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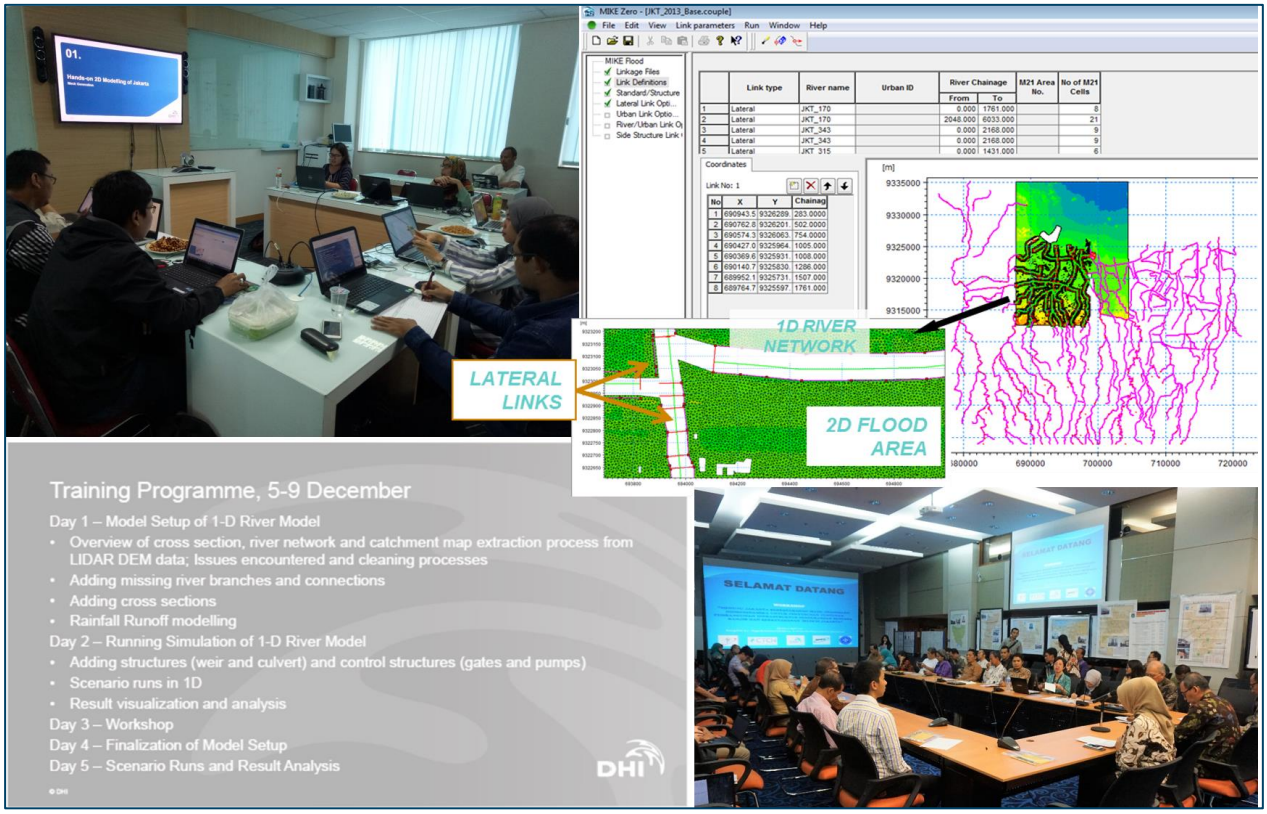
Hydrodynamic modelling for flood reduction and climate resilient infrastructure development pathways in Jakarta

Lesson-Learned Report



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Hydrodynamic modelling for flood reduction and climate resilient infrastructure development pathways in Jakarta

Lesson-Learned Report

(Final Draft)

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1 Introduction

Jakarta is increasingly threatened by flooding from a combination of land subsidence, rising sea levels particularly with relation to the spring tide cycle and higher river levels resulting from potentially increasing rainfall intensity and land use changes within the catchment areas. Strategies currently defined to address these threats include but not limited to creation of a Giant Sea Wall (GSW) to reduce the risk of flooding and coastal inundation.

The objectives of the Climate Technology Centre & Network (further called CTCN) technical assistance are (i) to better assess flood risks and hazards, and (ii) to design climate-resilient pathways to reduce the magnitude and scale of the impacts from this flooding. This assessment and strategy definition will help shape the design of climate resilient infrastructure technical assistance including, but not limited to, the GSW. The outcomes are (a) a hydrodynamic flood model that can be used to evaluate a number of hard and soft engineering interventions to reduce the risk of flooding (b) a socio-cultural survey to examine inhabitants' perceptions of flooding, levels of acceptable risks and preferred adaptation options, (c) a series of technology transfer workshops to increase local capacity in high resolution hydrodynamic modelling and use of the model, (d) resultant policy and planning recommendations to reduce flood hazards, risk and vulnerability, and (e) a roadmap to sustain and expand the technical assistance using additional funding streams.

To meet the expected outcomes mentioned above, the technical assistance is divided into the following 4 activities:

- Activity 1 – Flood Risk Assessment
    - Activity 1A – Model development
    - Activity 1B – Sociocultural Risk Assessment
    - Activity 1C – Technology Transfer
- Activity 2 – Formulate Policy Recommendations
- Activity 3 – Developing further funding streams
- Activity 4 – Knowledge sharing and South-South Cooperation

The lesson learned report will be presenting one of Activity 4 output (Knowledge sharing and South-South Cooperation). This report contains Assessment and Evaluation in the implementation of the hydrodynamic flood model and socio-cultural risk in study location. All of the experience from previous activities is presented in this report.

1.1 Objectives

The objective of this report is to produce a summary dealing with the lessons learned in the implementation of the hydrodynamic flood model and socio-cultural risk assessment in Jakarta. This report will contribute to the measuring and evaluating the impact of this technical assistance.

1.2 Summary Activities

Outputs of this technical assistance activities have been presented to the key stakeholders and audiences. They consisted of hydrodynamics and socio-economic assessment.

The following points are the result of hydrodynamics modelling:

- The flood modelling results (flood maps) are consistent with the increase of the rainfall intensity, tides and the land subsidence.
- The resulted flood map has been validated with different model and flood survey in year 2007 and 2013.
- The rainfall intensity plays important role to worsen the flood condition in Jakarta compared to other factor such as tide (for example).
- The Land subsidence also worsen the Jakarta flood condition. Based on the model result, the combination between extreme rainfall intensity and land subsidence increase the impact on flooding and area of inundation.
- The starting flood point in hydrodynamic model shows the weak points that cause the overtopping of water from drains and canals into the adjacent infrastructure in the study area.

From the result above, a comprehensive study of the hydrology aspect which includes the future spatial planning is required. Revitalization boundary in the technical assistance area considering the social-economic and infrastructure which are resilient to the climate change is also needed. Regarding to the land subsidence problem, it is suggested there should be a law reinforcement related to the ground water extraction and land subsidence management and monitoring.

The socio-economic survey has been done through three approaches, namely: a) macro study, b) meso study, and c) micro study. Macro study has been carried out through gathering the secondary data. Meso study has been carried out by conducting focus group discussion (FGD), attended by related experts and stakeholders. While, Micro

study has been done by household survey in 4 (four) villages, i.e.: Kapuk, Kedaung Kali, Kapuk Muara, and Pejagalan.

The following points are the brief result from socio-economic survey results:

- There has been various community responses toward mitigation and adaptation effort that has been done both by private and government.
- The response of community indicated several requirement to the effort that has been done by the government.
- Related to relocation, community showed a tendency to resistance, based on the consideration of location, facility, transportation and economic impact. The community suggested an alternative: conducting the settlement area management by relocating “brown” industries and warehouses area to another place.

In order to finalize the cooperation activity with CTCN and to fulfil detail Activity 4 above, a south-to-south cooperation workshop has been held by inviting 4 ASEAN country participants (Thailand, Malaysia, Filipina and Vietnam) and related work units of DKI Jakarta provincial government. Activity 4 (Knowledge sharing and South-South Cooperation) has been conducted in September 2017, in order to gain:

- experience arising from the aforementioned activities
- South-South potentialities amongst countries
- South-South Cooperation efforts to further promote this technical assistance, including for example invitations of relevant institutions to a lesson-learned/good practice workshop.

2 General remarks on over all CTCN technical assistance activity

From the hydrodynamics modelling activities, time allocation and data availability became the main concern especially in data collection process and model development. The data required was substantial and was hosted in several institution. The process required a lot of direct contact and lobbying with government's institution so that the process took longer time than the time allocation. Data processing and model calibration data also took longer time because the data available was not all in 'ready to use' state condition. Apart from these constraints, the hydrodynamic model that has been built is quite successful in representing flood conditions in 2007 and 2013 which is a representation of floods with return period of 50 and 20 year.

The Constraints that occur in the hydrodynamic model development process had a significant impact on the next activity of socio economic impact assessment. Previously, socio-economic surveys were planned to be executed after hydrodynamic modelling activities were completed, but eventually it was done in parallel with model development. The basis of sample survey sampling is finally taken based on information from Focus Group Discussion (FGD) activities. The timing of survey activities coincided with governor election (PILKADA) which turned out to be also a constraint in the implementation of surveys and FGDs. Apart from the constraints faced, the socio economic survey activity has successfully collected detail household vulnerability data.

Transfer technology activities which ran in parallel with model development has been completed, a series of training and workshops have been implemented as a form of knowledge transfer from DHI as the technology holder to the BPPT / JRC as recipient. The technology transfer activity has increased the recipient capabilities to be able to duplicate and to build their own model. Unfortunately, this transfer technology activity is constrained by the license of software that expires when this technical assistance activity is completed.

Result of analysis of hydrodynamic modelling and socio economic survey which have been done then become the baseline for making policy recommendation. The biggest achievement of this activities was the policy recommendation that has been made will be include in the Regional Mid-Term Development Plan of DKI Jakarta Province (RPJMD) 2018-2022.

3 Technical notes on each activities

Specific description of obstacles which was encounter during the technical assistance activity and the suggestion to improve the activity is summarized in Table 3.1

Table 3.1 Lesson learned from CTCN technical assistance activity

Category/Activity	Issue Name	Problem/Success	Impact	Recommendation
Hydrodynamic modeling	Data gathering	• Some data which needed for this technical assistance is scattered in different government work unit and national agency. • The first focus group discussion that has been held on July 2016 has successfully given important information about the data availability that needed for the technical assistance. • Collecting data from different government work unit and national agency after the focus group discussion still took long time, because we have to deal with a lot of bureaucracy administration and endless meeting.	• Data gathering process spent the first three months, longer than the expecting period • hampers the process of hydrodynamic modelling it hampers the process of hydrodynamic modelling	• Should allocate more time for data gathering • the time-frame of data collection should consider the data availability in the field. In this technical assistance, the data collection took longer time than it is expected due to the required data were still in the manual script and incomplete.
	Pre-processing	• We expected to get some processed data, since there are some previous study in Jakarta (for example : River Network and Cross section information) • In the actual, almost all the data that we got still in raw condition	• The data pre-processing took longer time than the expecting period.	• It is better to assume that all data that has been gathered is raw and need special treatment (pre-processing). So that more time allocation for data processing is necessary, for example LIDAR data.

Category/Activity	Issue Name	Problem/Success	Impact	Recommendation

	Modeling Calibration	• The data that have been already gathered is not enough to calibrate the model
		  • Discharge data: there are some discharge data, but still not sure whether the location information is true (since some of them located on land)
		  • Cross section measurement: the cross section data that have been gathered only covers a few river, and some of them do not have the datum reference information
		  • Control structures and their regulation: the latest model only used 2 pumps and 6 gates
			• Model calibration was not performed due to the non-availability of data mentioned previously	• Model performance can be improved by: (a) discharge calibration using observed data, (b) cross-section measurements, (c) addition of more control structures and their operation rules.

Socio-cultural risk assessment	Data collection through Socio-economic Survey	• Although the household survey has been approved by the Jakarta government, it was difficult to be conducted, particularly to interview the respondents, due to campaign period of Jakarta gubernatorial election	• Some respondents rejected or delay the interview as they assumed that the survey corresponds with the election	• A good coordination among local governments is important, i.e., between districts and sub-districts officers.

Category/Activity	Issue Name	Problem/Success	Impact	Recommendation
	Information gathered from FGD	• We conducted 3 focus group discussions (FGD), which the last FGD aimed to obtain information from flood-affected industries. Although industry and energy agency of Jakarta province helped us to invite many industries, only 4 industries attended this event	• The assessment cannot completely capture the flood damages and types of mitigation measures from all types of affected flood industries in study area	• It is should be a new approach to invite the industries, for example making a phone call instead of only invitation letter • Conduct the FGD in the "neutral" place or outside the government offices may increase the probability of attending
	Results from hydrodynamic modeling (Activity 1A) and socio-cultural risk assessment (activity 1B) were less combined	• In the beginning, the Socio-cultural risk assessment was planned to conducted after hydrodynamic modelling provided some results, e.g., the inundated areas. However, the modelling delayed for providing such results, consequently the survey areas were identified by gathering information from FGD participants	• The boundary of survey area was less accurate	• It is better to allocate more time for hydrodynamic modelling activity
	Data collection through Socio-economic Survey	• Although the household survey has been approved by the Jakarta government, it was difficult to be conducted, particularly to interview the respondents, due to campaign period of Jakarta gubernatorial election	• Some respondents rejected the interview as they assumed that the survey corresponds with the election • Households survey took extra time than expected	• A good coordination among local governments is important, i.e., between districts and sub-districts officers.

Category/Activity	Issue Name	Problem/Success	Impact	Recommendation
Technology Transfer	The agency/ the institution that attend the technology transfer	• The training participants only came from two agencies, i.e. Agency for the Assessment and Application of Technology (BPPT) and Meteorological, Climatological, and Geophysical Agency (BMKG).	The training participant did not represent all the agencies that related to Jakarta flood risk management	• The training participant should include all the representative from all Regional Jakarta Work Unit SKPD, related institute/agency in Jakarta.
	The list of training participant	• The training participant list was not fixed, changing in every training • The availability of the software license or the training is limited, the number of the software licenses was adjusted based on the list before the first training. • Some participant did not attend a whole training series	• The new participant that was not listed as a training participant, cannot use the software license, since the number of software license available is limited based on the list that given before the first training • The pace of the training is slower than the expecting time, because if the participant did not attend one of the training series, sometime the trainer should repeat again the previous material	• The training participant list should be fixed before the first training, and should not change up to the last training. • The training participant should attend all the training activities series

Category/Activity	Issue Name	Problem/Success	Impact	Recommendation
	The training tools (Laptop or computer)	• Participant have not installed the MIKE software before the training • In the first training, installing the MIKE software took a half day, and there was some problem in installing the MIKE software in some participants' laptop	• The first day of training was not efficient, most time has been spent for installing the software and solving the problem in installing the software	• The participant should try to install the MIKE software first before the first day of training.
	Software License	• The period of software license for technology transfer recipient will be expired with the end of the technical assistance activity (20 June).	• There is only a little time left for technology transfer recipient to modify the final model	• The period of software license for partner/ technology transfer recipient should be longer than the technical assistance activity period, in order to give the recipient the opportunity to modify the hydrodynamic modelling result • Arrangements are required to ensure continuous access for the institutions that have been targeted by the CTCN support.
Policy recommendation	Policy implementation	• Lack of integration between local and national institution regarding the flood management regulation • Indonesia does not have a clear regulation regarding who have the authority to integrate the local and national institution in integrated river	• This problem cause some obstacle in implement the designed policy.	• In order to make the policy recommendation implementable, there should be a pilot project for integration program among related local and national institution, for example integrated polder management

Category/Activity	Issue Name	Problem/Success	Impact	Recommendation
		management		• A matrix about the relationship between all Local Government Work Units (SKPD) and/or related stakeholders regarding flood and water management could be made to help integrate all related stakeholder processes.
	Flood issue	• Indonesia has many priorities	• Flood management is not Indonesia's first priority yet.	• Raise flooding issue into prioritized agenda in RPJMD program.
Developing further funding stream	Activity formulation And proposal preparation	• Defining the next activity which in line with the DKI Jakarta government long term plans and the vision of current activity.	• Secure implementation of CTCN technical assistance activity.	• Recommendation from previous study should act as a benchmark to define the next step towards the vision of the activities • JRC must actively involve stake holders directly working on the water management and city planning such as Ministry of public work and housing, water management department, regional and national disaster management agency, and Regional development and planning broad)
	Preparation of	• The activity has to be specific and	• too many study proposal will not attract donors.	• Every donors has their own interest :

Category/Activity	Issue Name	Problem/Success	Impact	Recommendation
	proposal	addressed the issues.		study or study and infrastructures (KOICA)
	Defining funding donor agencies	• Some funding donor has specific scheme for funding. • Different interests / concerns of donor agencies in flood management	• Proposal was made in different thematic options that is tailored to the interests of each donor agency	• Before submitting the proposal. a little research on the funding stream donor capability and scheme is recommended, therefore funding stream activities will be more effectives • CTCN should help Indonesian local team in offering the proposal to other donor agencies
South-south cooperation		• Local team who already have capacity building can be involved in south- south cooperation's team	• The study can be continued directly	• CTCN should facilitate local team to disseminate the results to other parties who have similar problems

4 Lesson Learned

About the flood in the study area

The flooding in the study area caused mainly by the runoff from the three rivers, sea level rise, and land subsidence. Result from hydrodynamic modelling shown that among those causes, the river runoff and land subsidence are the dominant factors which contributing the Flood occurrence in Jakarta meanwhile sea level rise will worsen the flood if it is combine with the land subsidence as modelled in scenario 2050.

How climate change worsen the flood

The fact that river runoff is directly influenced by the rainfall intensity lead to the indication the northern part of Jakarta is vulnerable to climate change. The climate change factor that has been calculated by Budiyono et al (2016) using Global Climate Model (GCMs) and Representative Concentration Pathways (RCPs) scaled down to Jakarta region shows that the increasing of maximum rainfall in 2030 is around 33% and in 2050 is about 41%.

Impact to the city

As the capital city of Indonesia the climate change induced flood vulnerability can cause a big loss to the city. In the pilot project area, the loss caused by 8 flood scenario has been calculated using damage scanner software by Budiyono et al (2016) in the report of summary report on analysis of different risk assessment. the model shows that the combination of rainfall with 50 year return period, with projected climate change factor and land subsidence for year 2050 will obtain the maximum damage in the project area that consist of three polders. In Pantai Indah kapuk 8 polder (PIK 8 polder) the damage is about 20.975 million USD, and in Kapuk Muara polder is 64.965 million USD and the maximum damage between these three polders caused in Kapuk Poglar polder (96.752 million USD). The detail calculation about this damage can be seen in summary report on analysis of different risk assessment.

The Kapuk poglar polder area itself is an area with high density population. Based on statistic report of DKI Jakarta in the socio cultural risk report study, Kapuk Poglar polders which belong to Kapuk and Pejagalan sub-distict shows increasing density population trend during the period of 1995-2015 while the number of industry in this area is decreasing. The flood is subjected to be one of the main cause that makes the industrial activity is decreasing (see socio cultural risk assessment report).

The challenging factor for flood reduction in the city

Socio economic character of the study area can be one challenging factor to solve flood problem in Jakarta. Study of socio cultural risk in pilot project shows varies characteristic of the people who lives in the pilot project area. In PIK 8 polder which is a high-end housing area and already occupied with well-maintained private polders system is relatively easy to manage.

The area which need more attention is in Kapuk Muara and Kapuk Poglar polder area. The people in this area are relatively a middle-low society with low education background. They tend to have a high social resilience and mostly have made a private mitigation for their house such as raising their house floor, and installing embankment at the source point of the flood. Therefore, the people in Kapuk Muara and Kapuk Poglar polder area are generally resistant to the proposed flood problem solutions such establishment of a reservoir or relocation of existing industrial area because it is constrain by the land

availability and required relocation of some resident whom earning from the existing industrial activity in the area.

How we see the flood problem after this TA

Looking at the complexity of the flood problem in Jakarta, particularly in the pilot project area, our point of view about flood problem has been changed. Flood problem is no longer a matter of technical problem because every solution that will be chosen will give impact to the existing social, cultural, economic condition. Therefore, the social economic impact of each technical recommendation has to be carefully examined to get the optimal solution for the flood prone area.

What can we do to reduce the flood problem in the city (particularly in the pilot area)

Several technical recommendation and alternative solution for the social economic condition in the pilot project area which resulted from hydrodynamic study and the socio economic study has been formulated for example:

- Unify the management of all three polders which requires coordination through strengthened public-private partnership and designing a drainage system that able to accommodate 25-year flood event

- Applying the blue green metropolis city concept which encompass a distributed retention pond.

The detail recommendation from this study and its impact to the existing social economic condition in the pilot project area can be seen in report of policy note summary document on recommendation to relevant policy maker and stakeholders.

Delivering the result of the TA

The result from the hydrodynamic, socio economics study, and the policy recommendation which were formulated in above document has also been socialized to the local stakeholder and experts who's working directly to the water management and flood related problem, through a series of stakeholder-expert meetings and workshop.

Through these activities, an active discussion has been facilitated among local stakeholders, experts and DHI-JRC as the executor of this TA. The formulated policy recommendation has been accepted by NDE representatives during this meeting with positive response that NDE representaive will include the proposed policy recommendation as one of consideration factor to finishing the Regional Mid-Term Development Plan of DKI Jakarta Province (RPJMD) 2018-2022.

Futhermore, the stakeholder-expert meeting and workshop has an important role as a medium to get latest information related to the water management improvement or progress of flood management works and planning in each local government institution, to gain feedback for improving further activities, and to build and strengthen the network connection among local stakeholders, government institution, consultant and expert who work closely to the water resource and flood related problem.

5 References

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