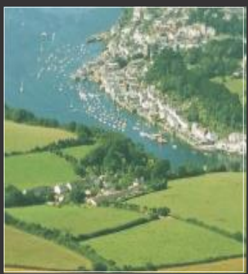

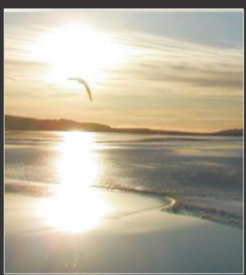

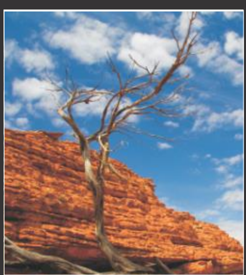

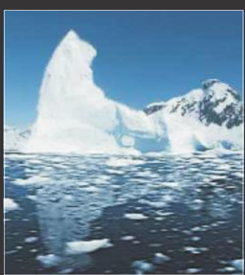

untuk kejayaan bangsa

The Proceedings of

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Japan-Indonesia Workshop on Estuary and Climate Change

8 - 10 August 2010
Seminar Room, Rectorat Building
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Kampus ITS Sukolilo Surabaya

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TOHOKU UNIVERSITY

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Contents

PREFACE

It is my great honor and pleasure to organize "Japan-Indonesia Workshop on Estuary and Climate Change" in the campus of Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia on the occasion of the memorial 50th year anniversary of ITS. Since we organized previous "Japan-Indonesia Estuary Workshop" last time in Jakarta with great success in 2005, five years has passed already. After 2005, the estuary workshop has been held in various countries in Asian regions such as Hanoi and Ho Chi Minh City, Vietnam and Bangkok, Thailand. Now we come back to Indonesia again to exchange our knowledge and experiences related to estuary and climate change.

It should be mentioned here that in the year 2006, a Memorandum of Understanding (MoU) has been signed between Tohoku University and Institut Teknologi Sepuluh Nopember to promote further collaboration between two institutions. We are highly confident that this workshop will serve as an important step to accelerate further cooperation between these two universities in term of collaborative research, faculty and student exchange, joint educational program etc.

Finaly, on behalf of the organizing committee of the workshop, sincere appreciation is expressed to all authors contributing to our workshop. Special thanks are also due to all keynote speakers and chairpersons for the efforts in preparing the manuscripts and managing the sessions, respectively.

With best wishes,

Prof. Hitoshi TANAKA, PhD
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THE PERFORMANCE OF DREDGING VESSEL TOWARDS SEDIMENTATION PROBLEM AND EXTREME RAINFALL IN MAIN SHIP CHANNEL KAPUAS RIVER - WEST KALIMANTAN

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Abstract

Main ship channel of Kapuas river is one of the most strategic infrastructure in West Kalimantan. Every year, the entrance of Kapuas river faces the sedimentation process and siltation. The extreme rainfall also can give some problem toward the dredging work. Regular maintenance is conducted by using dredging method with Trailing Suction Hopper Dredge type with hopper volume is 1500 m^3.
This research is to analyse and evaluate the performance of dredging vessel during 180 days. The method is using paramater relation between distance, time and speed of dredging vessel performance. Goal seek is used to enable the performance of dredging vessel to fulfill the progress of dredging work.
The result shows that dredging vessel has no good performance where the vessel speed is only 3-4 knot and causes time delay 6 – 9 months longer. The dredging vessel should have a speed of at least 7 knot. To overcome the problem due to vessel speed and extreme rainfall, the additional dredging vessel is required to fulfil time schedule with minimum speed and volume of 7 knot and 1800 – 2500 m^3 respectively.

1. INTRODUCTION

Kapuar river is important for various purposes. The most important purpose is to navigation channel and shipping transportation in West Kalimantan. Kapuas river is also as the shipping channels provide access to the port of Dwikora, Pontianak. Port of Dwikora is the largest port with total area 96.789 m^2, eight piers and it can contain 2000 containers.

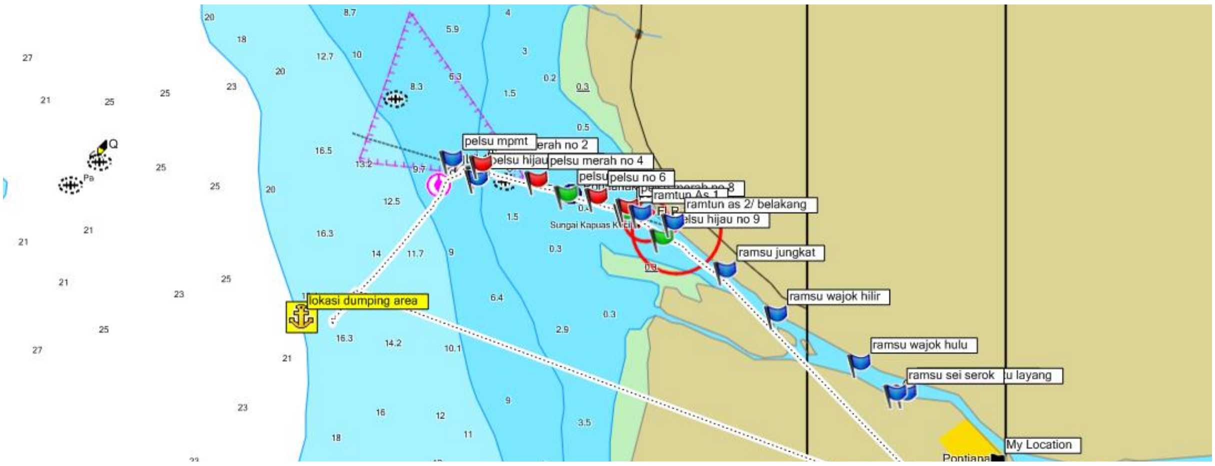
The length of shipping transportation channel between Dwikora Port and river mouth is about 22.1 km with range of channel width between 40 m – 80 m and time travel of ships between Dwikora port and outer channel in the river mouth is about 2 hours. The channel width in the front of Dwikora port is quite wide about 200 m – 300 m.

Not along shipping channel experience siltation and the sedimentation process usually occurs and concetrated in the mouth of Kapuas river and cause shoaling of river mouth. So the river mouth, especially in navigation channel need to deepen in order to ensure ongoing safe ship passage every year. Pelindo II is a stakeholder that have authority and responsibility to conduct the dredging work to maintain the shipping channel almost every year due to the sedimentation process that can cause a shallow location of river channel.

One of the threat for dredging work is extreme rainfall condition, where usually occurs during rainfall period especially between August and October. Due to extreme rainfall problem, the dredging work become more difficult and can cause delay for finished it as on time. In the future, the effect of climate change such as extreme rainfall and extreme river discharges could give some bad influence toward sedimentation problem and shoaling of entrance ship main navigation in Kapuas river (Laboyrie, P. 2009).

2. DATA AND METHODS

Navigation channel for shipping transportation in Kapuas River has width of channel 60 m and water depth -4.0 m of low water spring (LWS). The length of navigation channel that should be dredged is about 8.5 km. Disposal site is located at coordinate UTM 49 N 277405 3687 where the water depth is -20 m LWS. The distance between disposal site and dredging location is about 11.5 km (Pelindo,2009).



Source: MapSource 6.15.6

Figure. 1. Area of dredging works

The dredging vessel type is Trailing Suction Hopper Dredge (TSHD) whereas the specification of hopper capacity and vessel speed is 1500 m^3 and 8 knot, respectively. This dredger works by pumping the dredged material into a hopper contained within the dredger. When the hopper is full the dredger sails to the dredged material disposal site and deposits the dredged material via opening doors in the bottom of the hull (Nicol, G., 2002).

Dredging work is conducted during six months or 180 days. It is important to be known that the total time of dredging works is still reduced by survey of bathymetry after finishing the dredging works, final calculation of dredging volume and confirmation by the stakeholder or Pelindo II. So, the total of dredging works is only about 165 days (Pelindo, 2009).

Method to analyse performance of dredging vessel is using parameter correlation between distance (S), speed (V) and time (T) from simple equation as follows:

$$S = V \times T \qquad (1)$$

From Equation 1, the actual result of vessel speed performance is compared with the speed of dredging vessel based on the specification data. If actual speed value of vessel less than specification data of vessel speed, then the vessel speed performance is not good due to under performance. On the contrary, if actual speed of vessel equal than specification data of vessel, the vessel speed performance is very good.

To analyse the minimum speed of vessel is used the goal seek method using Equation 1. Goal seek is a what-if analysis tool and solving function invers problem single. Goal seek is useful to determine unknown value of travel time of dredging vessel based on the known value of vessel speed.

The capacity of hopper is 1500 m^3 and each dredged material pumped into a hopper should not contain 100% of dredged material of river, so that the total material in the hopper also contain some other material such as water, garbage, and etc. From this condition, the dredged material must be estimated using coeficient parameter. In this research, coeficient parameter is determined as reduction factor. The reduction factor is 0.5, so that the real of dredged material in hopper is about 0.5 x 1500 m^3 or 750 m^3 every one trip.

Table 1 shows the analysis to finish dredging work to deepen the main ship channel. This analysis assume that all condition is normal without some disturbances such as extreme climate, heavy rain, storm wave, etc. This analysis is also not consider that the vessel could be damage due to some problems. If the dredging vessel experience damage, the time schedule must be corrected and must be analysed to overcome the problem.

Table 1. Finish Analysis of Main Ship Channel Dredging Work

Capacity volume of Hopper	1500	m^3
Coeficient reduction	0.5	coef.
Dredged volume /Trip	750	m^3
Amount of trip /day	6	Trips
Dredged volume /day	4500	m^3
Total time to finish dredging work	159.3862	days
Total Time schedule of dredging work	180	days
Final sounding and calculation of final volume of dredged material	15	days
Effective time to dredging work	165	HARI
Remain of days	5.613777778	
Conclusion	**On schedule**	

3. RESULTS AND DISCUSSIONS

The performance of dredging vessel speed can be analysed using parameter relation between distance, speed and time. Each performance of vessel speed is devided with three condition, namely loading time condition, shipping to disposal area or dumping area (DA), and unloading condition.

Loading time condition is time that be required from starting to dredge until hopper volume capacity is fulfilled. Shipping to disposal area or dumping area is a condition where the dredging vessel transporting the sediment material lead to dumping area (DA). Unloading condition is a condition where dredging vessel already disposed of at certain location that has been determined.

Table 2. Performance of Dredging Vessel Benco 5 Capacity 1500m^3 for one cycle trip

Dredging works	*Mean of Loading time* / day (minute)	To Disposal Area/day (menit)	Mean of Off-Loading time / day (minute)	Total time of dredging cycle (minute)	Total time of one dredging cycle (hour)
Week- 7	46.80	110.32	93.45	250.57	4.18
Week- 8	55.48	150.71	122.95	329.14	5.49

Source: PT. Trimulia Rekayasa Utama. (2009)

Based on the evaluation report of dredging for daily and weekly respectively, it can be seen that dredging vessel performance only can achieve about 4 – 5 hours in each cycle trip (See Table 2). Table 3 shows that the vessel speed performance at loading condition, sailing to dumping area and sailing from dumping area of 1.98 knot, 3.64 knot, and 4.5 knot respectively.

It can be seen that vessel speed performance at loading condition or dredge condition is quite slow with 1.98 knot, whereas at condition of sailing to dumping area, the vessel speed is increase become 3.64 knot and at condition where the hopper is empty or at sailing back to dredging site, the vessel speed is more increase with 4.5 knot.

Table 3. Performance of Dredging Vessel Speed at each condition

Weekly Report	Vessel speed at Loading Time (knot)	Vessel speed at Sailing to DA (knot)	Vessel speed at Off-loading/Sailing from DA to spot (knot)	Note
Week -7	1.96	3.79	4.63	mean speed
Week- 8	1.99	3.48	4.38	mean speed
	1.98	3.64	4.50	mean speed

Source: Source: PT. Trimulia Rekayasa Utama. (2009)

Because the dredging work does not work in good performance due to vessel speed, then a minimum speed of vessel must be analyzed to be able to finish the dredging work on schedule. Using goal seek tool, the minimum speed of dredging vessel can be calculated easily using parameter speed (V), distance (S) and time (T).

Steps to get the minimum speed of dredging vessel is determine the speed of vessel as known variable, then using goal seek, the time (T) as a parameter function related to the speed and distance can be calculated. Note that speed is a function of distance devide time. Analysis of goal seek to seek the fastest time can be seen in Table 4. Table 4 shows that mean of time travel in every one cycle of dredging work only need about 2.7 – 2.8 hours if the vessel speed could achieve 7 knot.

Table 4. Performance Analysis of Dredging Vessel Speed/cycle with 7 knot

No.	Location Segment	Distance (meter)	Time Travel		Time unit
1	Spot 40 - 75	2500 - 4000	11	15	minute
2	Spot 75/80 to DA	16500 - 17000	76	77	minute
3	DA to Spot 75/80	16500 -17000	76	78	minute
			163	170	minute
			2.72	2.83	hours

From Table 4, we then can confirm that the minimum speed of dredging vessel is about 7 knot to achieve one cycle of dredging work in 3 hours. This speed of dredging vessel is already including influencing factors that can give some impact for delay of time schedule such as extreme rainfall and other disturbance during operation of dredging work. From Table 4, we then can make a fomula like in Table 5 to analyse trip amount in one day (24 hours). The result shows that dredging work is able to achieve 6 trips with total time is about 18 hours as can be seen in Table 5.

Table 5. Analysis of trip amount with dredging vessel speed 7 knot

Amount of trip	Time length	
1 trip	3	hour
5 trip	15	hour
6 trip	18	hour

Besides the problem of vessel speed that not in good performance, there is some other problem occur during the dredging work, namely the dredging vessel has experience damaged such as the suction pump and components of pump. Total time of dredging work that did not operated is about 40 days.

Table 6 shows the implication of damaged of vessel toward time delay in relation to finishing dredging work on time. The result shows that time delay can cause additional time more than 6 months until 9 months. Besides that, the remaining volume of dredged material at eight weeks is still achieve 26.652 m^3 (4%).

Table 6. Finished analysis of main ship channel dredging work due to damaged of vessel

Dredged volume at week 8	26.652.56	m^3
Remaining volume that not yet be dredged at week 8	690.585.44	m^3
Volume capacity of Hopper	1.500.00	m^3
Coeficient reduction	0.5	coef.
Dredged volume /Trip	750.00	m^3
Amount of trip /day	3	trips
Dredged volume /day	2.250.00	m^3
Time estimation of dredging work based on remain volume that not yet dredged	306.93	days
Total Time schedule of dredging work	180	days
Final sounding and calculation of final volume of dredged material	15	days
Remain of effective time to dredging work	108	days
Remain of days due to total delay	198.92686	days
Remain of months due to total delay	6.63089535	months
Conclusion	Delay	

Remaining volume of 447.585 m^3 in Table 7 is at condition where dredging works has achieved fifth month or sixteenth weeks, so that only about 38% from dredging work progress. Table 7 shows that additional vessel is required in order to fulfil time schedule of dredging work. The second vessel with same hopper capacity is able to overcome the remain of time delay of dredging work so that can finishing the dredging work on time.

Table 7. Finished Analysis of Main Ship Channel Dredging Work Due To Second Vessel

Remaining volume of dredged material due to delay from first vessel	447.585.44	m^3
Volume capacity of Hopper	1.500.00	m^3
Coeficient reduction	0.5	coef.
Dredged volume /Trip	750.00	m^3
Amount of trip /day	6	trips
Dredged volume /day	4.500.00	m^3
Time estimation of dredging work based on remain volume that not yet dredged by first Vessel	99.46	days
Total time schedule of dredging work	180	days
Final sounding and calculation of final volume of dredged material	15	days
Remain of effective time to dredging work	108	days
Remain of days due to total delay	8.5365698	days
Remain of months due to total delay	0.28455233	months
Conclusion	OK-On Schedule	

4. CONCLUSIONS

1. The result shows that dredging vessel has no good performance because of the vessel speed is only 3 - 4 knot.
2. The time needed to achieve one cycle trip of dredging and disposal work is about 5 hours so that in one day, there is only 3 or 4 cycle or trip.
3. Vessel damaged can cause the implication toward time schedule of dredging work. The impact can cause additional time about 6 – 9 months if there is no.
4. From the results, the dredging vessel should has vessel speed about 7 knot per trip.
5. Additional vessel of dredging is required in order to fulfil the time schedule of 180 days with the spesification of dredging vessel should has speed and hopper volume of 7 knot and 1500 m^3 – 2500 m^3, respectively.
6. In the future, the dredging works must face the effect of climate change and some preparation should be done to overcome the problem that will rise.

5. ACKNOWLEGEMENTS

I would like to thanks to PT. Pelindo II Pontianak, Consultant Engineering PT. Trimulia Rekayasa Utama, and Contractor PT. Mekarjaya Abadipratama as partner for dredging works of Main Ship Channel Kapuas River Pontianak West Kalimantan.

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