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Penulis : Pini Wijayanti, X.zhu, P.Hellegers, Y.Budiyono, E.C. van Ierland
Keterangan : Pernah dipresentasikan pada Wageningen University & Research
Email : pini_wijayanti@apps.ipb.ac.id

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Estimation of river flood damage in Jakarta, Indonesia

P. Wijayanti, X. Zhu, P. Hellegers Y. Budiyono, E. C. van Ierland

Background

Flooding is a serious problem in Jakarta. In order to design optimal flood management strategies, an accurate estimation of the incurred flood damage is needed.

Objectives

1) to estimate flood damage in a densely populated area in Jakarta by means of a survey,
2) to understand the relationship between flood characteristics and flood damage, and
3) to compare the damage estimates from the survey with the damage estimates obtained by a flood damage model for Jakarta i.e. the damage scanner model.

Methods

Statistical method:

- Survey on 300 households and 150 business units along *Pesanggrahan* River for damages due to flood in January 2013.
- Estimate the actual flood damage model by OLS:

$$AFD_i = \beta_0 + \beta_1 DEP_i + \beta_2 DUR_i + \beta_3 DIS_i + \beta_4 INC_i + \beta_5 ARE_i + \varepsilon_i$$

where:
AFD_i : actual flood damage (US$),
DEP_i : flood depth (cm) ,
DUR_i : flood duration (hours),
DIS_i : distance from river to the building (or housing) (m),
INC_i : family income (IDR/month),
ARE_i : building (or housing) area (m^2),
ε_i : error term.

Damage scanner model:

- Consist of three major inputs:
  1) flood hazard, represented by the inundation depth and extent map,
  2) flood exposure, represented by the land use value, and
  3) flood vulnerability, represented by the depth-damage curve.
- The 30-year flood return period of rainfall that occurred from 15 to 18 January 2013 was used to estimate the flood damage in the study areas by the damage scanner
- Expert workshops were used to obtain the vulnerability curves

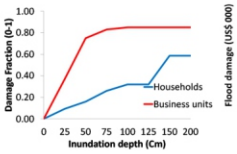

Figure 2. Vulnerability curves

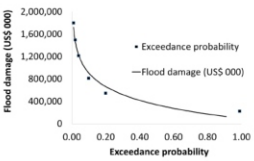

Figure 3. Flood damage in Jakarta under different exceedance probabilities

Results

Table 1. Estimated damage costs for the flooding in 17-19 January 2013 based on survey and damage scanner

Sector	Flood damage costs (US$) survey	Damage scanner
Residential	524,999	1,318,235
Business	697,050	9,248,201

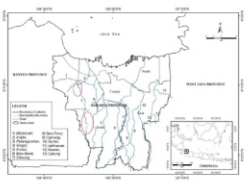

Figure 3. Map of Jakarta indicating the study area

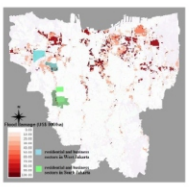

Figure 4. Flood damage map under a 50-year flood return period

The following causes explain the differences in the results from the two approaches

1) A survey was used to create an empirical flood model, while the damage scanner was used as a synthetic model.
2) The survey approach used the micro scale, while the damage scanner approach used the meso scale. The survey produced an actual and detailed estimation, but it is labour intensive especially for a large-scale study. The damage scanner gave a more global estimate of the potential flood damage in Jakarta, but the calculations tend to be less accurate at the detailed level.
3) Uncertainties arise in the survey method because flood damage was assessed only based on one single event and the assessment was limited to certain ranges of depth and duration. In the damage scanner model, uncertainties appear in the construction of damage curve, and the asset values associated to the curve. There exists a difference in methodological framework between two approaches.

Conclusions

The flood damage estimates obtained by the survey approach are lower compared to the damage scanner approach due to different ways of obtaining flood damage data and defining the maximum flood damage per object, the different spatial levels, and the uncertainties in constructing the flood damage curves in the damage scanner model.

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Wageningen University & Research
Environmental Economics and Natural Resources Group (ENR)
Contact: pini.wijayanti@wur.nl

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