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DEVELOPING STRATEGIC OPERATION OF WATER MANAGEMENT IN TIDAL LOWLAND AGRICULTURE AREAS OF SOUTH SUMATERA, INDONESIA

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BACK GROUND

- Indonesia has the largest lowland areas in the world, there was about 33.393.570 ha, which consist of 20.096.800 ha tidal lowland and 13.296.770 ha non tidal lowland. (see Map)
- There was about 372,000 ha of tidal lowland area of South Sumatra had been reclaimed up to year of 2002 (P2DR, 2002),
- A major constraint in tidal lowland agriculture development is created by the water status in the tertiary block
- Therefore, the main point for the success of agriculture development in tidal lowland reclamation areas is how farmers are capable to control water table in the farm level to fulfill crop water requirement. Therefore the key for sustain tidal lowland agriculture is water management

The Map of Lowland Areas Distribution in Indonesia

The big areas were located in Sumatra, Kalimantan and Papua

South Sumatera Reclamation Areas

Morethan 300.000 ha, Tidal lowland has been reclaimed for agriculture

Drainage Network

OBJECTIVES

It was necessary to find the optimum combination treatment to achieve water table requirement for crop by developing water management scenarios with in different seasonal operation.

The research objective is to develop operational plan of water table control at tertiary block for rice and corn crops growth.

To achieve that goals the specific objectives has to be developed:

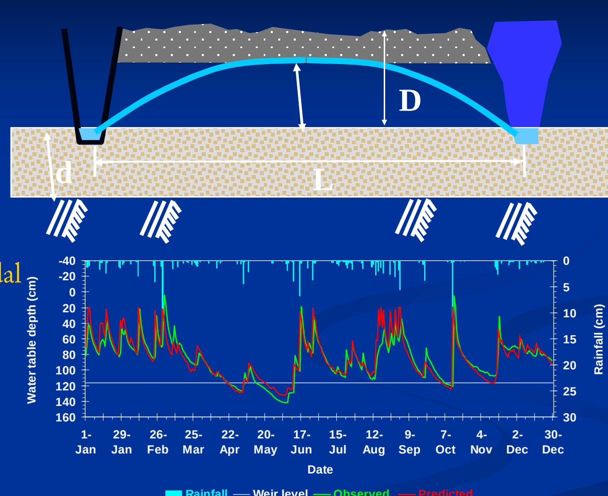
1. First, To construct some water management scenarios in different option water management objective for agriculture purposes (food crop only), and
2. Second, To use computer model to simulate and evaluate the performance of different water management scenarios, by considering agronomic and practical aspects.

DRAINMOD

A computer model had been develepod to test the effectiveness of drainage system on micro levels. This model is called DRAINMOD (Skaggs, 1982; Skaggs, 1991). It was developed to evaluate water balance on shallow water table condition which made it very suitable to be used for tidal swamp areas (Susanto, 2002).

DRAINMOD

To predict water table dynamic in tertiary blok of tidal lowland areas

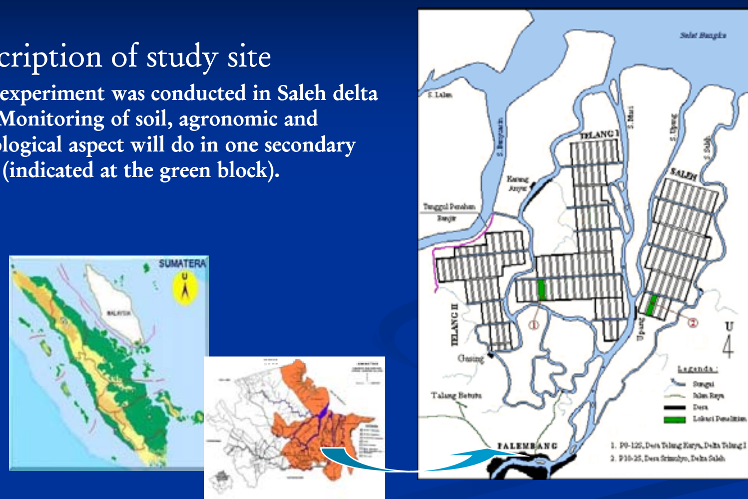


(Skaggs, 1982)
NC state

METODOLOGY

A. Description of study site

Field experiment was conducted in Saleh delta area. Monitoring of soil, agronomic and hydrological aspect will do in one secondary block (indicated at the green block).



The Situation of Area Study in Saleh Deltaic Area South Sumatra




Data Collection

No	Data Field Collection	Insturement	Method
1.	Soil Charasteristics	Auger, Munsell Book	Soil survai standar, FAO,
2	Hydroulic conductivity	Auger, permeameter	Direct Measurement
3	Daily Water level in the field	Well tube	Direct Measurement
4	Daily Water level in the canal	Pielschal	Direct Measurement
7	Daily Rainfall	standard rain gauge	Direct Measurement
8	Air Temperatur	Termometer	Direct Measurement
9	Existing water management and crop management	Quisioner	Interview and discussion focus group
10	Water profil between drain	Well tube	Direct Measurement

Field Data Monitoring

Ground water monitoring

Rainfall Monitoring

Soil Descriotion

GENERAL MODEL STRUCTURE FOR DEVELOPING OPERATIONAL AND WATER MANAGEMENT STRATEGIES

Characterizations of physical land resource, soil characteristics, farming system technology, and existing water management

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Formulating some scenarios of water management in various land type and agriculture purposes (rice and corn) in wet and dry condition

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Simulate and evaluate the performance of those different water management scenarios, considering agronomic and practical aspects. Use DRAINMOD

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Model Adaptations by validate the simulation result with field measurement and construct the practical guideline (operational) for water management in the field level (on-farm) and scheme level for government policy

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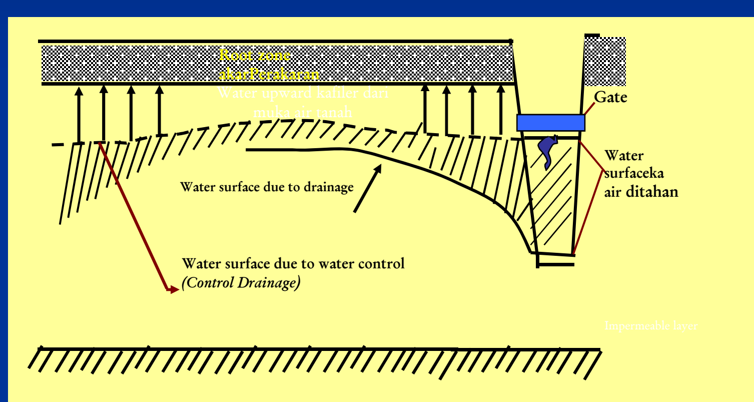
Fields Recommendation for Operational and Water Management Strategies of Tidal Lowland Agriculture

The water table profile as affected by water gate operation



Drainmod Input File

Table 1. Soil water characteristics at Delta Saleh

Soil layer depth (cm)	Texture fractions (%)			Organic matter (%)	Soil water retention (% volume)		
	Sand	Clay	Loam		Sat	FC	WP
0-30	32.98	24.5	42.6	3.07	0.48	0.32	0.16
30-60	23.32	33.5	43.2	1.8	0.48	0.36	0.21
60-90	25.26	37.9	36.8	1.0	0.48	0.37	0.23
90-120	25.39	37.9	36.7	1.27	0.50	0.38	0.24

Note: Sat is stand for Saturated; FC is stand for Field Capacity; and WP is stand for Wilting Point

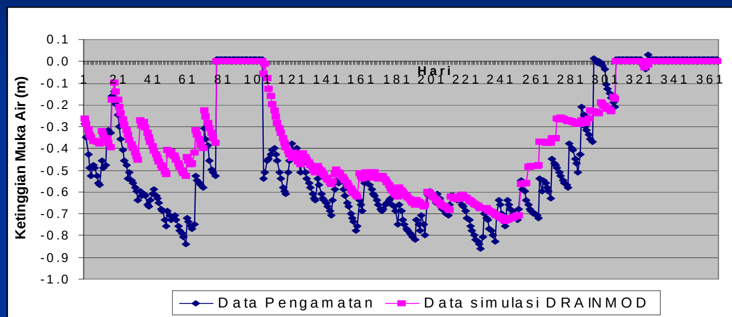
Rainfall inputs in DRAINMOD model is hourly rainfall as well as maximum and minimum temperatures which is read from weather data and water balance that is conducted every hour.

WETER MANAGEMENT OBJECTIVES

- Focusing In Tertiary Block (On Farm Level)
- Scenario Options: Maximum Drainage, control Drainage, Sub-surface Drainage in combination with Sub-Irrigation, and Tidal Irrigation.
- DRAINMOD will use as a tools for evaluating those scenarios to find out the best option of water management

RESULT AND DISCUSSION

A. Using DRAINMOD Model in Constructing Land Use Scenarios

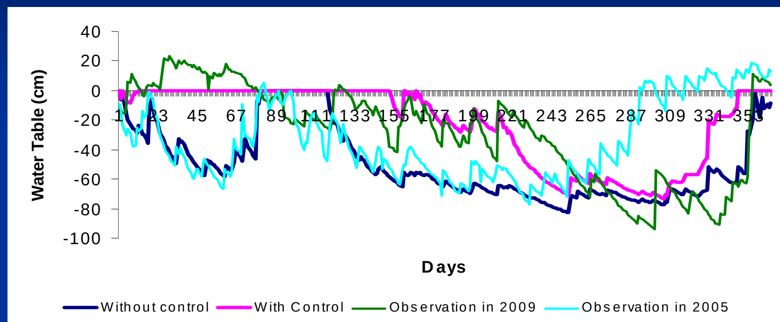


by statistics analysis results that showed correlation value of 0.92; the model efficiency has positive value close to unity, i.e. 1.09, and mean square root of error is 2.75 cm. It can be concluded that the model performance is very good based on these results. Means that DRAINMOD model was accepted for simulating water balance in the area study

Adaptation Result of DRAINMOD model in developing land utilization pattern guidance at C-typhology land (dry).

No	Months	Water status condition in land		Recommendation of land utilization
		Observation	DRAINMOD simulation	
1	January	Saturation	Saturation	Rice
2	February	Saturation	Saturation	Rice
3	March	Drop below soil surface, below zone of 30 cm	Drop below soil surface, below zone of 30 cm	Rice
4	April	Saturation	Saturation	Bare soil
5	May	Drop below soil surface, above zone of 30 cm	Drop below soil surface, above zone of 30 cm	Land preparation for corn
6	June	Drop below soil surface, below zone of 30 cm	Drop below soil surface, below zone of 30 cm	Corn cultivation
7	July	Drop below soil surface, below zone of 30 cm	Drop below soil surface, below zone of 30 cm	Corn cultivation
8	August	Drop below soil surface, below zone of 30 cm	Drop below soil surface, below zone of 30 cm	Bare soil
9	September	Drop below soil surface, above zone of 30 cm	Drop below soil surface, above zone of 30 cm	Land preparation for rice
10	October	Saturation	Saturation	Land preparation for rice in first cropping system
11	November	Flooding	Saturation	Rice cultivation in first cropping
12	December	Flooding	Saturation	Rice cultivation in first cropping

Model Adpatation in Developing of Water Control Operation for Rice at C-typhology Land (Dry Condition)



- The recommended water management scenario was land cultivation using cropping pattern of rice-corn in which rice was planted on first cropping season in November-January/February and corn was planted in April to June/July.

Tertiary gate operation in the field for first cropping season of rice in December-February 2009 period

Crop growth phases	Activity time	Gates operation	
		DRAINMOD simulation	Field adaptation
Land preparation Soil tillage	September-October October-November	Open Close/water retention	Open Close/water retention of 50 cm
Planting, direct seeds sowing (Tabela)	November	Close/water retention	Close/water retention of 50 cm
Vegetative growth	December-January	Close/water retention of 50 cm	Close/water retention of 50 cm
Reproductive growth	January-February	Close/water retention of 50 cm	Close/water retention of 50 cm
Maturity stage	February	Close/water retention of 50 cm	Close/water retention of 50 cm

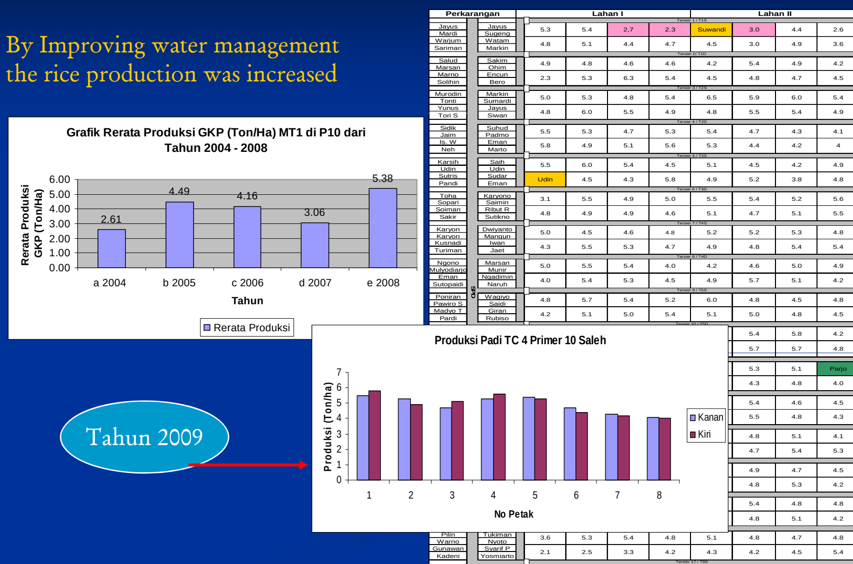
Water table control in the tertiary block (January 2009)

Water Management Objective

- Based on the soil characteristic:
- High water losses due to high hydulic conductivity
- The water management objective is mainly for water retention,
- To retain water as much as possible, in tertiary canal, we decided to Dam Secondary canal in Drainage site.

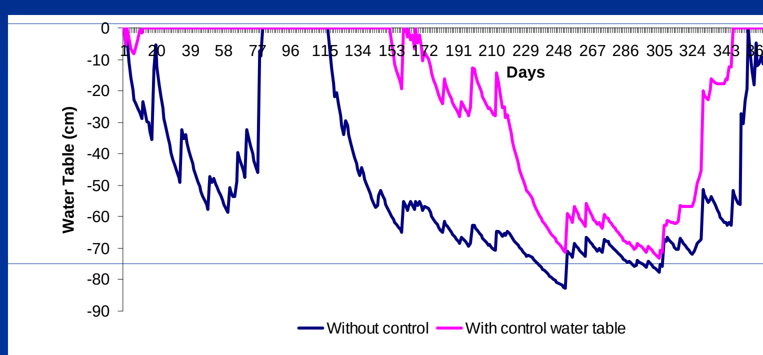
Rice Yield In Primer 10 Saleh

By Improving water management
the rice production was increased



Tahun 2009

C. Model Adpatation in Developing of Water Control Operation for Corn at C-typhology Land (Dry Condition)



Water management operational strategy for corn crop at C-typhology land (dry condition) at Delta Saleh

Crop growth	Months	Required water status condition	Water management objective	Water gate operation
Soil tillage	May	Field capacity, water table depth was -30-50 cm	Maximum drainage – land leaching	Maximum opening
Planting	May	Field capacity	Maximum drainage – land leaching	Maximum opening
Vegetative growth	June-July	Field capacity	Water retention	Closing/retention of 50 cm
Reproductive growth	June-July	Field capacity	Water retention	Closing/retention of 50 cm
Maturity-harvest phase	July	Field capacity	Water retention	Closing/retention of 50 cm

CONCLUSION

- Determination of water table dynamics at tertiary block could be conducted by using DRAINMOD program. Model adaptation in dry land condition (C-typhology) showed that the best scenario was land utilization pattern by using rice-bare soil.
- Monthly operational plan of water management for rice crop (first cropping season) was as follows: Water gates was opened (maximum drainage) at early phase of soil tillage (plowing); water control was needed by operating water gates as combination of supply and water retention in tertiary channel (kept at 50 cm) near the end of soil tillage.
- Water gates were opened (maximum drainage) in seeds sowing phase which was followed by operation of water gates as combination of supply and water retention until ripening stage. Field test showed that this operational system was capable to maintain water table condition in zone of 20 cm above soil surface.

CONCLUSION

- Recommended operation for corn crop was dominated by water table control system in tertiary channel (water retention) where all water gates operation at all corn crop growth phases was as water retention and as water supply before the entering of salt water (June-July). The maximum drainage was only be carried out after rice planting had finished and during land tillage for planting preparation.