Flood damage influencing factors for residential buildings in Can Tho city, Mekong Delta

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Introduction

Floods in the Mekong delta occur on a recurring basis during the flood season from July to November. In line with the projected rise in sea level and the estimated increase in precipitation during the wet season, which is expected to be especially pronounced in the south of Vietnam (MONRE, 2009), flood hazard could increase considerably in the Mekong Delta. In Can Tho city, the biggest city in the Mekong delta, extreme floods like the one during the flood season in 2011, cause significant damage to buildings, businesses and infrastructure. Comprehensive risk and damage assessments are essential for an efficient flood management.

To improve the knowledge about flood losses and the loss-influencing factors, 858 households and small businesses affected by the flood in 2011 in Can Tho city were interviewed (Do et al. 2014 accepted).

Important flood damage influencing factors for residential buildings and contents were identified by multi-variate statistics. The single and joint influence of factors was quantified.

Data characteristics

Flood characteristic

water depth (wst), flood duration (d), flow velocity (v), contamination (con)

Preparation, Response

precautionary measure and their efficiency (pre, epre), flood experience (fe), knowledge (kh), early warning: lead time, information, elapse (wt, wi, wte), emergency measures (em)

858 flood-affected buildings

Building characteristic

Building value (bv), content value (cv), building quality (bq), floor space of building (fsb), absolute loss (loss), loss ratio (rloss)

Socio-economic status

Socioeconomic status (Plapp 2003) (socp), Age (age), income (inc), elderly person (eld), children (chi), ownership (own), house size (hs)

Data analyses

The Pearson correlation coefficient was used to investigate the correlation among 24 variables.

Multi-variate statistical analyses including tree-based approaches were used to identify most important damage influencing factors

Principle component analyses were undertaken to investigate the correlation structure of the damage influencing factors

Result: quantitative information about single and joint effects of important damage influencing factors

Results

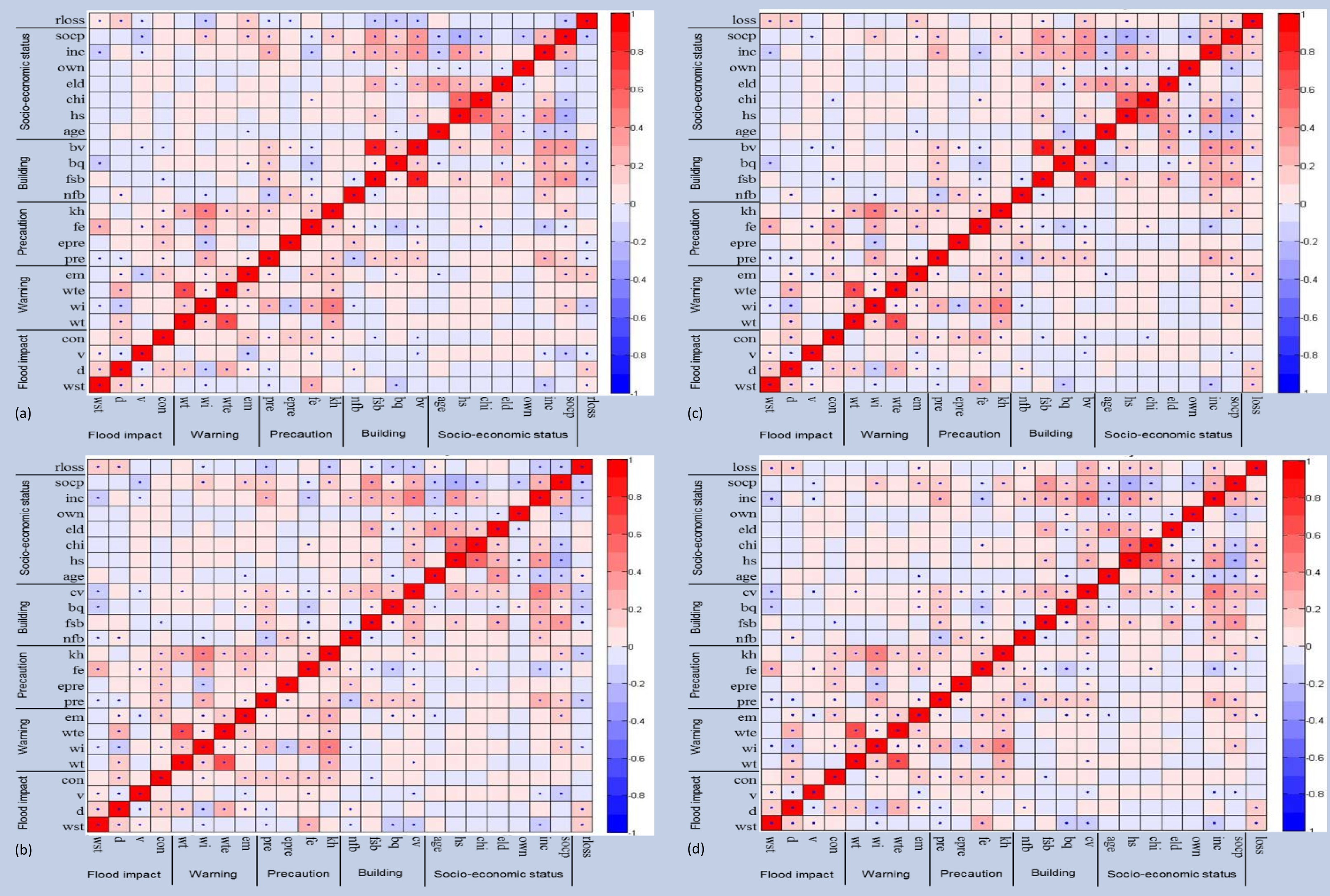

Figure 1: Pearson correlation of 23 candidate predictors and (a) loss ratio for buildings, (b) loss ratio for contents, (c) absolute damage for buildings [$], (d) absolute damage for contents [$]. Significant correlation (0.05 sig. level) is marked by a dot.

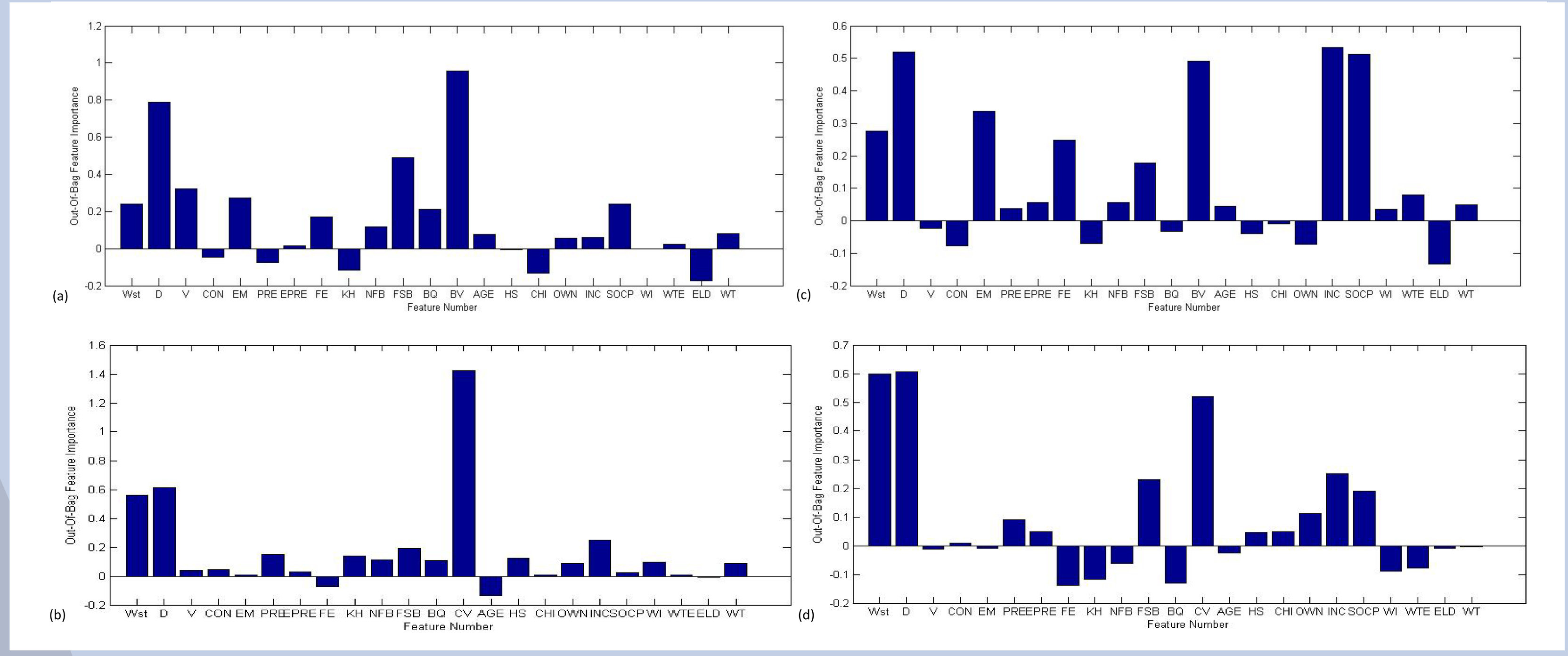

Figure 2: Out-of-bag feature importance for bagging decision trees for predicting (a) loss ratio for buildings, (b) loss ratio for contents, (c) absolute damage for buildings [$], (d) absolute damage for contents [$].

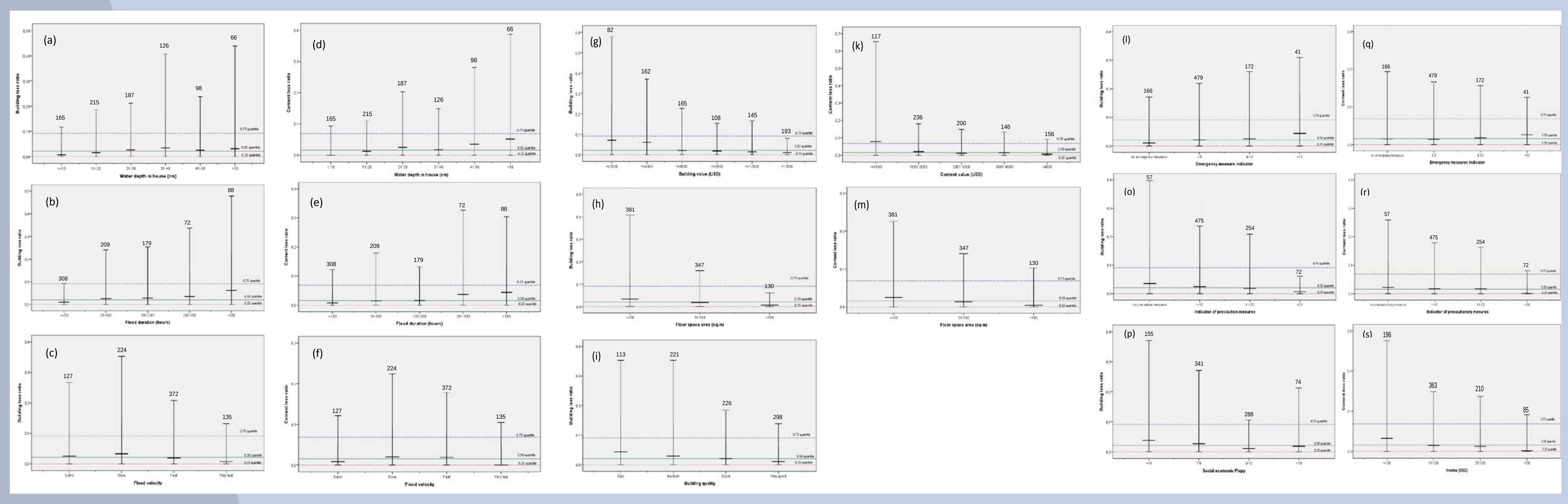

Figure 3: The 0.25, 0.50, and 0.75 quantiles of building loss ratio and content loss ration in relation to various potentially damage influencing factors. The horizontal lines represent the 0.25, 0.5, 0.75 quantiles of loss ratios of the total data set

Table 1: Results of principal component analyses: Component loadings for variables that probably influence building and content loss ratios

Item	Components (n=858)		
	1	2	3
Water depth in house (cm)	-0.07	**0.79**	-0.08
Flood duration by hours	-0.03	**0.61**	0.45
Flow velocity	-0.14	0.12	**-0.64**
Emergency measures	0.09	0.03	**0.67**
Building value in USD	**0.92**	0.09	-0.12
Floor space of building	**0.88**	0.16	-0.21
Socioeconomic status according to Plapp	**0.63**	-0.05	0.14
Pearson correlation			
Building loss ratio	-0.16**	0.18**	0.12**

Extraction Method: Principal Component Analysis. Total variance explained 56.65%.
Bold value indicate variable with absolute loadings ≥ 0.5
** Correlation is significant at the 0.01 level (2-tailed).

Item	Components (n=858)		
	1	2	3
Water depth in house (cm)	-0.26	**0.64**	0.40
Flood duration by hours	-0.03	**0.77**	0.03
Precautionary measure indicator	0.41	-0.31	0.48
Knowledge of flood hazard	0.19	-0.12	**0.67**
Content value in USD	**0.76**	0.12	-0.07
Floor space of building	**0.53**	0.15	0.29
Household size	**0.55**	0.17	-0.37
Income	**0.76**	0.09	-0.16
Pearson correlation			
Content loss ratio	-0.13**	-0.15**	0.21**

Extraction Method: Principal Component Analysis. Total variance explained 53.43%
Bold value indicate variable with absolute loadings ≥ 0.5
** Correlation is significant at the 0.01 level (2-tailed).

Conclusion

Results reveal that inundation duration is a more important damage influencing factor for residential building loss than water depth in Can Tho city. Also building characteristics such as building or content value, floor space of building and building quality are significantly influencing flood losses. Probably in relation to that, income and the socio-economic status are also important. Besides, precautionary and emergency measures are able to significantly reduce losses to residential buildings and contents. Thus, damaging processes in Can Tho city seem to differ significantly from those e.g. quantitatively characterised in Europe where water depth is the most important damage determining factor.

Based on these quantitative results about the single and joint effects of various damage influencing factors, novel multi-parameter flood loss models will be developed. We expect, that such region specific flood loss models will significantly reduce uncertainty in flood risk analyses for the Mekong Delta.

References:

Do T.C., Bubeck P., Nguyen V.D., Kreibich H. (2014 accepted) The 2011 flood event in the Mekong delta: preparedness, response, damage, and recovery of private households and small businesses. Disasters

MONRE (2009) Climate change and sea level rise scenarios for Vietnam. Ministry of Natural Resources and Environment, Hanoi.