RESIDENTS AND FLOOD RISK MANAGEMENT IN FLANDERS: TWO WORLDS APART?

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Although flood risk is usually framed as a physical problem, there is also an i
side to the issue. Potential damages are influenced by a large number of indivi
location choice or private flood protection measures. Flood risk management i
including these elements through responsibilization of spatial planners and civi

However, since flood risk management in Western Europe is strongly government-
were usually confined within the boundaries of the water system itself, there is
to do this. Therefore, this paper looks into the point of view of residents in f
a survey (n=183) in the Dender basin (Flanders, Belgium). The paper first discu
residents knowledge, risk perception, location choice, sense of responsibility,
and seeds of self-initiative. The survey shows that residents are very much atta
at the same time take little action. Remarkable is that even though Flanders
tradition in spatial planning, residents place responsibility for living in fl
government, and therefore they feel entitled to public protection.

1. Introduction

Under influence of increasing flood risks and uncertainty, many Western Europear
recently adopted a risk-based approach to flood management (Kellens et al., 201
While the earlier flood protection paradigm considered the socio-spatial contex
and tried to find solutions within the confines of the water system itself
altogether, the risk-based approach incorporates the socio-spatial aspect o
urbanization in floodplains and increases in sealed land. Subsequently this ri
emphasis on avoiding damage due to flooding (Johnson and Priest, 2008). Th
dimensions of natural hazards are becoming more and more important (Raschky, 20
reciprocal interaction between society and water management (Tempels and Hartman

Consequently, there is a growing awareness that spatial planning could play an i
risk management (Jong and van den Brink, 2013, White, 2013, De Smedt, 2014, Pa
2012). Flood management is no longer reactive to changes in spatial developmen
integral part of spatial planning and the conception of spatial developments (Wo
line with the tendency in spatial planning theory towards actor involvement (Bo
press), societal actors should play an increasingly important role in flood ris
et al., 2014, Penning-Rowsell and Pardoe, 2012, Fleischhauer et al., 2012). Ta
limited resources of governments, climate change and inherent limitations o
involving residents in flood risk management can become an important part of th
et al., 2011).

However, until now flood management research has mainly focused on the isolated
technical) systems (Pahl-Wostl, 2007). As a result, the frequency of flooding a
have been well studied (de Moel et al., 2009), while the role of societal acto
debate. Only in the United States, social issues in relation to flood risks
subject to research for some time (Waterstone, 1978, Montz and Gruntfest, 19
Western European context they gained relevance only recently due to the high de
responsibility (Kreibich et al., 2005, Bubeck et al., 2013, Terpstra and Gutte
most of these topics, such as flood risk knowledge and awareness, risk perceptio
individual responsibility and protective behavior, including the economic, psy

mechanisms behind them, have been mainly described individually within diff
geographical or political contexts (see further). Therefore, an integrated unde
risks and societies interact, and how this affects spatial planning and flood
lacking.

This paper analyzes a wide array of interactions of residents with flood risk
(Flanders, Belgium), based on a survey amongst residents in flood-prone areas
include (1) the availability and use of knowledge, (2) the way risks are experie
chose their location and the extent to which they are willing to move, (4) who
for different aspects of the issue and (5) what they do to protect themselves.
these interactions contribute to flood risk management, and how they could becc
flood risk management in the future.

As such, this research contributes to the existing knowledge in two ways. On the
specifically on residents and spatial planning, since the debate on flood ris
conducted from the perspective of water managers. On the other hand, it discus
topics from psychosocial aspects such as awareness and knowledge, to behav
eventually the translation to policy.

In what follows, we will give an overview of the state of the art on resident
based on literature review. Next, the main elements of flood risk management an
Flanders (Belgium) will be discussed, as a context to the survey results pres
paper ends with a discussion on what these results imply for flood risk manageme

2. Research design and case study area

2.1 Key topics

2.1.1 Knowledge

Knowledge on flood risks is a prerequisite for taking action. As memories of f
trough time, risks are disregarded. Therefore, risk communication is an impor
strategy to activate residents. However, the rigid institutionalization of risks
maps can give rise to a biased and oversimplified perception of complex concep
(e.g. return period). Accordingly, local knowledge is often undervalued.

2.1.2 Risk perception and experience

Since knowledge of risks does not always translate into personal worry, merely p
about risk is not enough (Parker et al., 2009, Willis et al., 2011). Risk percep
personal characteristics, situational factors and risk characteristics (Lind
Explicitly dealing with risk perceptions in risk communication can make flood ri
effective (Buchecker et al., 2013, Grothmann and Reusswig, 2006, Kellens et a
Klijn, 2004). Flood forecasting and warning play a central role in this (Brilly

2.1.3 Location choice and willingness to move

Filatova et al. (2011) state that low individual flood risk awareness leads
developments and increased flood risks. They argue that by increasing individua
likely that flood risks are integrated in the individual economic decisions at
housing prices are often lower in flood-prone areas (Tobin and Montz, 1988, Eves

Individual decisions on private risk mitigation measures and location choice are
extent to which insurance premiums internalize actual variations in risk and

subsidized by the whole population (Bouwer et al., 2007). Possible incentives reduction might include lower premiums, higher coverage and lower deductibles (B However, in practice, premiums generally do not as risk is reduced (Penning-Rowsell and Pardoe, 2012).

2.1.4 Sense of responsibility

The limits of the capacity of the state to manage flood risk is widely recognize an overall plea towards more individual responsibility in flood risk management 2008). However, the division of responsibility between state, public organizatio management of flood risk is often not clearly established. Lalwani and Duval (2 personal responsibility is not assumed when there is no clear information inc personally responsible for threat management, even under conditions of high resources to deal with the risk. When governments are assumed to provide protec reluctance to accept responsibility. The strong reliance on and confidence in hampers the private sense of responsibility (Grothmann and Reusswig, 2006). responsibility is clear, it is mostly accepted if individual resources or instru available (Filatova et al., 2011).

2.1.5 Protective behavior

Risk perception and awareness are often analyzed in the light of understandi precautionary action against flooding (Waterstone, 1978, Grothmann and Reusswig al., 2013). However, perceived risk does not contribute directly to taking prot et al., 2009). Several studies have shown that there are wider socio-psychologic These include risk appraisal elements (e.g. risk perception, awareness, poten exposure) and coping appraisal (e.g. self-efficacy, resources and outcome expe ratio), within an institutional context (e.g. political focus and reliance (Grothmann and Reusswig, 2006, Waterstone, 1978, Kreibich et al., 2011, Zhai et

On the other hand, the impetus for individual adaptation can be reduced or technological or financial assurances (Smithers and Smit, 1997). The confidence and centrally led, engineered solutions implicitly triggers a low risk awarene efficacy and practicability of private damage prevention, which may contribute towards autonomous adaptation measures (Grothmann and Reusswig, 2006).

The above shows that the interaction between residents and flood risk manageme complex economic, psychological and social mechanisms. Therefore, the transit residents involvement and a more active role for spatial planning in flood man in literature and policy plans alike, is difficult to realize. Existing flood ma a way self-preserving as they reproduce themselves through feedback mechanisms Brink, 2013). The path dependencies following the high expenditures for flood low responsibility awareness among the involved citizens.

2.2 Flood management and spatial planning in Flanders

Flanders, the low-lying northern part of Belgium, is densely built (more than and has a dense river network, causing it to be sensitive to flooding. Accord water assessment maps 71,556 ha or 5.3 % of Flanders have recently been floode return period of 100 years with a flood depth of 30 cm. According to the Fle Agency 36,000 to 56,000 buildings and 23,000 building parcels are located within

Until the 1990s, flood risks were not systematically included in the conception plans, due to a variety of reasons such as the limited knowledge on flood risks

political prioritization of flood-related issues in planning, and even fr
(Boussauw and Boelens, 2015). In addition, the impact of the enormous increase
up land and the subsequent increase in flood frequency was not anticipated in
and Van Rompaey, 2009). Moreover there was a strong belief in an engineering
prevention, as exemplified by the Dutch Delta Works. After the 1976 floodi
materialized in the Sigma plan. Within this plan, a remarkably strong divide be
and spatial planners was maintained. Controlling flooding through engineer
considered to be the main or even sole responsibility of water managers, while d
was still not a core issue for spatial planning. Therefore, little effort was
development in flood-prone areas. It was only in the revision of the Sigma pla
based approach was adopted, in which spatial planning for the first time pla
limited to providing space for retention basins.

Since the Spatial Structure Plan for Flanders (in Dutch Ruimtelijk Structuur
1997 and the adoption of the principles of integrated water management in 2003,
is receiving more attention in planning practice. Nevertheless, the integratio
spatial planning is difficult since water management (especially for larger riv
scale, while spatial planning is practiced – to a large extent – on a local le
This complex actor network makes integration, responsiveness and decisiveness ha

To deal with this, the 2003 Decree on Integrated Water Management has led to th
Coordination Commission on Integrated Water Management (CIW), which brings the
domains and levels within the Flemish government administration together (Van
Sutter, 2014, Wiering and CrabbØ, 2006). Over the last decade, they have develo
and tools to improve this situation. Examples include the so-called water asses
mandatory part of the approval procedure for buildings or spatial plans, and th
of signal areas where rezoning is considered because of imminent water issue
The goal is to have a more steering role through regulation, especially fo
However, decision-making remains the responsibility of the individual planning i

Additionally, regulations on insurance and damage compensation, and information
been developed. Federal legislation from 2007 stipulates that flood damages are
the private fire insurance. Even though fire insurance itself is not obligato
households buy such insurance, as it is often a condition for obtaining a mortg
risk maps indicate where residents pay a higher premium, as determined by the
legal limit of a 90% surplus premium related to natural disasters. For houses
2008, insurers are free to decide whether they want to provide insurance and a
This accommodates a certain, but limited solidarity principle.

Since 1992, the location of real estate in a flood risk zone (following the fede
be disclosed in the real estate deed. Since 2013, flood risks (based on the re
maps) also need to be mentioned in publicity for real estate for sale or for lon
information on flood risks and possible measures residents of flood prone are
available online, but not actively disseminated. Moreover, the different flood
regional) cause inconsistent communication towards citizens and therefore ambigu

The above shows little involvement of residents in flood risk management on t
weak planning tradition on the other. While the first element suggests a relati
awareness and responsibility, and therefore no inclination toward self-initia
suggest the exact opposite.

2.3 Study area: Dender basin

Within these settings, the Dender region is one of the areas with the most freq
devastating consequences within Flanders. The most recent floods took place in

2002-2003, 2010, 2011 and 2014 (Coninx and El Kahloun, s.d.). The Dender basi
Scheldt basin. The upstream part of the basin (675 km2) is located in the Wal
downstream part (709 km2) is located in Flanders and managed by the Flemish go
1). The flooding issue in the Dender basin is often debated in the media and
political debate going on about what needs to be done to reduce floods and fl
Known problems are the (relatively) high density of buildings and sealed land
already reported in the 1960s by Van Nuffel (1969)), the outdated infrastruc
coordination with the Walloon Region, both during floods as in general (CIW, 201

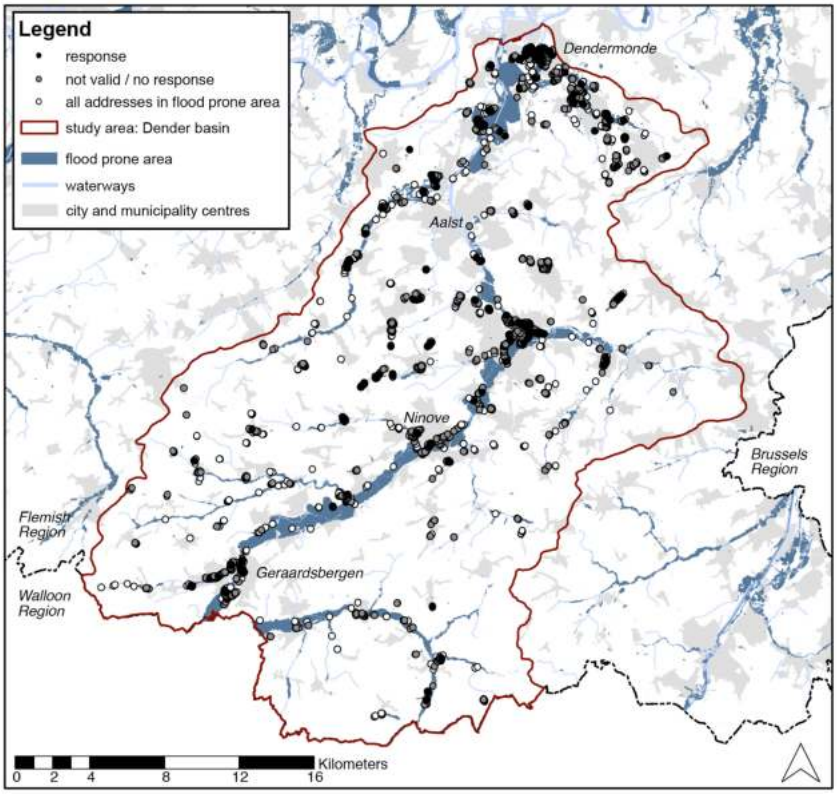

Figure 1. Map of the case study area: the Flemish part of the Dender basin, wit
prone areas according to the water assessment maps and the sample of the

2.4 Research hypothesis and design

We conducted a survey amongst residents of flood-prone areas in the Dender basin
attitude and behavior of residents in relation to riverine flood risks for the
questionnaire comprised 66 questions and resulted in a database with 317 u
discussed the respondents experience with flooding, their knowledge on the ris
measures, their housing location choice and flood protection behavior, and the
management. It was the explicit choice of the authors, in line with the researc
broad and comprehensive questionnaire, addressing a wide range of flood-relate
relation to the role of spatial planning in flood risk management, as illustra
given above.

In September 2014 the survey was distributed amongst residents of actual flood-p
the Water Assessment maps (version 1 September 2014). These areas have recently
flood return period of 100 years with a flood depth of 30 cm. From the populati
1,100 were sampled. Businesses and public institutions, vacant homes and incor
omitted, based on onsite assessment. This led to a sample of 916 active pri
relatively small sample was chosen in order to use the available resources to

possible response rate and therefore better representativeness. In order to max the questionnaire was personally delivered and could be returned on paper and on

We used different explorative methods, including bar charts, chi square tests Subsequently, we analyzed the pairwise relation between variables from the su Spearman s bivariate rank tests for non-parametric variables (such as likert Mann-Whitney tests for dichotomous variables (such as yes/no question). For S correlation coefficients (r_s) and significance level (* = 0.01 < p < 0.05; ** = p < 0.01) a the Mann-Whitney test, the significance level is reported. Some socio-economic survey that did not yield significant correlations were left out.

3. Results

We received 184 completed questionnaires. One response was excluded be double entry, resulting in 183 valid responses (response rate 18.8%). Co of the questionnaire and the relatively small population, this was conside Representativeness of the sample could not be tested because socio-economic dat (residents of actual flood-prone areas) are not available for privacy reasons. the sample can be found in Table 1.

Table 1. Descriptive statistics on the survey sample

		total
N		183
age, mean (standard deviation)		57.0 (15.5)
gender	male	61.2 %
	female	38.3 %
occupation	retired	39.3 %
	non-active	7.1 %
	active	53.0 %
flood experience	none	41.2 %
	without damage	25.3 %
	with damage	33.5 %

Following the research design, the results are discussed in five themes: (1) aw (2) risk perception, (3) location choice and willingness to move, (4) sense o protective behavior and seeds of self-initiative.

3.1 Awareness and knowledge

About two thirds of the respondents are aware that they live in a flood-prone ar the respondents think their residence is not situated in a flood-prone area. Thi with flood experience (p<0.01, Mann-Whitney). This is confirmed by the fact that respondents indicate they were aware of the flood risk when they moved there. Th to the length of residency: respondents that have recently moved were at that ti more aware of the flood risk. However, younger respondents are better aware of f moving (0.01<p<0.05, Mann-Whitney).

However, the knowledge on the flooding issue is rather limited. A bit more tha (57.5%) say they know little or very little about the flood risk. Here again experienced is of significant relevance (r_s=0.16*), but also length of residency (r_s=0.16*) and (r ownership (r_s=0.25**). Respondents that were aware of the flood risk at the time of that they know more about the flood risk (p<0.01, Mann-Whitney). Respondents t

they are living in a flood-prone area however do not necessarily feel that the flood risk ($p>0.1$, Mann-Whitney).

About 80% of the respondents say they know little about measures they can take the knowledge on flood risks, the respondents who have experienced more flood ($r_s=0.26^{**}$) and have lived longer in the same house ($r_s=0.16^{*}$) indicate that they know more about possible m Respondents that know more about flood risks ($r_s=0.51^{**}$) and were aware of the flood risk at th of housing choice ($p<0.01$, Mann-Whitney) know more about measures. However risk not yield a significant correlation ($p>0.1$, Mann-Whitney).

The above suggests that knowledge on flood risks and measures is for a large pa This is confirmed by looking into where this knowledge is coming from (Figure experience, the most important actors that provide information on flood risks ar parties, followed by governmental bodies (especially local governments) and b relative importance of these actors in information dissemination is generally t and possible measures, with the exception of the differences between civil part smaller for information on measures.

Although over half of the respondents (59.2%) know the water assessment maps, o respondents (36.9%) know the correct classification. Only18.7% of the respondent water assessment maps, which is nevertheless most of all information sources (e conversation, brochure or newsletter). Also the governmental website with infor reaches 13.7% of the respondents, which is similar to informal conversatio information.

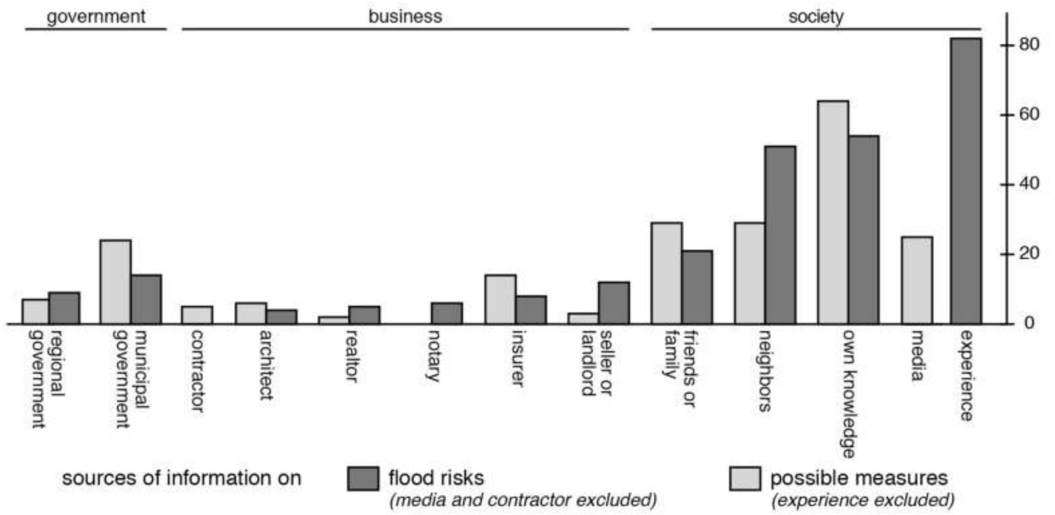

Figure 2. Sources of information on flood risks (a) and measures (b), measure respondents that have accessed these sources.

3.2 Risk perception and experience

Around half of respondents (55.6%) indicate not knowing when the next flood wil (21.3%) think it will be in less than 5 years, and another fifth (19.1%) betwee respondents live in areas that have a modeled return period of 100 years (or les at least 30 cm, these answers might indicate that there is no real underestimat but rather that there is a great uncertainty or lack of knowledge on the fl significant difference between the estimation of the current expected flood freq flood frequency in 2050 ($p>0.05$, Wilcoxon Signed Ranks test). This indicates tha expect a substantial increase in flood frequency.

The emotional impact from the flood risk is analyzed for three different aspec
worrying. About 40% indicate that they suffer from these emotional impacts. T
emotional impact is fearing floods (m=3.02 on a 5-point Likert scale, s.d.=1.47
the flood risk (m=3.00, s.d.=1.41), while suffering from the flood risk is p
important emotional impact (m=2.64, s.d.=1.45). All three emotional impacts (
worrying) show similar patterns of association with other variables. Signific
found with the age of the resi$_s$=0.28**, resp$_s$=0.22** and d$_s$=0.20**), flood experience
($resp_s$=0.61**, $_s$=0.45** and $_s$=0.43**) and risk awareness ($p<0.00$ for all three va
However, only for suffering correlations were found with kn$_s$=0.25** on the flood
suffering and fear also associations were found with len$_s$=0.22** and
r_s=0.20**) and state of resi$_s$=0.26** and $_s$=0.19**).

Subsequently, the impact of flooding in terms of the way different types of dama
respondents (with flood experience) was examined (Figure 3). Emotional impacts
effort to clean, and the uncertainty, fear, shock and helplessness appear to be
frequent impacts. More temporal effects, such as the difficult accessibility and
life are frequent, but less disruptive. However, more long-term effects such
negotiation with insurance companies and contractors, and financial and materia
to be less frequent, but very disruptive. These findings largely correspond
Gutscher (2008) have observed. However, it is remarkable that in this case fina
as quite hindering, which is not in line with Siegrist and Gutscher s obser
impacts are greater than material and financial ones.

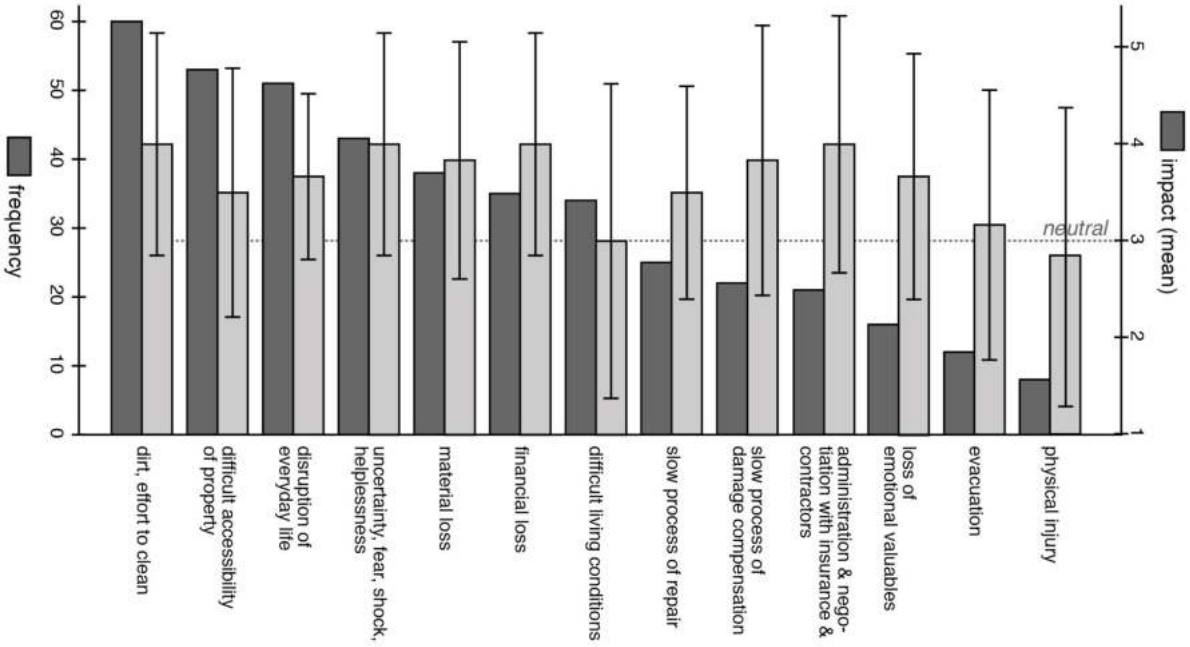

Figure 3. Frequency of different damage aspects (a) and perceived impact of diff
(b). The response categories for this question inspired by the findings from S
(2008).

3.3 Location choice and willingness to move

The respondents like living where they reside: more than three quarter of respo
their home and 60.7% are planning to spend the rest of their life there, while o
away within five years. Respondents who know more about flood risks more often
they live$_s$=0.18*) and plan on staying the$_s$=0.24** longer. Besides that, mainly non-floo
related variables play a significant role. The pleasure of living is associat

residence (r_s=0.22**) and income (r_s=0.20*). On the other hand, desired future length of r
correlated with ownership (r_s=0.32**), how long respondents have lived there (r_s=0.33**) and age
(r_s=0.33**). It is remarkable that respondents with experience of flooding do no
the idea of staying, as no significant correlation for these variables was found

The overall satisfaction with their home is confirmed by the fact that only 14%
their choice of location. There is a strong correlation (r_s=0.49**) with flood experien
respondents that regret their location choice have experienced floods. However,
having regrets correlates with the pleasure of living (r_s=0.38**) and the state of the reside
(r_s=0.22**), but not with the intended length of residency: respondents that regr
are not planning to move away faster. Respondents that were not aware of the flo
of their location choice, also regret having decided to live there more often (0

The question comes up why respondents live in flood-prone areas. The main motiv
choice are non-water related factors, such as accessibility, proximity of facili
residence and social ties with the area (Figure 4a). These are far more importan
to the location in the flood-prone area, such as proximity of water or possibly
So there is no clear link between location choice and flood risks. On the other
environment is an important attractor as well, but it is unclear whether this is
flood-prone area, or rather to the broader (rural or suburban) environment.

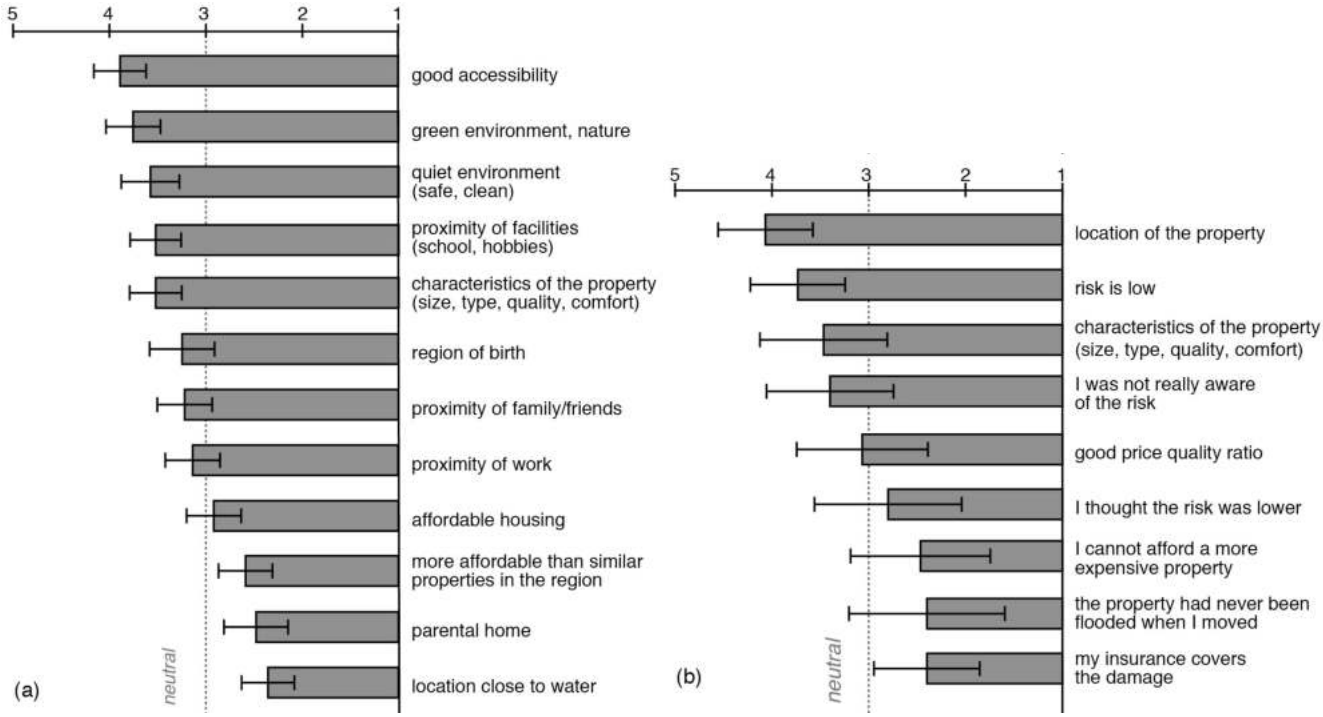

Figure 4. Reasons for housing choice in general (a) and for respondents aware
moment of housing choice (b), measured in mean score on a 5 point Likert scale,
95% CI

For respondents that were aware of the flood risk at the moment of locatio
considerations for their location choice are that the risk is low on the one ha
and characteristics of the residence are favorable on the other (Figure 4b).
desirable from a flood management perspective, such as misjudgment of flood
insurance and financial deprivation are of less importance. This might indicate
for respondents aware of the flood risk is well informed. However, it is possib
be higher than expected and issues could emerge in the near future.

In line with the finding that respondents like to live where they live, the des
low: 5.4% want to move, while 85.5% do not want to move. The desire to move i
flood experience (r_s=0.27**) and risk awareness at the moment of location choice (0.01
to the state of the environment (r_s=-0.17**). Also the willingness to move (as a flood protecti
is low: only 10.8% are willing to move, while 89.2 % are not willing to move. T
correlate with risk-related variables such as knowledge or flood experience, bu
related variables such as age (r_s=-0.21**) and length of residency (rs=-0.19*): the you
respondents and the shorter they live there, the more willing they are to move.
and willingness to move away is associated with high emotional attachment (r_s=0.22**) for respec
suffering (only desiring to move, r_s=0.37**), and r_s=0.29** for fearing, r_s=0.37** and r_s=0.29** for
worrying, r_s=0.59** and r_s=0.38** for regretting their location choice.

When asked after how many floods respondents might want to move, 40.5% of respo
that they would never move due to flooding. Surprisingly this persistence corr
flood experience (r_s=0.25**). This means that respondents with flood experience are m
in wanting to stay there than respondents without flood experience. These are
with the highest knowledge on risks (r_s=-0.22**) and measures (r_s=0.31**), and the respondents that
have lived there longest (r_s=0.28**).

Parallel to the considerations of respondents aware of flood risks at the moment
main reason why respondents do not want to move is that the risk is low (Figure
second most important reason is that the respondents can live with the flood ris
a certain acceptation of the flood risk, although again, it is possible that
Notwithstanding the low desire to move, 20.1% of respondents indicate that if
would be at least partly because of the flood risks, and a third of the respon
they would move to a similar residence outside of the flood prone area if it wou

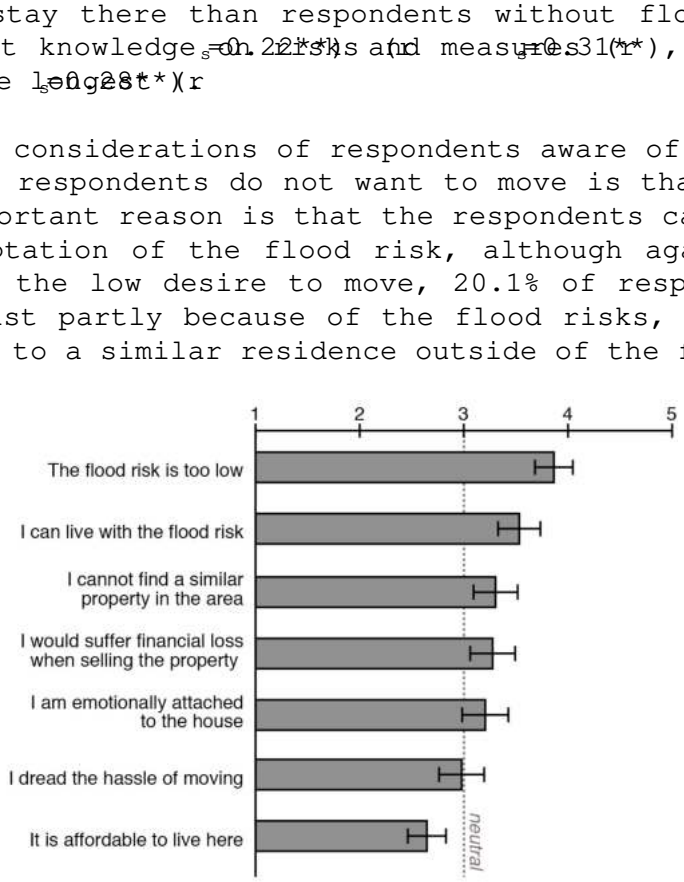

Figure 5. Reasons not (willing) to move, measured in mean score on a 5 point Li
indicate 95% CI

Thus, the attachment of respondents to their homes is rather associated wit
variables, such as socio-economic and real estate characteristics, while flood
not necessarily reduce this attachment. Also the willingness to move seems to
economic variables, rather than flood risks.

3.4 Sense of responsibility

The respondents consider the government (both local and regional) to be the mai
existing flooding issue, while they perceive the residents to be least respon

remarkable that there is a large consensus on this: the vast majority of respon
with the statement that the government is responsible for the existing problems,
with the statement on residents being responsible for the existing problems.

The extent to which different actors are expected to be able to help in resolvi
shows a similar pattern: 89% of respondents also deem the government to be respo
the issues, while only 19% believe that residents can help resolving the issues.
respondents wish to be involved in finding solutions to the flooding issue.

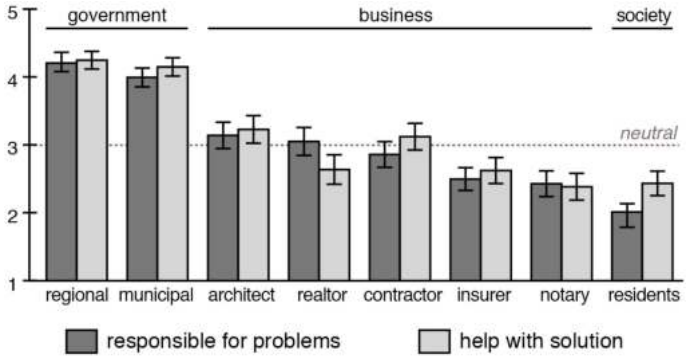

Figure 6. The extent to which different actors are responsible for the existing
help solving problems (b), measured in mean score on a 5 point Likert scale, er
CI

In relation to location choice and flood risks, 70.6% of respondents agree with
authorities have allowed me to come and live here, they are responsible to
flooding , while only 19.5% of respondents agree with the statement I have m
responsible to protect myself against flooding . This is quite remarkable con
regional zoning plans originally did not sufficiently take flood risks into acco

So the government is perceived as the leading actor in both causing and solving
respondents see only a limited role for themselves. However, the extent to whic
themselves to be responsible for the existing problems and can help in resolvi
with knowledge on flood risks (r_s=0.28**, respectively r_s=0.18*) and knowledge on measures (resp.
r_s=0.19* and r_s=0.30**). High levels of knowledge are thus associated with a hi
responsibility. Also risk awareness at the moment of location choice is of rele
were aware of the flood risk at the moment of location choice put less responsi
problems on the government (0.01<p<0.05) and more on residents (p<0.01), while
more often that residents can help in resolving the issue (p<0.01). This indic
knowledge on risks and measures, and risk awareness at the moment of location
responsibility.

When asked to what extent governments and residents take sufficient action
respondents indicate that they themselves take sufficient action while only 30%
does so. This is associated with flood experience: respondents with flood exper
that the government is not taking sufficient action (r_s=-0.19**) while they themselves do so (r_s=0.26**).

3.5 Protective behavior and seeds of self-initiative

About a third of respondents indicate they have taken initiative to inform them
risk and the measures they can take. These respondents indicate that they know
risk (p<0.01) and the possible measures they can take (p<0.01). Information-seek
risks seems to be inspired by risk awareness at the moment of location choice
information-seeking behavior on measures is related to flood experience (p<0.01)

A bit less than half of respondents (43.4%) are willing to take measures against that are willing to take measures have more often sought information on risks possible measures (p<0.01). The willingness to take measures is also associated (r_s=0.33**) and knowledge on measures (r_s=0.27**). Considering under which conditions respon would be willing to take measures, we see that an increased flood frequenc incentives such as subsidies, tax reduction and practical support are most pre low score for the option if the rest of the neighborhood does this as well inc collective action.

If we look at what type of measures the respondents are willing to take, it is low-cost and low-key measures are preferred (Figure 7b). However, it is remark action scores high, especially since the previous results showed little belief capacities in dealing with flood risks.

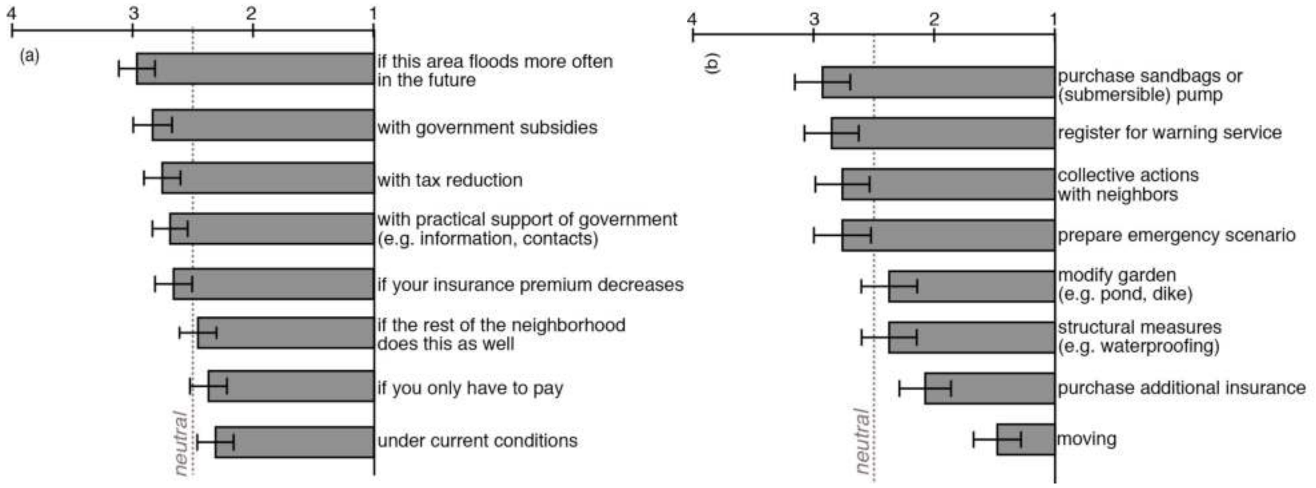

Figure 7. Willingness to take measures to reduce flood damage under different c type of measures (b), measured in mean score on a 4 point Likert scale, error b

Nevertheless, half of all respondents have already taken action to reduce the con Taking action is mainly associated with flood experience (r_s=0.63**): 16.4% of respondents without flood experience, 47,6% of respondents with flood experience without damage respondents with flood experience and damage have taken measures. This indicate is mainly reactive to flooding. Other significant flood-related variables ar (r_s=0.22**) and measures (r_s=0.31**), information-seeking behavior on risks (0.01<p<0 measures (p<0.01), but also non-flood related variables such as condition (r_s=-0.21**) of th and age of residence (r_s=0.27**), and length of residency (r_s=0.34**) play a significant role.

However, the investment in these measures is rather limited: 60% of the respond action, invested less than 500 in these measures. The invested amount is a experience (r_s=0.31**), knowledge on measures (r_s=0.29**) and the extent to which respondents to live there (r_s=0.30**). The most frequent measure is purchasing sand bags or installation) (73%), followed by storing valuables on an elevated spot in the measures (around 30%), while only a small fraction (around 5%) joined a neighb waterproofed their interior, registered for a warning service or purchased an ad again, low-cost and low-key measures are preferred above structural measures observe very little collective action, although the findings above have indic willingness to take collective action. About half of the respondents that have t with the measures they have taken. Nevertheless, only about a third of respo measures protect them sufficiently against flooding and feel more at ease since

The motives to take action (Figure 8a) are mainly flood-event related. We notic
more ad-hoc decisions in the context of a specific flood event, rather than
reasoning. In addition new information appears to be quite unimportant as a mot
So even though our survey has showed strong correlations between knowledge lev
responsibility on the one hand, and willingness to take action on the other, it
itself is not sufficient as an incentive to take action. However, if we lo
respondents do not take action (Figure 8b), we see that the main reasons are
collective action and government responsibility, followed by the consideration
the distrust in individual actions. Personal circumstances were mentioned least.
in collective action again conflicts with observed protective behavior.

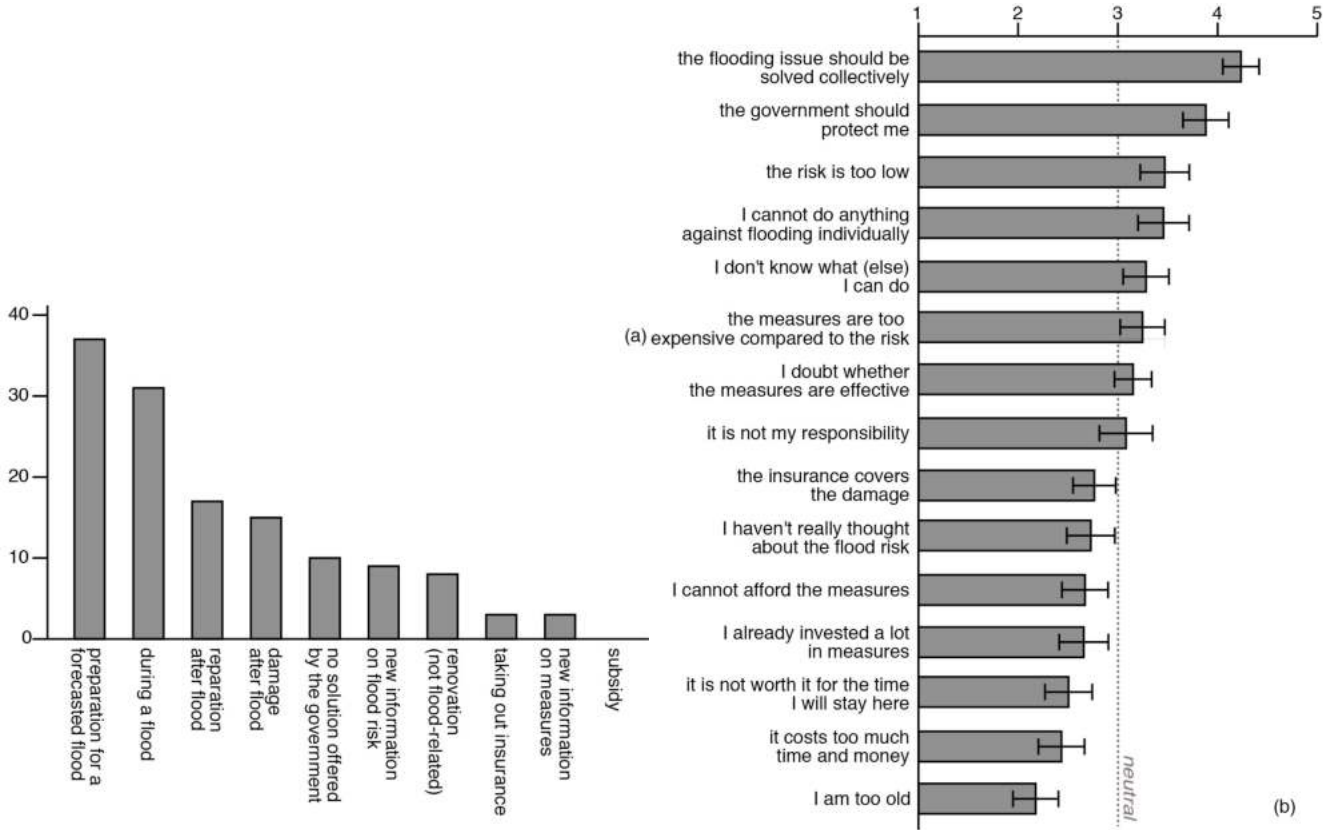

Figure 8. Motives to take action (a), measured in number of respondents, and m
action (b), measured in mean score on a 5 point Likert scale, error bars in

4. Discussion and conclusions

Research in water management and planning often presents the flooding issue as
matter, while the interrelationship with broader social dynamics and institutio
discussed thoroughly. We have therefore conducted a survey that assesses how r
prone areas in the Dender basin (in Flanders, Belgium) deal with the risk to wh
Our survey has probed for the residents knowledge of the flood problem, thei
associated risks, the measures they take, the satisfaction with their home
responsibility. We started from a sample of households whose residence is design
area in official maps. This research base is interesting since Belgium is kno
position in steering development (Boussauw and Boelens, 2015, Verbeek et al.,
neighboring countries such as the Netherlands. This context would suggest tha
active role in flood risk management. However, very little efforts have been
activate residents in flood risk management, as opposed to for example the Un

would suggest that residents included in our research would show a relatively awareness and responsibility, and would not be inclined toward self-initiative.

This hypothesis has largely been confirmed. A large majority of residents ar informed, have little or no intention to relocate, and strikingly often impose risk they run on the authorities. Residents do not really see themselves as bei do not believe they can actively contribute to managing flood risks. Neverthele action, but these actions are low-key, individual and ad hoc. So far, recent gov as publishing and regularly updating flood risk maps, adjusting insurance polic mandatory notification on flooding issues when a house is sold, seem to bring li

These findings represent a clear connection with the Belgian institution of re area-wide set of land use plans that are in force since the seventies and dis which in principle could be developed, and zones that are intended for agricul (and where construction is, in principle, not allowed). Although these plans hav managed to keep some open space areas free of any construction, they also impli build on land that was actually never thoroughly evaluated as being appropriat Therefore, today a number of flood-prone areas are still considered to be const by owners, developers and residents, while the responsibility to keep the lot c the house on it as well) is placed on the government.

A number of measures that are currently being taken by the government, aim at i and raising awareness and sharing responsibility between governments and citizen in the future these will contribute to improved control of the flooding issue. (2001) state that increased knowledge does not necessarily lead to declining dam of flood-prone areas may be in denial about the flood risks, and expect to be recent developments in policy-making are looking into the possibilities to loo between a particular land use designation in the zoning plan and the actual rig cases to cancel such existing, although inappropriately awarded development ri still unclear what how these policies will be implemented. Moreover, a st governmental technical protection has proven to be counterproductive in te community refusing responsibility. Therefore, we should also look at the unin common protective policies. In the context of budget cuts and uncertain clima growing need to rethink this position.

This research contributes to this discussion. On the one hand policy-making sh what residents think and do. On the other hand, individual action is framed by even if this is not addressed explicitly. Flood risk management choices generate towards civil society and the way they deal with flood risks through experience long time, flood protection was a governmental activity and flood risks were no account in spatial plans and developments. Dissemination of information has only form and there is very little experience in private flood protection measures. transition towards citizen responsibilization does not comply with the p responsibilities in flood risk management, and therefore, this discussion needs

From a resilience stance, one cannot expect that residents are spontaneously sel deal with flood risks has co-evolved with a flood risk management paradigm t importance to a technical, top-down approach. The shift towards more resident i needs to be openly addressed and supported in all aspects of the interactions risks. In this light, the survey provides some promising results. Respondents a their current homes, and civil parties play an important role in knowledge disse there is quite some confidence in the power of collective action, although cu seems to be lacking to put this into practice. These elements can be interpret could lead to more resident involvement and active contribution in flood risk conditions of appropriate support.

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