering yet (June-July). Maximum drainage can only be conducted after finishing of rice planting and land tillage for planting preparation.

4.2. Recommendation

File operation model to maintenance the water table in tertiary block was conducting by water retention system at dry land type (C-typology). Aapplied for long time will results in water quality degradation. Therefore, water flushing and leaching in channel should be routinely operated. Maintence tertiary canal by flushing once in two weeks is sufficient to improve water quality.

Some factors to be involped in constructing the field model operation in the field are as follows: farmer instrucution should be made as simple as possible and it is socially accepted by farmers. Finally the water management operation must be done continuously although land is in uncultivated condition in order to reduce environmental damage and to accelerate the soil remediation process.

REFERENCES

[1] Imanudin, M.S., Satria, J.P., Bakri., and M. Edi Armanto. 2020. Field Adaptation for Watermelon Cultivation under Shallow Ground Water Table in Tidal Lowland Reclamation Area. Journal of Wetlands Environmental Management. 8 (1): 1 – 10 http://10.20527/jwem.vol 8 No 1.211

[2] Bakri, Bernas M., and Imanudin, M.S. 2015. Water Retention option of drainage system for dry season corn cultivation at tidal lowland area. International Journal AGRIVITA 37 (3): 237-246.

[3] Bakri., Imanudin, M.S. & Chandra, Wahyu. 2020. Water Management and Soil Fertility Status at A Reclaimed Tidal Lowland of Telang Jaya Village, South Sumatra, Indonesia. Journal of Wetlands Environmental Management. 8. 85. 10.20527/jwem.v8i2.228.

[4] Saadat, Samaneh & Bowling, L. & Frankenberger, Jane & Brooks, Kyle. 2017. Effects of Controlled Drainage on Water Table Recession Rate. Transactions of the ASABE. 60. 813-821. 10.13031/trans.11922.

[5] Poddar, Arunava And Kumar, Navsal And Shankar, Vijay. 2018. Effect Of Capillary Rise On Irrigation Requirements For Wheat. International Conference on "Sustainable Technologies for Intelligent Water Management. Indian Water Resource Society (IWRS), February 16-19. 2018.
[6] Suryadi, F.X, Hollanders P.H.J., and Susanto. R.H. 2010. Mathematical modeling on the operation of water control structures in a secondary block case study: Delta Saleh, South Sumatra. Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB).Québec City, Canada June 13-17, 2010.
[7] Hartoyo, Susanto, R.H., Suryadi, FX, Baart Schultz, and Eelart A. V. 2009. Land and water management of tidal lowlands: Experiences in Telang and Saleh, South Sumatera (Irrigationand drainage Jurnal 2009 – on line, Wiley InterScience (www.interscience .wiley.com)).
[8] Blunden, B. & Indraratna, B. 2001. Pyrite Oxidation Model for Assessing Ground-Water Management Strategies in Acid Sulfate Soils. Faculty of Engineering - Papers. 127. 10.1061/(ASCE)1090-0241(2001)127:2(146).

[9] Imanudin, M. S. ., Sulistiyani, P. ., Armanto, M. E., Madjid, A., & Saputra, A. . (2021). Land Suitability and Agricultural Technology for Rice Cultivation on Tidal Lowland Reclamation in South Sumatra. *Journal of Suboptimal Lands*, *10*(1), 91–103. https://doi.org/10.36706/JLSO.10.1.2021.527

[10] Ale, S., L.C. Bowling S.M. Brouder J.R. Frankenberger M.A. and Youssef. 2008. Simulated effect of drainage water management operational strategy on hydrology and crop yield for drummer soil in The Midwestern United States. Agricultural Water Management Journal. Volume 96, Issue 4, April 2009, Pages 653-665.

[11] Fahmi, A. and Ani Susilawati. 2018. Environmental friendly management of acid sulphate soils. Proceeding Of International Workshop And Seminar Innovation of Environmental-Friendly Agricultural Technology Supporting Sustainable Food Self-Sufficiency. 870.878 , DOI: 10.5281/zenodo.3339423
[12] Skaggs, R.W. 1982. Field Evaluation of Water Management Simulation Model. Transaction of the ASAE 25 (3):666-674
[13] Susanto., R.H. 2009. Agricultural Development in the Lowlands : Dynamics, perspective and time frame – leasson Learnt from STLD and the way forward (Makalah disampaikan pada "Workshop on Sustainable Lowland Development in Indonesia), Jakarta 21 Januari 2009.
[14] Ale, S., L.C. Bowling S.M. Brouder J.R. Frankenberger M.A. and Youssef. 2008. Simulated effect of drainage water management operational strategy on hydrology and crop yield for drummer soil in The Midwestern United States. Agricultural Water Management Journal. Volume 96, Issue 4, April 2009, Pages 653-665.
[15] Xihua Yang. 2006. Evaluation and application of DRAINMOD in an Australian sugarcane field. April 2008, Agricultural Water Management.95 (2006) 439- 446.
[16] Borin M., F. Morari, G. Bonaiti, M. Paasch, and R.W. Skaggs. 2000. Analysis of DRAINMOD Performances With Different Detail of Soil Input Data In The Veneto region of Italy. Journal of Agricultural Water Management 42: 259-272
[17] Zhonghua Jia, and Wan Luo. 2006. Modeling net water requirements for wetlands in semi-arid regions. Agricultural Water Management 81 (2006) 282–294.
[18] Susanto., R.H. 2007. Water Table Fluctuation Under Various Hydrotopographical Condition for Determining the Cropping Calendar (Jurnal Pengelolaan Lingkungan dan Sumberdaya Alam, Volume 6, Nomor 2, Juni 2007, ISSN .1693 – 0391
[19] Imanudin, M.S., Susanto, R.H, Armanto, E, and Bernas, S.M. 2009**.** The use of drainmod model for developinf strategic operation of water management in the tidal lowland agriculture areas of South Sumatera Indonesia. Proceeding of International Seminar on Wetland and Sustainability, Kota Kinabalu Sabah Malaysia. 26-28 Juni 2009. ISBN 478-983-3142-11-8

[20] Suryadi, F.X., 1996. Soil and water management strategies for tidal lowlands in Indonesia. PhD thesis, Delft University of Technology- IHE Delft. Balkema, Rotterdam, The Netherlands.

[21] Situngkir, A. M. 2016. Evaluation And Improvement Of Drainage Performance In Gedongtataan, Lampung Using Duflow Modeling Studio. Journal of Natural Resources and Environmental Management. 6(2), p. 111. doi: 10.29244/jpsl.6.2.111

[22] Triadi, B., P. Simanungkalit., M. Fernandus. 2010. Tersedianya Potensi Suplai Dan Drainasi Persawahan Danda Besar Melalui Revitalisasi Prasarana Hidraulik Tingkat Tersier. Jurnal Teknik Hidraulik 1(1): 69-82

[23] Suryadi, F.X. and E. Schultz, 2001. *Effects of operation rules on water management in tidal lowlands.* In: proceedings workshop on the Agricultural based development of tidal swamps and estuaries and environmental considerations, Seoul, Korea.

[24] Imanudin M.S., RH Susanto,, 2003. Application of DUFLOW Computer Model on Tidal Lowland Water Management Strategy : A Case Tidal Pilot Monitoring Area in South Sumatra (Paper presented at International Seminar And Exhibition On Prospectives Of Lowland Development In Indonesia, Palembang, 8-9 Desember 2003) ISBN: 979-97066-1-0.

[25] Suryadi, F.X, P.H.J. Hollanders, and R.H. Susanto. 2010. Mathematical Modeling On The Operation of Water Control Structures In A Secondary Block Case Study: Delta Saleh, South Sumatra. Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB).Québec City, Canada June 13-17, 2010.

[26] Davoodi, K., A.D. Nartchall., G.A. Mazandarani. 2019. Evaluating Drainmod-s to Predict Drainage Water Salinity and Groundwater Table Depth During Winter Cropping in Heavy-Textured Paddy Soils. Irrigation and Drainage 68 (3): 59-572 https://doi.org/10.1002/ird.2339

[27] Ashkan, A., Malakshahi, A. Darzi- Naftchali, Behrooz Mohseni. 2020. Analyzing water table depth fluctuation response to evapotranspiration involving DRAINMOD model. Agricultural Water Management 234(1) https://doi.org/10.1016/j.agwat.2020.106125

[28] Skaggs, R.W. 1991. Drainage (*in* Hanks, J and J.T. Ritchie, 1991. Modelling plant and soil system. ASA, CSSA, SSSA. Madison, Wisconsin).

[29] IHE, 2002. Duflow Reference Manual. VERSION 3.5 April 2002. Stowa/ MX.Systems. Unesco-IHE. Delft. The Netherlands.

[30] Imanudin, M.S., M. E. Armanto, Bakri. 2019. Determination of planting time of watermelon under a shallow Groundwater table in tidal lowland agriculture areas of South Sumatra, Indonesia. *Irrigation and Drainage Journal*, 68(3): 488-495.

[31] Selvaperumal, A. & Gurusamy, Thiyagarajan & Vallalkannan, s & Muthuchamy, I & Ramaswamy, K. 2020. DRAINMOD -Calibration and Validation for Prediction of Drainage Coefficient and Water Table Depth. Current Journal of Applied Science and Technology. 10.9734/CJAST/2020/v39i930607.

[32] Muhammad, E.Sh., M.M. Ibrahim., Ashraf El-Sayed. 2021. Effects of drain depth on crop yields and salinity in subsurface drainage in Nile Delta of Egypt. Ain Shams Engineering Journal 12(2): 1595-1606 https://doi.org/10.1016/j.asej.2021.01.008

[33] Bassey E. Udom, Onyinyechi J. Kamalu. Crop Water Requirements during Growth Period of Maize (*Zea mays* L.) in a Moderate Permeability Soil on Coastal Plain Sands. International Journal of Plant Research9(1): 1-7 doi:10.5923/j.plant.20190901.01

[34] Imanudin, M.S., Bakri., Armanto, M.E., Indra, B., and Ratmini, S.N.P. 2019. Land And Water Management Option of Tidal Lowland Reclamation Area to Support Rice Production (A Case Study in Delta Sugihan Kanan of South Sumatra Indonesia). Journal of Wetlands Environmental Management.6 (2): 93 – 111. http://dx.doi.org/10.20527/jwem.v6i2.165

[35] Imanudin, M. S. ., Sulistiyani, P. ., Armanto, M. E., Madjid, A., & Saputra, A. . (2021). Land Suitability and Agricultural Technology for Rice Cultivation on Tidal Lowland Reclamation in South Sumatra. *Jurnal Lahan Suboptimal : Journal of Suboptimal Lands*, *10*(1), 91–103. https://doi.org/10.36706/JLSO.10.1.2021.527

[36] Montazar. A., R. Kruege., D. Corwin., A. Pourreza., C. Little., S. Rios and Richard L. Snyder. 2020. Determination of Actual Evapotranspiration and Crop Coefficients of California Date Palms Using the Residual of Energy Balance Approach. Water 2020, 12, 2253; doi:10.3390/w12082253

[37] Koïta, M., H. Fabien Yonli., D. Dimitri Sor., A. Emmanuel Dara and J.M Vouillamoz. 2018. Groundwater Storage Change Estimation Using Combination of Hydrogeophysical and Groundwater Table Fluctuation Methods in Hard Rock Aquifers. Resources 2018, 7(5): 1-15. doi:10.3390/resources7010005

[38] Budianto. M. B., A. Supriadi., S. Hidayat., Salehudin. 2020. Water-Saving Irrigation Model Combining System of Rice Intensification (SRI) with Alternate Wetting and Drying (AWD) for Paddy Field. Jurnal Teknik Pengairan, 2020, 11(2) pp.128-136

[39] Tuong, T.P., L, V. Du and N.N. Luon 1993. Effect of Land Preparation on Leaching of an Acid Sulphate Soil at Cu Chi, Vietnam. In: D.L. Dent and M.E.F. van Mencvoort (editor): Selected papers of the Ho Chi Minh City Symposium, 281-287. International Institute for Land Reclamation and Improvement Publication 53., Wageningen.Vepraskas, X. He, M. J. Skaggs, R.W and Lindbo, D. L. 2002. Adapting a Drainage Model to Simulate Water Table Levels in Coastal Plain Soils. in Soil Sci. Soc. Am. Journal. 66:1722–1731.

[40] Talpur, Mashooque Ali. 2013. Effect of different water depths on growth and yield of rice crop. African Journal of Agricultural Research 8(37):4654-4659 DOI:10.5897/AJAR12.1693

[41] Zwart SJ, Bastiaansen WGM. 2004. Review of measured crop water productivity values for irrigated wheat, rice, cotton and maize. Agricultural Water Management 69 (2004) 115-133.

[42] Theol, S.A, Bert Jagers., F. X. Suryadi and Charlotte de Fraiture. 2019. The Role of Gate Operation in Reducing Problems with Cohesive and Non-Cohesive Sediments in Irrigation Canals. Water 2019, 11, 2572; doi:10.3390/w11122572

[43] Vepraskas, X., M.J. He, R.W. Skaggs, and D.L. Lindbo. 2002. Adapting a Drainage Model to Simulate Water Table Levels in Coastal Plain Soils. in Soil Sci. Soc. Am. Journal. 66:1722–1731.

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Second round of review and Request for revision

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Reviewer comments and Reply form

Paper ID : ISCEE_3 - 002

Paper Title : Integrated Duflow-Drainmod Model For Planning Of Water

Management Operation In Tidal Lowland Reclamation Areas

Authors : M S Imanudin, S J Priatna, M.Edi Armanto, and M.B Prayitno

Recommendation : **Accepted with minor revision**

Editor and Reviewer's Comments

Editor (Preliminary evaluation)	
Comments for Authors	**Authors' Reply**
1. The overall score for the similarity index is 18%. But the maximum similarity index is 20%. Also, two of the sources has a score above 3%, so we respectfully ask the author to paraphrase the sentence and to reduce the similarity.	Yes I was done
2. Overall score with grammarly is 42. The entire manuscript still has mayor grammar spelling correction. Please check carefully using English proofread i.e., Grammarly or any related software if possible.	Yes I was done

Reviewer #1	
Comments for Authors	**Authors' Reply**
1. Figure 4. There are 3 lines in chart but only 2 legends. 2. Figure 5. 2 lines but only one legend. 3. Figure 6, 4 lines with only 2 legends. 4. As English proofreading by Grammarly showed very low score, the paper should be revised and re-examine by English proof-reader or software such as grammarly.	Yes I was revised

Reviewer #2	
Comments for Authors	**Authors' Reply**

The paper is interested, however, the English should be improved properly. For the substance, it is better to add the validation model. For the detail, the following are some points should be considered: 1. English should be improved properly. 2. Abstract: Komputer model no need. 3. Abstract: SPD and SDU should be defined in the first appearance. 4. Abstract: Should be added validation model results. 5. Introduction: format for double citation should be revised. 6. Introduction: DUFLOW-DRAIMOD stand for? Should be defined properly. 7. Methodology > Place and Time : no information regarding time. 8. Methodology > Material and Equipment : The equipments used in this study were consisted of soil samples, corn seeds, rice seeds however no information regarding plant productivity, so this materials are not related directly to the paper. 9. Results and Discussion > 3.2 is too long, should be make shorter and clearly. 10. Result and Discussion: ● If possible, validation model should be added to evaluate the performance of models. ● Land productivity (corn and rice) should be added if available data, to compare control and uncontrolled water table. 11. Conclusion: too long, it is better to reduce and only to address the main objective.	We had already improve the content that you suggestion. Thank you

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Dear Momon Sodik Imanudin.

We have successfully received your revised paper, "Integrated Duflow-Drainmod Model For Planning Of Water Management Operation In Tidal Lowland Reclamation Areas '. Camera ready submission at 25th August 2021.

With best regards,
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TERLAMPIR MAKALAH HASIL REPISI

Integrated Duflow-Drainmod Model For Planning Of Water Management Operation In Tidal Lowland Reclamation Areas

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Abstract. The research objective was to develop field operational model to control water table level at reclaimed area of tidal lowland for food crop cultivation. The research site is reclaimed tidal lowland area in Delta Saleh primer 10 of South Sumatera Indonesia as representative of C typology land. DUFLOW computer model was used to evaluate the perfomance of water management network at secondary and tertiary levels, whereas DRAINMOD computer model is used to evaluate soil water status at tertiary block. Results of DUFLOW model simulation can be used to improve water management by passing the Secondary Irrigation Chanel (SPD) and Secondary Drainage Chanel (SDU) through tertiary channels, water gate installation of stop-log type and weir construction in Drainage Secondary Channel (SDU). The weir construction has function as long storage and capable to control or maintain soil water level in land not quickly drawdown. Drainmod simulation model is acceptable, this is indicated by the results of statistical analysis where the correlation coefficient value reaches 0.89. Analysis of DUFLOW-DRAINMOD computer model software showed mutually supportive results in which DUFLOW simulation results can provide water potential information in channel for supply purpose (irrigation). This water level condition is an important part in DRAINMOD model because it has effect on soil water level dynamics as targeted on tertiary block as well as on capacity to applied drainage operation system.

1. Introduction

In General the tidal lowland reclaimed area in Indonesia to date is could not optimally function in controlling water status. This condition is proved by the variety of water status and land productivity although located on the same land typology [1]. The existing design system is made with the same concept without considering land hydro-topography resulting in excessive soil water level drawdown on one side and excessive water (logged condition) on other side [2]. Therefore, evaluation of the existing drainage system is urgently needed to obtain proper information related to how and where the proper system design that is still suitable for agricultural purpose, especially for food crops cultivation [3]. Operation of drainage in wet land is mainly to control soil water level in order to create soil water depth condition that capable to supply crop water requirement which in turns reduce the irrigation water requirement [4][5].

Water management is one of the most important factors in managing agricultural land at tidal lowland area. The objective of this water management is not only to reduce or add surface water availability, but also to decrease soil acidity, prevent soil acidity due to oxidized pyrite layer, to prevent salinity and flooding hazards as well as to leach toxic elements accumulated in crop root zone [6][7]. In order to achieve the above objectives, water management operation is directed to aspect of soil water level detention that should be always kept above pyrite layer and land leaching through controlled drainage system [8][9]. Therefore, effort of water level control is important in management of tidal lowland area. The expected condition water level is highly depend on crop types, soil and hydrological condition of local area [10][11].

The computer model had been made and developed in order to examine drainage system effectiveness at micro level. This model is well known as DRAINMOD [12][13]. It was developed to evaluate water balance at shallow soil water level so that it is very acceptable to be used in tidal lowland area. This model can also be adapted to variety of land characteristics in accordance with local agro-climate characteristics Model had successfully tested in some states such as America [14]; Australia [15]; Europe [16]; China [17], and Indonesia [18][19].

Meanwhile, DUFLOW computer model had been developed to evaluate condition of water management network in the capacity as supply and drain [20][21]. This model is capable to predict how far the the reach of high tidal water that can be utilized for water supply. This model can also be adapted to variety of land conditions in accordance with local agro-climate characteristics and water level of low tidal effect for drainage potential [22]. Simulation results DUFLOW model can provide practical recommendation for effort of water network improvement and operational system of water management [23][24][25]. Integration of the DUFLOW-DRAINMOD models are expected capable to answer the problem of water level control from tertiary block to water network level so that operational design of water level control can be developed to provide condition of soil water status as required by crops. DRAINMOD model is very good to be used to predict the depth of soil water level [26][27]. Estimation value of soil water level prediction resulting from simulation and modelling was $r^2 = 0.93$ [27].

Research aimed to develop field operational model of water management on tertiary block in effort to control water level in accordance with water requirement for corn and rice. The use of DUFLOW-DRAINMOD computer model should be tested as auxiliary equipment in operational plan composing of water level control at tidal lowland area.

2. Methodology

2.1. Place and Time

This reserach was conducted at tidal lowland reclaimed area of Delta Saleh, South Sumatra Province. Two tertiary blocks were chosen as representative (1 in the end and 1 in the middle) within one secondary block for each sample locations. Sample location of adaptation model was located at primer 10 Delta Saleh (Figure 1). The observation period (ground water level monitoring) was carried out from November 2008-2009. For model simulation required, field data has been used since 2005 to 2016.

2.2 Material and Equipment

The equipments used in this study were consisted of soil samples, corn seeds, rice seeds, fertilizers, pesticides, plant protection plastic and chemical materials for soil analysis in laboratory. Materials used in this study were consisted of piezometer, wells (perforated paralon pipe), metering board, water pass, tape measure, soil augers, disposal tube (*bailer*), stopwatch, GPS (*Global Positioning System*), digital camera and farm equipments. Computer simulation was conducted by using DRAINMOD 5.1 software [28]) to evaluate water status at tertiary block. DUFLOW software [29] was used to analyze water network perfomance..

2.2. Method

Some stages are required to compose the recommended design for water level control at each land hydro-topography class. The first stage is primary data compilation to conduct physical characteristics identification of land environment and scenario composing of water management. The second stage is design testing (simulation model) and field testing (model validation). The third stage is composing of the recommended management for each sample areas and the last stage is information presentation of management operation at micro level.

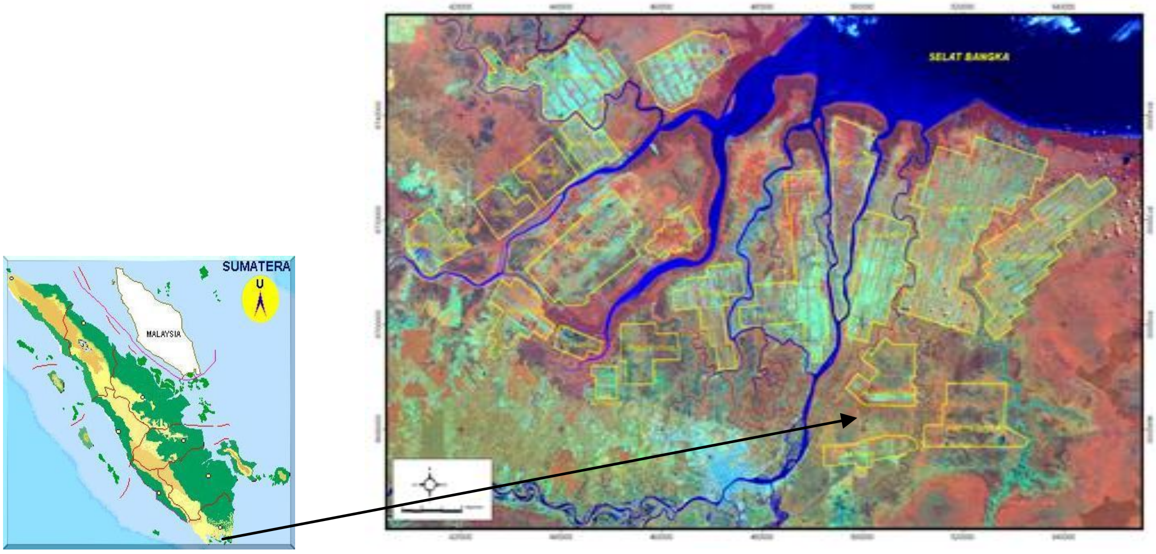

Figure 1. Research area situation map at Delta Saleh of South Sumatera Indonesia.

Operational design of water management that will be developed in model adaptation of water management at tertiary block is as follows:

- Water disposal concept *(drainage)* and soil leaching
- Controlled drainage concept (*control drainage)*
- Channel water seepage concept *(sub irrigation)*, and
- Tidal irrigation concept *(tidal irrigation)*,

For simulation of computer model, one unit of water management system is taken as the boundary condition, i.e. one secondary block consisting of 17 tertiary channels. Tie points for borderline of modeling is estuary of supply and drainage secondary channels at upstream and downstream sites. Tertiary block is used as monitoring block for validation.

The scenarios to be developed for water network improvement at Delta Saleh Area with land typology C/D (dry) are as follows:

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- Scenario 1: Tertiary network of grid system, connected in two directions toward village secondary channel (SPD) and drainage secondary channel (SDU), channels are equipped with valve gates and secondary water gates only available at SPD level ,
- Scenario 2: Tertiary network of grid system, connected in two directions toward village secondary channel (SPD) and drainage secondary channel (SDU), channels are equipped with stop-log gates, secondary water gates are available at SPD level and weir is built at drainage secondary channel (SDU).
- These two scenarios will be combined with objective to be used for rice and corn crops with variation of dry, normal and wet rainfall conditions (probability of 20, 50 and 100%).

DRAINMOD model simulation is conducted to determine soil water status as a results of water operation in tertiary channel. There are three management scenario plans consisting of controlled drainage through water retention combined with land leaching, maximum water disposal as long as crop is unavailable in order to leach hazardous substances, and pump irrigation opportunity for short live plants.

Condition of tidal water and daily rainfall will also be analyzed to obtain opportunity of planting pattern that probably be implemented at two types of land. Meanwhle, value of water level status will be related to availablity of acid sulphate layer in order to determine how long the land experience oxidation and when land leaching operation can be implemented. These combination will be used as a basis for composing of water management scenario.

Calibration will be conducted by using DRAINMOD computer model prior to evaluation of some scenarios of selected water management. Some data input farticularly soil and drainage system parameters will be simulated in order to obtain simulation results data that is close to field measurement data [30]. If this condition is met, then DRAINMOD computer model can be used as a means to evaluate the perfomance from each selected scenarios and it is already proven that model results can be adapted to field condition [31] [32]. Data input that should be available for the purpose of calibration and DRAINMOD computer model simulation can be seen in Table 1.

Table 1. Water management objective for rice and corn cultivation at tidal lowland for each crop growth phases.

Crop growth phase	Water management objective for rice crop	Water management objective for corn crop
Land tillage	Plowing: soil is below field saturation capacity Flooding: puddle 0 – 5 cm Levelling: puddle 5 cm	Water table elevation is dropped up to 40-50 cm so that soil is in field capacity condition which suitable for land tillage operation
Seedling	Water saturated soil/no flooding	Water table elevation control at depth of 30-40 cm. Soil should be at field capacity, not in

		saturation condition.
Vegetative growth	puddle 5 – 10 cm, water replacement, drain water during fertilizing time	Water table elevation is dropped up to 40-50 cm, except for area in which phyrite layer is located below 50 cm
Reproductive growth	puddle 5 – 10 cm, water replacement replacement, drain water during fertilizing time	Water table elevation is dropped up to 40-50 cm
Maturing phase	Soil in saturation condition up to field capacity.	Water table elevation control is not neccessary, it will dropped naturally

Source: [20]

Adaptation model of water management for each scenarios was conducted through expermental plot in the field with farmers group. The main observation indicator is monitoring of daily water level fluctuation and crop growth performance. Field water management operation model covers tertiary water gate operation and develop of micro water management network. Illustration of water table control operation in tertiary canal through water gate operation can be seen in Figure 2.

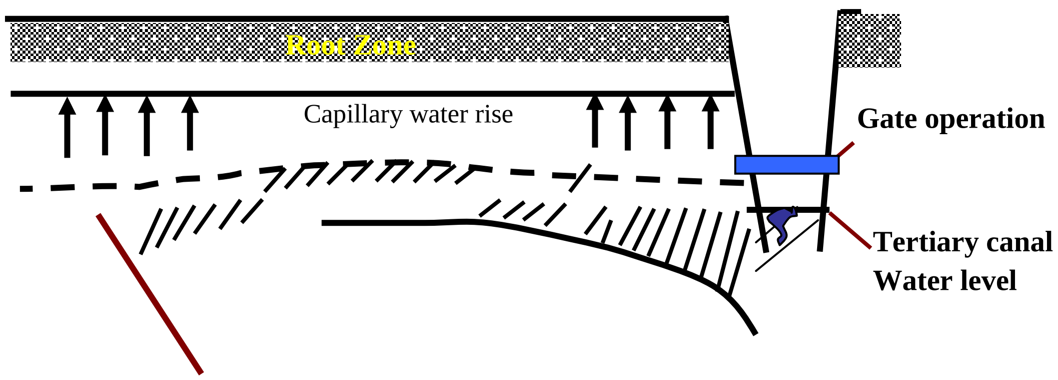

Figure 2. Water table profile between two tertiary channels due to water gate operation.

3. Results and Discussion

3.1. Water Management Objective

Water management aims to fulfill crop water requirement at tertiary block. Suplay water in tidal lowland is highly affeted by crop growth phase, and rainfall [33]. This condition cause different water management objective plan on respective phase and land type (Tabel 2). For second crop such as corn, the main objective in water management on farm land area is retained water in tertiary canal and maintened ground water table control by gete operation..

Water management objective is also highly depend on land hydro-topography classes. For tidal lowland area with C-type (high tide water is unable to enter the land), then water management aims to retain rainfall water and to maintain water level in tertiary channel at depth of 40-50 cm below the canal dike [34]. Water pump sometimes is still needed for crops during long dry season [35] It was commonly famer done in generatif growing phase on July-August-September period.

Table 2. Water management objective for rice and corn cultivation at tidal lowland for each crop growth phases.

Crop growth phase	Water management objective for rice crop	Water management objective for corn crop
Land tillage	Plowing: soil is below field saturation capacity Flooding: puddle 0 – 5 cm Levelling: puddle 5 cm	Water table elevation is dropped up to 40-50 cm so that soil is in field capacity condition which suitable for land tillage operation
Seedling	Water saturated soil/no flooding	Water table elevation control at depth of 30-40 cm. Soil should be at field capacity, not in saturation condition.
Vegetative growth	Puddle 5 – 10 cm, water replacement pergantian, drain water during fertilizing time	Water table elevation is dropped up to 40-50 cm, except for area in which phyrite layer is located below 50 cm
Reproductive growth	puddle 5 – 10 cm, water replacement, drain water during fertilizing time	Water table elevation is dropped up to 40-50 cm
Maturing phase	Soil in saturation condition up to field capacity.	Water table elevation control is not neccessary, it will dropped naturally

Source: [20].

3.2. DUFLOW Model Adaptation in Composing Operation and Improvement of Water Management Network at Tidal Lowland Area with Dry Land Typology(C/D Type).

Analysis of wáter network perfomance is also conducted for dry área of C/D land tipology. As borderline within computer simulation model, one secondary block is used as simulation borderline (boundary condition). Some basic data of measurement used in this simulation are average soil surface level of 2.07 m (msl), average tidal water level of 1.7 m (msl). Crop evapotranspiration is made constant with average value of 5-7 mm/day [36] and rainfall condition is divided into three categories of dry (0 mm), normal (50 mm) and extremely wet (100 mm).

Scenario which is composed in DUFLOW simulation at the study area can be seen in Table 3. Variation of rainfall condition with and without waterworks at tertiary level is observed at this dry tipology land as well as water gate construction to maintain water level in SDU channel. The choice of waterworks at tertiary level is water gate of stoplog type and water level control is conducted by setting water gate height. Water retention with height of 50-60 cm in tertiary channel will capable to keep the ground water table under 40-50 cm below soil surface. [34].

DUFLOW simulation as water supply and water retention is an effort to maintain stable soil water level in order to prevent quick water losses into tertiary channel which subsequently wasted into secondary channel. This can be done by installing water gate of simple stoplog type and by restraining water with weir in drainage secondary channel (SDU). The objective of restraining water with weir in drainage secondary channel (SDU) is to obtain fixed water level in drainage secondary channel (SDU) which in turn can maintain water level in tertiary channel. Drainage channel has function as long storage in order to prevent drop of soil water level because there is strong correlation between fluctuation of water level in channel and soil water level [37].

Table 3. Scenario of DUFLOW program simulation for land type of C/D.

Water management scenario	Simulation treatment
Current condition evaluation, no water gate in secondary channel Networking improvement evaluation with wáter retention in drainage secondary channel (SDU) through wáter gate installation	• Dry rainfall (0) mm • Normal rainfall (50) mm • Wet rainfall (100) mm

Simulation results of computer model in which secondary channel is retained with weir and land had normal raifall (50mm) are presented as initial phase. Duflow gives an overview that water retention in secondary channel is capable to increase water level in tertiary channel (Figure 3). Water level in tertiary channel during initial water intake is relatively high close to 2 m msl, but subsequently drop and water level in the middle of tertiary channel is close to 1.5 m msl. Application of water retention in tertiary channel is difficult to be applied on the last period of wet season or dry season due to high soil porosity. Thus, effort to develop drainage secondary channel as long storage is highly appropriate so that water losses can be reduced.

DUFLOW model is incapable to respond the effect of high hydraulic conductivity of soil in the field. DUFLOW only capable to evaluate flow capacity of channel as supply and disposal. The increase of water level in tertiary channel as results of weir development effect in SDU ca be seen in Figure 4. This is due to the increase of water level in secondary channel which capable to supply water for tertiary channel. Water level in tertiary channel has increase and finally can be maintained at height of 1.5 m msl. It means that tertiary channel receive constant water supply at height of 50-60 cm from soil surface. But what is more important is that the available of water level in tertiary channel is to maintain soil water balance at tertiary block so that water is not quickly drop.

Figure 3. The effect of supply operation combined with water retention in tertiary channel at minimum rainfall condition

If water depth in tertiary depth is maintained at 50-60 cm height, then soil water level at tertiary block is still at safe level for rice crop or it is above 15 cm zone. Water level condition at depth of 10-15 cm for long period can significantly reduce production [38].This condition is similar to study result by [39] which show that rice crop will experience water stress if soil water depth is drop below 20 cm zone. Optimum water depth for rice crop is 5 cm above soil surface [40]. According to [41] production of 1 kg rice requires 1,432 liter water to fulfill crop evapotranspiration requirement.

According to [25] DUFLOW computer model is very good to evaluate the flow and disposal potential at network system of tidal lowland. This condition corresponds to the study result in which Duflow computer model capable to give an overview of water level rise due to waterworks operation. One of important operation that should be conducted is channel flushing to dispose poor water quality due to water retention for long time in secondary and tertiary channels. The increase of water level in SDU can be flown into tertiary channel and to dispose water from tertiary channel into SPD which is subsequently flown into primary channel. This water operation can also be arranged based on simulation of DUFLOW model and one of them is used to decrease sedimentation effect in channel [42].

Figure 4. Results of DUFLOW simulation at SDU (main drainage channel) condition as longstorage and water table elevation in tertiary channel is elevated at 70 cm.

Leaching and flushing activties can only be done at the end of rainy season after rice planting. Water in tertiary channel can be disposed into secondary channel which subsequently flow into primary channel. Observation of soil water level at tertiary channel before and after the existence of waterworks at SDU secondary channel can be seen in Figure 5.

Figure 5 shows that there is an increase of ground water table during the growing period (MT1) of rice crop. Soil water level never drop beyond -30 cm so that soil water status stays in saturation condition. Meanwhile, previously soil water level drop to -60 cm resulting in water stress experience by rice crop, especially during initial period of the flowering stage.

Figure 5 . Water table elevation at tertiary block for first planting season 2005 before and after weir construction in 2008-2009 at P10-2S delta Saleh.

The disadvantage of weir construction in SDU is the difficulty in water management system operation because it is not equipped with operational water gate. At least a culvert is needed in combination with fiberglass flap gate.

3.3. DRAINMOD Model Adaptation for constructing field operation model

DRAINMOD simulation had been done at dry land (Saleh). This simulation use several assumptions such as *steady state condition,* crop water requirement use empirical approach in which potential evapotranspiration is calculated by using Thornwhite equation [43]. The drainage system had distance between channel of 200 m and the depth of impermeable layer is located 1.5 m below soil surface.

Water management scenario is based on land utilization pattern potential and farmer socioecomic aspect in which the proposed planting pattern is rice-corn. Based on water status in land, the main objective of water management at Saleh area is water retention and water leaching.

The results of statistical analysis of the DRAINMOD simulation using one year of data (rainy and dry conditions) showed good performance where the results of modeling and observations had the same trend of water level fluctuation patterns. This means the model is acceptable, with high reliability. This condition is strengthened from the results of statistical analysis where the correlation coefficient value reaches 0.89; the efficiency model has a positive value and is close to one, namely 0.97, and the root mean error (Root Mean Square Error) is 1.45 cm. With these results, it can be concluded that the performance of the model is said to be very good, and the DRAINMOD model can be used to evaluate the status of shallow groundwater levels.

The recommended water management scenario is to cultivate land with planting pattern system of rice-corn in which rice is planted at first planting season of November-January/February and corn is planted at April up to June/July. The problem for corn cultivation is that soil is still in water saturation condition in February, March and April so that drainage is required. Entering the month of May, soil water level drops below 30 cm so that corn crop experience water stress. Water retention in channel is required during this condition and whenever possible irrigation can also be given. Water level dynamics resulting from DRAINMOD simulation can be seen in Figure 6.

Model adaptation in the field is conducted in 2009-planting season and showed good result in which the effect of water gate retainer and water gate retainer in secondary channel showed the significant increase of soil water level (Figure 6). Soil water can be maintained due to the existence of water in tertiary channel and water can be stored in land in case of rainfall occurence. This condition causes the land to be flooded resulting in increase of production. Production for 2005 year in average is 2.5 ton/ha, whereas production is increase in average of 4 ton/ha for 2009 year.

Monthly operation of water gate according to crop growth phase can be seen in Table 4. Soil tillage for rice crop is started since November. The main objective of water management at initial soil tillage is disposal. This drainage process had been started since September- Oktober. Its objective is to leach hazardous substances and soil acidity out of the root zone of the plant. Water retention process is started since soil puddling up to seeds sowing phase. Water disposal is done at seeds sowing phase in which quarterly channel gate is opened so that water in land can be disposed through quarterly channel into tertiary channel.

Figure 6. Daily water dynamics resulting from computer simulation of DRAINMOD model at location of P10-2S Delta Saleh.

Option for water gate in tertiary channel is closed during rice crop growth in December up to February. Water gate is not fully closed at this operation, only about 40-50 cm. It is expected that suplay water is possible during high tide water and water in tertiary channel is not all discharge because it is retained by the gate at height of 40-50 cm during low tide water.

The proposed planting pattern is rice-corn based on field study and input from farmers. Gate operation is mostly in retaining condition during rice crop cultivation which is started from October-December and January-February. Water retention is done at height of 50 cm. Gate operational is by retaining water at depth of 50 cm (Table 4). It is expected that water in tertiary channel can be retained at height of 50 cm by this gate operation and water level at estuary of tertiary channel can increase to 60 cm during high tide water so that high tide water can fill tertiary channel. The entering of high tide water is also to maintain water quality.

It is obvious that without operation of water level control, water deficit will occur at Delta Saleh (Figure 7). Water level drops far beyond acid sulphate layer and land can not be cultivated for the whole year. DRAINMOD simulation results showed that ground water table is drop below root zone of 0 cm without water retention in tertiary channel although at rainy season condition. Therefore, farmers in the field are strongly agree that water retention is done during rainy season, especially during rice growing period.

Table 4. Field Operation on farm for first planting season of rice during December- February 2009) at Location of P10-2S Delta Saleh (dry type).

Crop growth phase	Activity period	Tertiary canal operation system	
		Modeled by Drainmod simulation	Farmer done for model adaptation
Land preparation	September-October	Open	Open
Land tillage	October-November	Close/water retention	Close/water retention at 50 cm
Planting, direct seedling (Tabela)	November	Close/water retention	Close/water retention at 50 cm
Vegetative growth	December-January	Close/water retention at 50 cm	Close/water retention at 50 cm
Reproductive phase	January-February	Close/water retention at 50 cm	Close/water retention at 50 cm
Maturing phase	February	Close/water retention at 50 cm	Close/water retention at 50 cm

3.4. Model Adaptation in Composing Water Control Operation for Rice and Corn Crops at C/D Typology Land (Dry Condition)

In tidal lowland corn cultivation can be started if soil water drops below root zone of 30 cm. This activity can be done directly after rice harvesting. This is due to the fact that soil water level is still high so that soil layer in the root zone is still saturate with water. Therefore, water gate is totally opened at March period and at the same time flushing acid substances is done that are accumulate during water retention period at rice cultivation season. Computer simulatin of DRAINMOD had succeed in composing seasonal operational plan for water table control. The results of desired water level for corn as impact of water level control can be seen in Figure 7.

Figure 7. Simulation result of DRAINMOD under two option water management.

Field operation should include water retention effort entering the dry season. Water level condition drops close to 60-70 cm below soil surface during generative phase of crop (August). This condition is vulnerable if no rainfall occurrence because crop will experience water stress [35]. Therefore, water supply from surface is needed. Water addition should be given to fulfill crop evapotraspiration requirement especially when entering the generative phase. Pump irrigation with output or discharge diameter of 8 ich can be operated with interval once in 10 days. Pump operation is done during high tide water. Gate operation after rice harvesting in March is by total disposal to flush acid substances and to lower soil water level for corn planting preparation.

IV. Conclusion And Recommendation

4.4. Conclusion

The best cropping patern in C typology land class of tidal lowland is rice-corn based on water availability analysis in tertiay block. Water gate construction is needed to apply water control operational system at tertiary block. Stop log type gate is the best compared to flap gate type on C typology land (dry).

Computer simulation showed good result in which soil water level dynamics from simulation result tend to be similar with field measurement results. It was stated that the root mean square value of error is 1.45 cm, model efficiency value is 0.97 and strong correlation value is 0.84.

Network improvement effort can be composed through adaptation of DUFLOW model for C typology land (dry). Network improvement is conducted by connecting tertiary channel SPD and SDU, water gate installation of stop-log type, and weir construction at drainage secondary channel (SDU).

Analysis to computer model software of DUFLOW-DRAINMOD showed the mutually supportive results in which DUFLOW simulation results can provide water potential information in channel for supply objective (irrigation)..

Field operation model of water management for corn was achieved by control drainage in which all water gates at all corn growth phase are operated as water retention and supply when salt water is not entering yet (June-July). Maximum drainage can only be conducted after finishing of rice planting and land tillage for planting preparation.

4.2. Recommendation

File operation model to maintenance the water table in tertiary block was conducting by water retention system at dry land type (C-typology). Aapplied for long time will results in water quality degradation. Therefore, water flushing and leaching in channel should be routinely operated. Maintence tertiary canal by flushing once in two weeks is sufficient to improve water quality.

Some factors to be involped in constructing the field model operation in the field are as follows: farmer instrucution should be made as simple as possible and it is socially accepted by farmers. Finally the water management operation must be done continuously although land is in uncultivated condition in order to reduce environmental damage and to accelerate the soil remediation process.

REFERENCES

[1] Imanudin, M.S., Satria, J.P., Bakri., and M. Edi Armanto. 2020. Field Adaptation for Watermelon Cultivation under Shallow Ground Water Table in Tidal Lowland Reclamation Area. Journal of Wetlands Environmental Management. 8 (1): 1 – 10 http://10.20527/jwem.vol 8 No 1.211

[2] Bakri, Bernas M., and Imanudin, M.S. 2015. Water Retention option of drainage system for dry season corn cultivation at tidal lowland area. International Journal AGRIVITA 37 (3): 237-246.

[3] Bakri., Imanudin, M.S. & Chandra, Wahyu. 2020. Water Management and Soil Fertility Status at A Reclaimed Tidal Lowland of Telang Jaya Village, South Sumatra, Indonesia. Journal of Wetlands Environmental Management. 8. 85. 10.20527/jwem.v8i2.228.

[4] Saadat, Samaneh & Bowling, L. & Frankenberger, Jane & Brooks, Kyle. 2017. Effects of Controlled Drainage on Water Table Recession Rate. Transactions of the ASABE. 60. 813-821. 10.13031/trans.11922.

[5] Poddar, Arunava And Kumar, Navsal And Shankar, Vijay. 2018. Effect Of Capillary Rise On Irrigation Requirements For Wheat. International Conference on “Sustainable Technologies for Intelligent Water Management. Indian Water Resource Society (IWRS), February 16-19. 2018.

[6] Suryadi, F.X, Hollanders P.H.J., and Susanto. R.H. 2010. Mathematical modeling on the operation of water control structures in a secondary block case study: Delta Saleh, South Sumatra. Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB).Québec City, Canada June 13-17, 2010.

[7] Hartoyo, Susanto, R.H., Suryadi, FX, Baart Schultz, and Eelart A. V. 2009. Land and water management of tidal lowlands: Experiences in Telang and Saleh, South Sumatera (Irrigationand drainage Jurnal 2009 – on line, Wiley InterScience (www.interscience .wiley.com)).

[8] Blunden, B. & Indraratna, B. 2001. Pyrite Oxidation Model for Assessing Ground-Water Management Strategies in Acid Sulfate Soils. Faculty of Engineering - Papers. 127. 10.1061/(ASCE)1090-0241(2001)127:2(146).

[9] Imanudin, M. S. ., Sulistiyani, P. ., Armanto, M. E., Madjid, A., & Saputra, A. . (2021). Land Suitability and Agricultural Technology for Rice Cultivation on Tidal Lowland Reclamation in South Sumatra. *Journal of Suboptimal Lands*, *10*(1), 91–103. https://doi.org/10.36706/JLSO.10.1.2021.527

[10] Ale, S., L.C. Bowling S.M. Brouder J.R. Frankenberger M.A. and Youssef. 2008. Simulated effect of drainage water management operational strategy on hydrology and crop yield for drummer soil in The Midwestern United States. Agricultural Water Management Journal. Volume 96, Issue 4, April 2009, Pages 653-665.

[11] Fahmi, A. and Ani Susilawati. 2018. Environmental friendly management of acid sulphate soils. Proceeding Of International Workshop And Seminar Innovation of Environmental-Friendly Agricultural Technology Supporting Sustainable Food Self-Sufficiency. 870.878 , DOI: 10.5281/zenodo.3339423

[12] Skaggs, R.W. 1982. Field Evaluation of Water Management Simulation Model. Transaction of the ASAE 25 (3):666-674

[13] Susanto., R.H. 2009. Agricultural Development in the Lowlands : Dynamics, perspective and time frame – leasson Learnt from STLD and the way forward (Makalah disampaikan pada “Workshop on Sustainable Lowland Development in Indonesia), Jakarta 21 Januari 2009.

[14] Ale, S., L.C. Bowling S.M. Brouder J.R. Frankenberger M.A. and Youssef. 2008. Simulated effect of drainage water management operational strategy on hydrology and crop yield for drummer soil in The Midwestern United States. Agricultural Water Management Journal. Volume 96, Issue 4, April 2009, Pages 653-665.

[15] Xihua Yang. 2006. Evaluation and application of DRAINMOD in an Australian sugarcane field. April 2008, Agricultural Water Management.95 (2006) 439- 446.

[16] Borin M., F. Morari, G. Bonaiti, M. Paasch, and R.W. Skaggs. 2000. Analysis of DRAINMOD Performances With Different Detail of Soil Input Data In The Veneto region of Italy. Journal of Agricultural Water Management 42: 259-272

[17] Zhonghua Jia, and Wan Luo. 2006. Modeling net water requirements for wetlands in semi-arid regions. Agricultural Water Management 81 (2006) 282–294.

[18] Susanto., R.H. 2007. Water Table Fluctuation Under Various Hydrotopographical Condition for Determining the Cropping Calendar (Jurnal Pengelolaan Lingkungan dan Sumberdaya Alam, Volume 6, Nomor 2, Juni 2007, ISSN .1693 – 0391

[19] Imanudin, M.S., Susanto, R.H, Armanto, E, and Bernas, S.M. 2009**.** The use of drainmod model for developinf strategic operation of water management in the tidal lowland agriculture areas of South Sumatera Indonesia. Proceeding of International Seminar on Wetland and Sustainability, Kota Kinabalu Sabah Malaysia. 26-28 Juni 2009. ISBN 478-983-3142-11-8

[20] Suryadi, F.X., 1996. Soil and water management strategies for tidal lowlands in Indonesia. PhD thesis, Delft University of Technology- IHE Delft. Balkema, Rotterdam, The Netherlands.

[21] Situngkir, A. M. 2016. Evaluation And Improvement Of Drainage Performance In Gedongtataan, Lampung Using Duflow Modeling Studio. Journal of Natural Resources and Environmental Management. 6(2), p. 111. doi: 10.29244/jpsl.6.2.111

[22] Triadi, B., P. Simanungkalit., M. Fernandus. 2010. Tersedianya Potensi Suplai Dan Drainasi Persawahan Danda Besar Melalui Revitalisasi Prasarana Hidraulik Tingkat Tersier. Jurnal Teknik Hidraulik 1(1): 69-82

[23] Suryadi, F.X. and E. Schultz, 2001. *Effects of operation rules on water management in tidal lowlands.* In: proceedings workshop on the Agricultural based development of tidal swamps and estuaries and environmental considerations, Seoul, Korea.

[24] Imanudin M.S., RH Susanto**,**, 2003. Application of DUFLOW Computer Model on Tidal Lowland Water Management Strategy : A Case Tidal Pilot Monitoring Area in South Sumatra (Paper presented at International Seminar And Exhibition On Prospectives Of Lowland Development In Indonesia, Palembang, 8-9 Desember 2003) ISBN: 979-97066-1-0.

[25] Suryadi, F.X, P.H.J. Hollanders, and R.H. Susanto. 2010. Mathematical Modeling On The Operation of Water Control Structures In A Secondary Block Case Study: Delta Saleh, South Sumatra. Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB).Québec City, Canada June 13-17, 2010.

[26] Davoodi, K., A.D. Nartchall., G.A. Mazandarani. 2019. Evaluating Drainmod-s to Predict Drainage Water Salinity and Groundwater Table Depth During Winter Cropping in Heavy-Textured Paddy Soils. Irrigation and Drainage 68 (3): 59-572 https://doi.org/10.1002/ird.2339

[27] Ashkan, A., Malakshahi, A. Darzi- Naftchali, Behrooz Mohseni. 2020. Analyzing water table depth fluctuation response to evapotranspiration involving DRAINMOD model. Agricultural Water Management 234(1) https://doi.org/10.1016/j.agwat.2020.106125

[28] Skaggs, R.W. 1991. Drainage (*in* Hanks, J and J.T. Ritchie, 1991. Modelling plant and soil system. ASA, CSSA, SSSA. Madison, Wisconsin).

[29] IHE, 2002. Duflow Reference Manual. VERSION 3.5 April 2002. Stowa/ MX.Systems. Unesco-IHE. Delft. The Netherlands.

[30] Imanudin, M.S., M. E. Armanto, Bakri. 2019. Determination of planting time of watermelon under a shallow Groundwater table in tidal lowland agriculture areas of South Sumatra, Indonesia. *Irrigation and Drainage Journal,* 68(3): 488-495.

[31] Selvaperumal, A. & Gurusamy, Thiyagarajan & Vallalkannan, s & Muthuchamy, I & Ramaswamy, K. 2020. DRAINMOD -Calibration and Validation for Prediction of Drainage Coefficient and Water Table Depth. Current Journal of Applied Science and Technology. 10.9734/CJAST/2020/v39i930607.

[32] Muhammad, E.Sh., M.M. Ibrahim., Ashraf El-Sayed. 2021. Effects of drain depth on crop yields and salinity in subsurface drainage in Nile Delta of Egypt. Ain Shams Engineering Journal 12(2): 1595-1606 https://doi.org/10.1016/j.asej.2021.01.008

[33] Bassey E. Udom, Onyinyechi J. Kamalu. Crop Water Requirements during Growth Period of Maize (*Zea mays* L.) in a Moderate Permeability Soil on Coastal Plain Sands. International Journal of Plant Research9(1): 1-7 doi:10.5923/j.plant.20190901.01

[34] Imanudin, M.S., Bakri., Armanto, M.E., Indra, B., and Ratmini, S.N.P. 2019. Land And Water Management Option of Tidal Lowland Reclamation Area to Support Rice Production (A Case Study in Delta Sugihan Kanan of South Sumatra Indonesia). Journal of Wetlands Environmental Management.6 (2): 93 – 111. http://dx.doi.org/10.20527/jwem.v6i2.165

[35] Imanudin, M. S. ., Sulistiyani, P. ., Armanto, M. E., Madjid, A., & Saputra, A. . (2021). Land Suitability and Agricultural Technology for Rice Cultivation on Tidal Lowland Reclamation in South Sumatra. *Jurnal Lahan Suboptimal : Journal of Suboptimal Lands*, *10*(1), 91–103. https://doi.org/10.36706/JLSO.10.1.2021.527

[36] Montazar. A., R. Kruege., D. Corwin., A. Pourreza., C. Little., S. Rios and Richard L. Snyder. 2020. Determination of Actual Evapotranspiration and Crop Coefficients of California Date Palms Using the Residual of Energy Balance Approach. Water 2020, 12, 2253; doi:10.3390/w12082253

[37] Koïta, M., H. Fabien Yonli., D. Dimitri Sor., A. Emmanuel Dara and J.M Vouillamoz. 2018. Groundwater Storage Change Estimation Using Combination of Hydrogeophysical and Groundwater Table Fluctuation Methods in Hard Rock Aquifers. Resources 2018, 7(5): 1-15. doi:10.3390/resources7010005

[38] Budianto. M. B., A. Supriadi., S. Hidayat., Salehudin. 2020. Water-Saving Irrigation Model Combining System of Rice Intensification (SRI) with Alternate Wetting and Drying (AWD) for Paddy Field. Jurnal Teknik Pengairan, 2020, 11(2) pp.128-136

[39] Tuong, T.P., L, V. Du and N.N. Luon 1993. Effect of Land Preparation on Leaching of an Acid Sulphate Soil at Cu Chi, Vietnam. In: D.L. Dent and M.E.F. van Mencvoort (editor): Selected papers of the Ho Chi Minh City Symposium, 281-287. International Institute for Land Reclamation and Improvement Publication 53., Wageningen.

[40] Talpur, Mashooque Ali. 2013. Effect of different water depths on growth and yield of rice crop. African Journal of Agricultural Research 8(37):4654-4659 DOI:10.5897/AJAR12.1693

[41] Zwart SJ, Bastiaansen WGM. 2004. Review of measured crop water productivity values for irrigated wheat, rice, cotton and maize. Agricultural Water Management 69 (2004) 115-133.

[42] Theol, S.A, Bert Jagers., F. X. Suryadi and Charlotte de Fraiture. 2019. The Role of Gate Operation in Reducing Problems with Cohesive and Non-Cohesive Sediments in Irrigation Canals. Water 2019, 11, 2572; doi:10.3390/w11122572

[43] Vepraskas, X., M.J. He, R.W. Skaggs, and D.L. Lindbo. 2002. Adapting a Drainage Model to Simulate Water Table Levels in Coastal Plain Soils. in Soil Sci. Soc. Am. Journal. 66:1722–1731.

Surat Penerimaan

Acceptance Announcement

Yahoo/Email Masuk

ISCEE IPB <iscee@apps.ipb.ac.id>

Kepada:MOMON SODIK IMANUDIN

Cc:Andik Pribadi

Sab, 28 Agu 2021 jam 15.40

Dear **Momon Sodik Imanudin**

Sriwijaya University

On behalf of the 2nd International Seminar on Civil and Environmental Engineering (ISCEE) 2021 Committee, we are pleased to inform you that your paper **ISCEE_3 002** entitled **'Integrated Duflow-Drainmod Model For Planning Of Water Management Operation In Tidal Lowland Reclamation Areas'** has been accepted and considered for publishing in Proceedings of the 2nd International Seminar on Civil and Environmental Engineering (ISCEE) 2021 at IOP Conference Series: Earth and Environmental Science (EES). We are very glad to say Congratulations on your great efforts for your research paper.

Please send us your camera-ready paper (final version) of the manuscript (word and pdf), presentation file (ppt), and payment proof for publication fee before August 30th, 2021 through our website at https://iscee.ipb.ac.id/camera-ready/.

Once again, please check the IOP conference template again and make sure that your paper follows the author guideline and template (**an example is available in the attachment**). The committees also provide the **PowerPoint cover** for your presentation, please kindly find it in the attachment. For the payment process, please kindly find the invoice for your paper in the attachment.

In order to anticipate any connection issues during the live presentation, the committee would like to request a pre-recorded video presentation. This video is only used if the author cannot make a live presentation during the parallel session, and should be decided by committees. The video presentation is done in English, recorded by zoom meeting or any related application for 10 minutes. Please use the ISCEE background during the preparation of the pre-recorder video (**ISCEE zoom Background** was attached). For example, please visit *https://www.youtube.com/watch?v=02uOsE3RT0U.* Please drive the video in google drive and send the link through our website on the camera-ready submission process (please don't forget to open the share setting to our email at iscee@apps.ipb.ac.id).
Please note that papers that will be submitted to IOP Conferences Series Earth and Environmental Science are accepted and presented at the conference.
If you have any questions regarding the reviews of your paper, please do not hesitate to contact us

See you on the 2nd ISCEE 2021.

Best regards,

Heriansyah Putra

The 2nd International Seminar on Civil and Environmental Engineering

ISCEE 2021, Bogor, Indonesia

ISCEE 2021 <iscee@apps.ipb.ac.id>

Kepada: Momon Unsri

Min, 12 Sep 2021 jam 16.22

Dear Momon Sodik Imanudin

Thank you for your great contribution and make ISCEE 2021 successfully. Please kindly find your certificate in attachment. See you on next International Seminar on Civil and Environmental Engineering (ISCEE)

We have also provided the material for our event, please kindly visit our website.

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Once again, thank you for your contribution, see you on next International Seminar on Civil and Environmental Engineering (ISCEE)

Best regards,
Heriansyah Putra
Chairman of Organizing Committee

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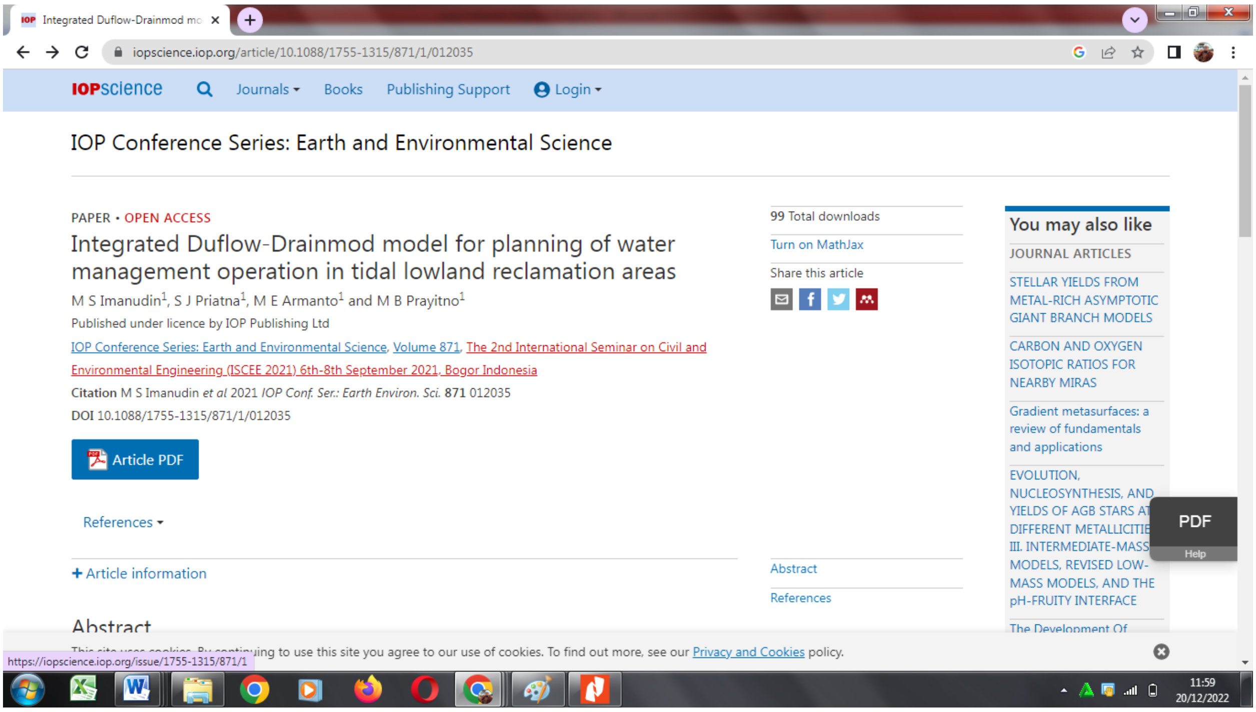

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