



Bottom-up citizen initiatives in natural hazard management: Why they appear and what they can do?

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ABSTRACT

In the face of increasingly frequent and severe extreme weather events due to climate change, merely top-down governance approaches are increasingly found inadequate and ineffective. Recent climate change adaptation policy strives to promote bottom-up, citizen-driven initiatives to improve local resilience. How and under what conditions citizens may engage in collective action remains unclear, however. We employ a mixed-methods approach in Eastern Tyrol, Austria, combining stakeholder workshops with a survey of 216 citizens at risk. Results show that bottom-up citizen initiatives can provide multiple benefits, such as increasing risk awareness and local adaptive capacities. While citizens are open-minded to assuming a broad range of activities and responsibilities, local stakeholders in natural hazard management prefer to limit civic engagement to support roles, mostly during recovery from a natural hazard event. Citizen initiatives tend to emerge in communities with weak institutional capital. This may lead to conflicts with existing institutions over allocation of competences and power. Contrastingly, social and human forms of capital support the formation of initiatives; however, low willingness of citizens to assume leadership positions may be a bottleneck for sustained initiatives. Public administration and emergency organisations should address current institutional barriers. They should empower and allow citizens to act autonomously.

1. Introduction

Recent developments clearly show increasing risk of extreme weather events. Despite considerable efforts to reduce disaster risk by using technical solutions, losses due to hydro-meteorological hazards remain significant (Ashley et al., 2014; Fuchs et al., 2017). As a consequence, political and academic discourses revolve around making citizens more resilient against possible future events. Improving the preparedness of modern societies, in particular by expanding on technical solutions, raises multiple questions regarding who is involved in the decision-making process and how to address issues of procedural justice, accountability, legitimacy and power.

Leveraging cultural and socio-economic change to increase resilience implies a need for current policy discourses to be transformed towards a new understanding of the roles of citizens and public administrations in natural hazard management (Thaler and Levin-Keitel, 2016; Mees et al., 2017; Maskrey et al., 2018). The current debate calls for a gradual shift from the ‘classical’ practice employed in past decades that limited vulnerability assessments to physical assets and risk management to top-down technical protection (Wisner et al., 2004; Fuchs

et al., 2017). These evolutionary shifts can occur reactively (such as after a natural hazard event) or proactively (in advance) (Kates et al., 2012; Thaler et al., 2019). Transformative change typically develops as a long-term process, which provokes an extensive change to current institutional settings, including legal frameworks, administrative practices, institutional duties, common norms and individual behaviour (Feola, 2015; Few et al., 2017); to this end, local stakeholders, especially citizens at risk, should have a stronger position in decision-making.

Bottom-up citizen initiatives (BUIs) are an emergent option for involving and engaging citizens in natural hazard management (Seebauer et al., 2018). BUIs are defined as community-based civic action groups organised by private households. BUIs may contribute to all stages of risk management: prevention (e.g. co-designing hazard maps and land use regulation), protection (e.g. implementing structural defences at focal points), preparedness (e.g. conducting emergency exercises), response (e.g. sandbagging and evacuation) and recovery (e.g. cleaning up and distributing donations). Regardless of whether BUIs are initiated by the local administration or grow out of grassroots protest, they encourage a responsibility shift from the authorities to the citizens (Mees et al., 2017).

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BUIs are often seen as controversial. On the one hand, stakeholder engagement might result in various conflicts between public administration and citizens (Haughton et al., 2015). In anticipation of conflict, some political strategies are oriented towards marginalising stakeholders instead of providing spaces to engage and interact (Tseng and Penning-Rowsell, 2012; Begg et al., 2018). However, BUIs are criticised for lack of procedural justice if only certain groups stand to gain from the new circumstances and those less politically outspoken cannot participate equally in decision-making (Thaler and Priest, 2014; Cloutier et al., 2018). On the other hand, BUIs develop innovative risk management solutions that clearly go beyond mainstream approaches (Thaler et al., 2019). BUIs may bridge the gap between centralised institutions and individual citizens by enabling citizens to express their interests in decision-making process (Seebauer et al., 2018).

Implementing non-structural risk management strategies into the politics of natural hazards has made stakeholder engagement noticeable in ongoing policy discourses (Tseng and Penning-Rowsell, 2012; Buchecker et al., 2016). Citizen engagement increases—in some cases—individual risk awareness, perception and even preparedness for future events (Poussin et al., 2014; Dittrich et al., 2016; Mees et al., 2016), as well as encourages public legitimacy and acknowledgement of natural hazard measures and activities (Alexander et al., 2018). Nevertheless, participatory processes require additional resources from public administration (in terms of information, funding etc.), as the objective of the engagement is to develop and implement a common solution for the community (Thaler and Priest, 2014; Thaler and Levin-Keitel, 2016). Key challenges in participatory practice are: which information (and how) is shared with broader parties, what is done with the outcome and how does the outcome ensure accountability or legitimacy. Underlying these challenges is the issue of redistributing or sharing power. Power comes from whoever formally or informally influences, excludes or includes stakeholders and BUIs in decision-making. The possession of power greatly depends on the position from which each stakeholder enters the policy debate (Thaler and Levin-Keitel, 2016). Power may be considered a mechanism by which to transform decision-making in natural hazard management (Begg, 2018).

Involving a large array of stakeholders often calls for the development of new governance structures within the current institutional framework (Cloutier et al., 2018). BUIs can act as a bridging structure to encourage and arrange stakeholder engagement in natural hazard management (Seebauer et al., 2018); however, endorsing engagement in terms of collaboration (overcoming institutional reluctance) and capacity-building (providing knowledge and expertise at a local level) may overstretch current governance arrangements (Tseng and Penning-Rowsell, 2012; Thaler and Priest, 2014; Maskrey et al., 2018). In particular, highly heterogeneous communities create clumsy solutions for natural hazard problems (Hartmann, 2011). In an ideal situation, BUIs cluster individual interests, views and possibilities within a common group and then facilitate the integration of those topics into local management plans and strategies (Thaler and Levin-Keitel, 2016; Seebauer et al., 2018).

A community at risk from natural hazards may draw on a range of resources (Tierney, 2014; Mees et al., 2016). We argue that the availability or lack of resources, or in other words, forms of capital, provides the initial setting for BUIs to form (Gil-Rivas and Kilmer, 2016). *Institutional capital* encompasses the administrative procedures carried out and organisational structures provided by regional governments and civil services (Adger, 2003). In the context of natural hazards, this includes building permits, technical solutions, emergency routines or support payments for reconstruction after a hazard event. *Social capital* describes shared norms, trustful relationships and reciprocal assistance within a community (Norris et al., 2008; Aldrich and Meyer, 2015): here, supporting the evacuation of people and property, providing

immediate aid until emergency organisations arrive or helping in clean-up and repair. *Human capital* refers to the assets, skills and attitudes a household commands for tackling natural hazards and for effectively contributing to a BUI (Abramson et al., 2015; McEwen et al., 2018): personal affluence, risk awareness, technical training, negotiating skills, and so forth.

Although often intangible, these forms of capital are critical for natural hazard management (Kuhlicke et al., 2011; Aida et al., 2013). As BUIs are intended to transform the status quo, it seems reasonable to assume that the availability of certain capital offers fertile or infertile ground for BUIs to emerge. BUIs are better sustained in areas well-endowed with human and social capital (McEwen et al., 2018). In particular, social capital can be expected to play a major role as it improves citizens' access to physical and informational resources, increases their say in policy decisions, and ensures that spontaneous help during the hazard event is transformed into support structures that persist after the immediate threat has passed (Vallance and Carlton, 2015; Gil-Rivas and Kilmer, 2016).

Availability of institutional, social, and human capital cuts both ways in regard to BUI formation: a trusted and respected government may invite the citizenry to collaborate (Adger 2003), or dysfunctional institutions may push frustrated residents to step in (McEwen et al., 2018). Strong social networks may facilitate the development of a common cause among neighbours (Gil-Rivas and Kilmer, 2016), or being overly trusting of social support may undermine the perceived need to engage in protective action, such as participating in a BUI (Babcicky and Seebauer, 2017). Personal competencies may enable incremental contributions towards a BUI's purpose (van Zomeren et al., 2013) or may suggest that one is self-sufficient and does not need to team up with others. Similar polarities also appear as resilience versus efficiency rationale in co-producing flood risk management (Mees et al., 2016), and as collaborative versus contractual/confrontational arrangements between citizens and authorities (Geaves and Penning-Rowsell, 2015; Cloutier et al., 2018). Thus, capital should be conceived as a continuum between favourable and adverse conditions for the establishment of BUIs.

Use of the monetary word 'capital' suggests that institutional, social, and human assets may be spent, restored, accrued, and balanced against each other. Different forms of capital may substitute for or complement each other (Adger, 2003; Grootaert et al., 2004; Abramson et al., 2015). In terms of substitution, social capital compensates for institutional shortcomings in natural hazard management (Adger, 2003). The depletion of one form of capital may lead to a downward spiral as other capitals are overextended bit by bit (Abramson et al., 2015). Social capital is associated with various complementary effects, such as facilitation of co-production between residents and institutions (Aida et al., 2013), increase of human capital in the sense of individual self-efficacy (i.e. personal confidence in being capable of protecting oneself; Dittrich et al., 2016), and transforming individual experiences of previous disasters into collective action when the next disaster strikes (Yamamura, 2010); however, unlike monetary transactions, social capital need not be traded off or exhausted. Instead, it is considered to sustain itself: drawing on social capital for pursuing joint activities strengthens interpersonal trust and collective efficacy, which in turn raises social capital (Gil-Rivas and Kilmer, 2016). Hence, BUIs need not undermine existing institutional, social and individual capacities for natural hazard management, but may contribute to them in synergy (Adger, 2003).

Despite the extensive debate on the shortcomings and benefits of BUIs, when and where BUIs emerge and which agenda they adopt remains an unguided and unpredictable process. The present paper compares institutional and individual perspectives on BUI formation in natural hazard management for the case of an alpine region in Austria. We analyse which roles and responsibilities public administrations and

citizens are willing to assign to BUIs. The socio-political environment (e.g. existing institutions, their engrained routines, social cohesion, community structures) play a crucial role where BUIs may grow. Furthermore, the aim of the paper is whether BUIs complement or substitute for existing capital or, from the opposite perspective, whether the abundance or absence of specific capital implies conditions that promote or hinder BUI formation. These perspectives are framed by the following questions:

- 1 Which activities can be undertaken by BUIs, and how can those activities be linked to the portfolio of current institutions?
- 2 Under which conditions can BUIs be expected to develop, and how can those conditions be designed to facilitate participatory and collaborative governance?

A mixed methods approach captures the perspectives of stakeholders from qualitative workshop documentation on the one hand, and of citizens and potential BUI members from quantitative survey data on the other hand. By this means, we illustrate the congruent or divergent views those two groups hold on BUIs in natural hazard management. From this, criteria are derived for how to identify communities and governance arrangements with a high likelihood of emerging BUIs.

2. Method

2.1. Study region of Eastern Tyrol

Eastern Tyrol is an alpine mountain region of 50,000 inhabitants in south-western Austria on the border with Italy. Eastern Tyrol shows a long and diverse history of natural hazard events. The largest events occurred in 1965/1966 during the Drava flood, affecting large parts of Austria, Italy and Slovenia, in 1998 when torrential floods mobilised approximately 50,000 m³ debris in the regional capital of Lienz (Hübl et al., 2002), and when the 2013 Felbertauern landslides destroyed approximately 100 m of road section (Pfurtscheller and Genovese, 2018).

The Austrian natural hazard management system is characterised by a strong federal policy with a complex distribution of responsibilities, competences, and financial flows between national, provincial and municipal bodies. Consequently, regulations, policy agendas and management practices are often not harmonised or coordinated between different actors at varying federal levels. Three key actors deal with risk prevention in the Eastern Tyrol region: (1) the Federal Water Engineering Administration, responsible for riverine floods, (2) the Austrian Service for Torrent and Avalanche Control, responsible for mountain torrents, avalanches and rockfall occurring in the upstream catchment, and (3) municipal authorities under the oversight of the provincial administration. The municipal authorities must develop and enforce local land use plans and have the responsibility for developing, training and implementing emergency routines for local events. These management plans are usually enacted in close co-operation with voluntary emergency and relief services, such as Red Cross ambulances or fire brigades. Within the current governance arrangements, no BUIs have formed yet in the study region; however, voluntary emergency services play an important role, as is typical for Austrian communities (Bachner et al., 2016).

2.2. Stakeholder workshops

Four workshops in July 2017 in Lienz and three other alpine communities in Eastern Tyrol involved stakeholders in local natural hazard management, including politicians, officials in civil protection, police officers and representatives of emergency services such as ambulance,

mountain rescue and fire brigade. The number of participants ranged from 4 to 15 people per workshop. Each workshop addressed the natural hazards observed in the respective local mountain environment. The purposive sampling of workshop participants does not reflect the actual prevalence of the respective stakeholder groups; rather, informants holding key roles in local natural hazard management were invited (Harris, 2008). The workshop discussions were transcribed and analysed based on grounded theory (Strauss and Corbin, 1998). The workshops focused on the interests, needs, preparedness and barriers of the public administration and emergency and relief services when collaborating with potential BUIs in their jurisdiction.

2.3. Household survey

From May to June 2018, standardised self-completion questionnaires were distributed as an insert in a regional newspaper issued in Eastern Tyrol. Responses could be returned by post with a prepaid return envelope or entered in an identical online survey. Respondents were invited to take part in a lottery. Overall, 216 valid questionnaires were returned; based on the newspaper's circulation of 14,000 copies, the response rate is 1.5%. The distribution by socio-demographics in the sample conforms fairly well to the overall Tyrolean population, except for the population segments of males, older citizens, homeowners and volunteers in emergency and rescue services, who are overrepresented to some degree (Table A1 in Appendix A). For this reason, results on willingness for BUI participation should be applied to other contexts with caution, as they might be biased by respondent self-selection.

BUI engagement and institutional, social, and human capital are all measured on continuous multi-item indicators, to correct for measurement error of single items. For detailed item wordings and descriptive statistics see Tables A2 and A3. Questionnaire items referring to the same indicator are aggregated to mean indices. Internal consistency is confirmed by Cronbach's Alpha > .7 throughout (Tables A2 and A3). The indices use the same scale as their underlying items. Higher rankings refer to higher availability of the respective capital, except for perceived injustice, which is reverse-coded.

BUI engagement is measured by six indicators covering the scope of potential BUI activities and formats (Seebauer et al., 2018; see Fig. 1): Willingness to engage in a BUI by activities, aggregated to two indicators: (1) co-design and flood warden activities (five items), and (2) emergency response activities (two items). Willingness to engage in a BUI in two specific formats: (3) A preventive BUI conducting emergency exercises, maintaining stores with hazard defence materials (sandbags, pumps, generators, first aid kits, etc.), and monitoring hazard areas. (4) A participatory BUI designing and negotiating risk zones and built structures with the public authorities. In both formats, respondents stated their willingness for being a member (three items) or a leader (one item; Kelly and Kelly, 1994). Results of factor analyses assigning items to the respective indicators are given in Table A4. Furthermore, collective efficacy captures the belief that a BUI will successfully organise joint action and will effectively contribute to hazard protection. Collective efficacy refers to the (5) preventive and (6) participatory format (three items each; Aida et al., 2013; van Zomeren et al 2013).

Institutional capital is measured by three indicators: (1) General institutional capital as participation and fairness in policy decisions (three items; Grootaert et al., 2004), (2) Reliance on public protection as satisfaction with and trust in public natural hazard management (three items; Seebauer and Babicky, 2018) and (3) Perceived injustice as a feeling of personal disadvantage and deprivation of public natural hazard protection (three items; Kelly and Kelly, 1994; van Zomeren et al., 2013).

Social capital is measured by three indicators: (1) General social capital as mutual trust, reciprocity, and contributing to the common

good (five items; Grootaert et al., 2004; Sadri et al., 2018; Wang et al., 2014), (2) Reliance on social support, standing for confidence in receiving sufficient help from community members during a disaster (three items; Seebauer and Babicky, 2018) and (3) Being a volunteer in emergency and relief services (one dummy item; Aldrich and Meyer, 2015).

Human capital is measured by five indicators: (1) Technical, (2) social and (3) political competencies for implementing preparedness actions at one's own home or for effectively participating in a BUI (two, three, and four items, respectively; Cloutier et al., 2018; McEwen et al., 2018 and the factor analysis reported in Table A5), (4) Self-efficacy as the feeling of being capable of carrying out preparedness actions at one's own home (three items; Poussin et al., 2014; Bubeck et al., 2018) and (5) Income to account for personal affluence (one item; Cloutier et al., 2018).

The analysis of the above indices relies on simple Pearson correlation coefficients. This caters to three methodological limitations in our assessment of forms of capital: they are dimensionless quantities not anchored to a uniform metric such as a specific currency, and therefore cannot be added together or subtracted from each other. They are interrelated, which makes their unique influences hard to disentangle (Table A6). Most importantly, the cross-sectional survey does not allow inference of a causal direction from capital to BUI engagement as it offers no more than a snapshot of a historically developed situation; however, capital may be assumed to influence engagement, since the capital indicators refer to the manifest situation and the engagement indicators refer to fictitious BUIs, as no such initiatives currently exist in Eastern Tyrol.

3. Results

3.1. Activities of BUIs

As found in the workshops, public administrators and emergency and relief organisations are quite sceptical of including BUIs in natural hazard management. A key concern is legal liability in terms of who is held accountable if BUI members become injured in the field. Stakeholders doubt the competencies of BUIs compared to existing qualified emergency organisations and local emergency management committees; therefore, stakeholders suggest restricting BUIs to an auxiliary role in support of existing organisations. The interviewees at the workshops stated that the main activities could be: (1) flood wardens (observing water levels in small rivers and creeks as well as inspecting for and removing debris from riverbanks), (2) providing meals for emergency personnel during an event, (3) providing temporary shelters, clothes and food for hazard victims, (4) providing cleaning materials during recovery, and (5) supporting especially elderly and frail neighbours in building repair and reconstruction.

In particular, emergency organisations fear loss of competences, resources and leverage within local decision-making processes; in other words, they fear loss of power. The main reason behind this is that if BUIs become involved in the current natural hazard management process, it is highly likely they will take over activities and responsibility from these emergency organisations. This would certainly shift relationships, activities and power among stakeholders and citizens. On the other hand, workshops showed that stakeholders blame citizens for expressing no or little interest in and willingness to participate in the ongoing natural hazard management actions. This paradox demonstrates that current stakeholders wish for BUIs but only under strict and limited conditions set by those currently in command, rather than

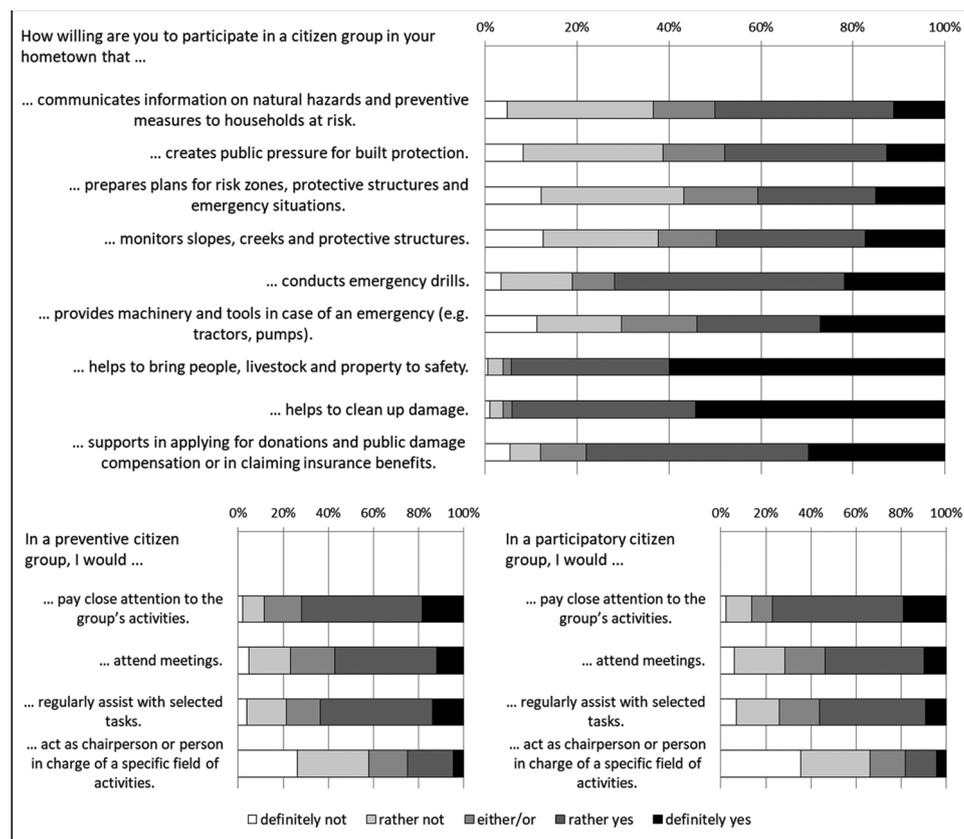


Fig. 1. Willingness to engage in a BUI by activity and format. Relative frequencies on a five-step response scale from 1 = definitely not to 5 = definitely yes.

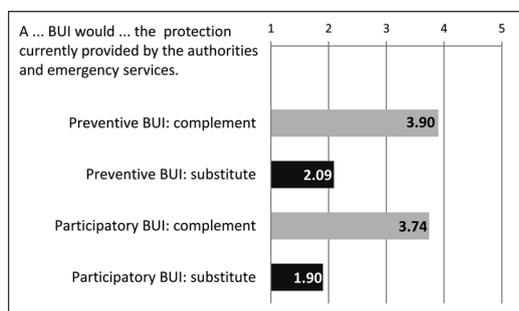


Fig. 2. Citizen responses on BUIs complementing or substituting for existing natural hazard protection.

Means on a five-step response scale from 1 = not at all to 5 = entirely. All mean differences $p < .05$ (preventive BUI: $t = 21.0$, $df = 201$; participatory BUI: $t = 21.1$, $df = 202$).

accepting BUIs as equivalent partners entitled to negotiate their position within the current system.

Contrary to the stakeholders’ reservations, citizens seem open-minded towards being involved in a BUI. Regardless of the specific activity pursued by a BUI, the majority of respondents would rather take part in it than not (Fig. 1, top graph); however, response and recovery roles are preferred over protection and preparedness activities. Almost all respondents would join a BUI effort, particularly in evacuation and clean-up. As a consequence, emergency response activities emerged as a dedicated indicator of BUI engagement in the factor analyses (see Table A4). This reflects the strong social cohesion when in the face of ongoing disaster typical in Austria and many other countries (e.g. Vallance and Carlton, 2015), but also lends credibility to the concerns of emergency organisations that BUIs might push into their field of competence. Still, extending civic engagement to preventive efforts meets with considerable interest from the citizens’ side.

Citizens prefer being a BUI member over being a BUI leader (Fig. 1, bottom graphs). When asked about the depth of their engagement, respondents commit to occasional and limited tasks but are less willing to

take responsibility as a spokesperson or manager of specific tasks. Just a fifth of respondents can imagine being personally in charge. If those potential leaders embrace their management role, however, this might suffice to coordinate the workforce of regular BUI members.

3.2. Conditions for establishing BUIs

As a central challenge for enabling BUI formation, the workshop participants express the need to build a close relationship with citizens in order to motivate them to act. The stakeholders identify three entry points: (1) using the policy window directly after an event to engage citizens, (2) creating and supporting local relationships and fostering neighbourhood communities, and (3) conveying appreciation to citizens. A key question is who takes the lead in promoting citizen willingness to participate. All stakeholders are reluctant to assume this role and instead propose a downscaling process, where the provincial, district and municipal governments transfer this task to a lower political level; however, passing the role of engaging and coordinating BUI down to subsidiary actors implies the risk of this role ultimately ending up in the hands of stakeholders without any of the necessary resources.

In sharp contrast to the concerns expressed by stakeholders, citizens hardly perceive rivalry between BUIs and existing institutions. Both a preventive and a participatory BUI format are expected to complement far more than substitute for the current responsibilities of local authorities and emergency relief services (Fig. 2); however, this collaborative view only holds when asking citizens directly. Inferring the balance between forms of capital and BUI engagement indirectly by correlating indicators paints a more nuanced picture. Generally, the survey results imply that BUI engagement complements social and human capital but substitutes for institutional capital (Table 1; positive coefficients point to BUI engagement complementing capital, negative coefficients point to BUI engagement substituting for capital). Although most correlations between the respective indicators amount to only $r = .20-.30$, this finding emerges consistently across various indicators for forms of capital and engagement.

To some degree, BUIs substitute for lack of fairness and justice attributed to how institutions allocate protective efforts to citizens at risk.

Table 1
Correlations of potential BUI engagement with institutional, social and human capital.

	Institutional capital			Social capital			Human capital				
	General institutional capital	Reliance on public protection	Perceived injustice	General social capital	Reliance on social support	Volunteer in emergency services	Technical competencies	Social competencies	Political competencies	Self-efficacy	Income
Co-design and flood warden activities	-.20	-.10	.26	-.18	.12	.15	.38	.34	.31	.28	.01
Emergency response activities	-.01	.14	-.06	-.02	.33	.10	.37	.27	.06	.24	-.04
Member in a preventive BUI	-.20	-.07	.21	-.09	.18	.05	.33	.36	.29	.25	-.15
Leader in a preventive BUI	.07	-.08	.06	.04	.14	.11	.38	.31	.46	.31	.07
Member in a participatory BUI	-.07	-.16	.31	-.05	.06	-.06	.23	.39	.31	.14	-.08
Leader in a participatory BUI	-.02	-.19	.21	-.06	-.02	.09	.31	.34	.42	.16	.15
Collective efficacy of a preventive BUI	-.14	-.01	.16	-.13	.20	-.08	.24	.25	.25	.14	-.14
Collective efficacy of a participatory BUI	-.10	.02	.09	-.06	.15	-.04	.23	.28	.27	.06	-.05

Pearson correlation coefficients. Coefficients $p < .05$ highlighted. Coefficients indicating complementing of capital: black letters highlighted on grey background. Coefficients indicating substitution of capital: white letters highlighted on black background.

Table 2
Criteria for identifying regions with high BUI potential.

Criterion	Stakeholder perspective	Citizen perspective
Institutional capability	Sufficient capacity to provide timely and comprehensive help to all victims. High trust in citizens' ability to act autonomously.	Low trust in institutional capability. Perceived lack of justice and fairness in allocating protective and relief efforts.
Power relations	Fair power sharing between public administration and citizens	Not assessed.
Policy window	A recent hazard event has raised risk awareness.	Not assessed.
Communication	Established formats and channels to inform and consult citizens on natural hazard-related issues. Citizens receive positive feedback and esteem for contributing to natural hazard management.	Not assessed.
Social cohesion	Local communities have strong neighbourhood ties.	Local communities have strong neighbourhood ties. High expectation of social support during a natural disaster.
Skill sets among citizens	None stated.	High confidence in personal ability to protect oneself from natural hazards (self-efficacy). High technical, social and political competencies for implementing precautionary measures or for coping with hazard impacts. High prevalence of persons with political competencies who could act as BUI leaders.

Perceived injustice in not receiving the public protection deemed necessary seems to make citizens turn to a BUI instead. Similarly, the lower the trust in the safety net provided by protective structures (i.e. reliance on public protection), the higher the intention to demand a say in the design of those structures by joining a participatory BUI. If general decision-making is seen as driven by vested interests (i.e. low general institutional capital), citizens feel inclined to band together for their own preventive action. This mirrors the confrontational mindset of protest groups (Cloutier et al., 2018). A single complementary relation appears, however: higher reliance on public protection is associated with a higher willingness to take part in emergency response activities, possibly because it is understood that even with comprehensive public protection, everybody should pitch in when disaster strikes.

BUIs seem to complement social cohesion specifically in coping with natural hazards. The more citizens rely on receiving social support during a hazard event, the more they are willing to join a preventive BUI and the more they believe that BUIs would effectively improve the current hazard situation. This reflects the reciprocity dimension of social capital: collaboration between the self and the group is more likely if the offered and provided services are similar so that both sides easily recognise the returned value of their cooperation (Norris et al., 2008). If individual and group contributions occur in different areas, the reciprocal relation becomes marginal or even the opposite, as in the negative correlation between general social capital and willingness to engage in co-design and flood warden activities. Surprisingly, being an active member in voluntary emergency and relief services, whose current portfolio includes many potential BUI activities, is mostly unrelated to BUI engagement. Thus, fears of BUIs cannibalising volunteering seem unfounded.

BUI engagement and human capital show a strong complementary relationship. Technical, social, and political competencies, as well as self-efficacy, are significantly and positively related to the various engagement indicators. Citizens seem surprisingly altruistic: although they command the necessary skills and believe in their capability to tackle natural hazards on their own, they are ready to bring those personal assets into a joint BUI effort. Income is largely unrelated to BUI engagement, which differs from previous observations that BUI participants are recruited from better-off social strata (Adger, 2003; Cloutier et al., 2018); on the contrary, lower income makes membership in a preventive BUI more likely.

Willingness to be a member or leader in a BUI is mostly related to forms of capital in a similar manner; however, weak institutional capital encourages citizens to assume membership, but not a leadership role, in a preventive BUI. Perhaps a developed distrust in inclusive decision-making makes people sceptical whether they could do better than the authorities. Political competencies are more strongly correlated with adopting a leadership position than with being a member. Referring to the specific skills summarised as political competencies, then, it seems advisable when recruiting potential BUI leaders to look for candidates who have a business and legal background and who are eloquent communicators.

4. Conclusions and policy implications

Bottom-up initiatives (BUIs) can act as linchpins to coordinate and integrate citizens in natural hazard management. Both sides, public administration and blue light services on the one hand and citizens on the other, demonstrate an interest in collaborating in local natural hazard management. While the current discourse is often restricted to raising risk awareness, the results suggest that promoting BUIs could be a promising approach to capacity building for local resilience against natural hazards. Introducing BUIs can deliver multiple benefits, such as transfers of certain tasks and duties from blue light services to citizens. Citizens are willing to adopt broad responsibilities in all stages of risk management; however, the wider the BUI activity portfolio, the greater the potential for conflict with current stakeholders over issues of power sharing or even over competition in providing community services. Stakeholders' objections regarding competition are, to some extent, justified since, from the citizens' point of view, BUIs may substitute for weak institutions. Public administrations should strive to act within good governance guidelines, as weak institutional capital, like competence gaps between institutions, lack of legitimacy, transparency and accountability, makes the emergence of (protest) BUIs more likely. Some public administrations may be inclined to use BUIs as fig leaves for public participation. However, as BUIs draw on self-reinforcing social capital, it is likely that they will request for extended involvement on the higher rungs of the participation ladder (OECD, 2015) as soon as they have reached critical mass in the policy arena.

Social and human capital support the formation of BUIs. Social capital shapes citizens' ability to align their interests and to organise their efforts within their local community. Individual capacities, such as

knowledge, self-efficacy, or resources make citizens turn to BUIs to put their abilities to full effect. Citizens state that they command the personal competencies and beliefs to contribute effectively in multiple roles. Just assigning support tasks, as some stakeholders prefer, would fall short of their abilities and would leave human capital untapped. When accounting for human capital towards BUI formation in a specific community, special emphasis should be given to identifying and motivating potential BUI leaders, as the low willingness to assume a leadership position may prove a bottleneck for BUI activity. Taking together the limited availability of BUI leaders, and the restricted scope of activities the stakeholders are willing to delegate to BUIs, a minimum BUI would just offer unqualified workforce ready to be called upon by centralised command in an emergency. However, this would fall short of the transformative potential of BUIs. Leader recruitment could target citizens who already have personal experience of heading community efforts or holding elected positions. Notably, existing social and human capital are not undermined but complemented by BUIs in natural hazard management. Thus, social and human capital, as well as BUI engagement, may enter a virtuous circle of reciprocal reinforcement.

Concerns may be raised if BUIs create a parallel system outside the standing political democracy (Thaler and Levin-Keitel, 2016). A further concern is that only wealthy communities may gain from BUI integration, as residents there usually have the necessary educational background, social networks and resources. Here, the key challenge pertains to uncovering hidden agendas from the public administration, blue light services and BUIs, as they usually occur if certain citizens gain direct access to policy makers. Ultimately, the task of including all citizens in democratic decision-making falls back to the authorities and the elected officials. Despite their valuable role in opinion formation, BUIs should not be taken as a convenient substitute for conducting legal hearings and for keeping close contact with the entire electorate.

While BUI activities manifest in their local hazard environment, their actions may affect upstream/downstream communities, leading to positive (e.g. role model learning) or negative (e.g. concentration of resources) externalities. BUIs are more successful if they collaborate across catchment boundaries or band together in umbrella organisations (Seebauer et al., 2018). However, Austrian natural hazard management is largely subsidised to local authorities, so in our study region the risk of BUIs spilling over to neighbouring regions seems rather low.

Results highlight that the initial step for establishing BUIs is to overcome current institutional barriers such as institutional culture (e.g. resisting power sharing or disregarding local knowledge), lack of institutional support (e.g. lack of resources and commitment), or institutional constraints (e.g. lack of or poor communication). Contrasting the stakeholder and citizen perspective (Table 2) underlines that public administrations and emergency organisations should empower and allow citizens to act autonomously. One central contrast between both groups arises regarding the skill sets among citizens. While the citizens themselves have a detailed understanding of the individual capacities needed in a BUI, the stakeholders do not even recognise that specific skill sets might be necessary. On the other hand, both perspectives converge in the crucial role of social cohesion. During the early stage of BUI formation, capacities and resources need to be transferred and built up at the local level. Fair power sharing and fair distribution of information among stakeholders need to be ensured. Bidirectional and continuous communication seems critical, as opposed to momentarily raising risk awareness. Communicative efforts should point out where BUIs could most effectively contribute to natural hazard management. However, in a similar vein to their fear of losing power (see Section

3.1), the stakeholders prefer to avoid a total break with the current policy system, but rather wish to channel BUIs in the existing governance framework (incremental change). Nevertheless, the stakeholders cannot provide a concrete action plan for integrating BUIs into natural hazard management. Note that Table 2 lists only criteria derived from our results; other factors might also support or hinder BUI formation, such as informal access to hydrological, legal and campaigning expertise; or an incumbent regime of unwilling authorities.

Capital has many other facets besides the institutional, social and human capital investigated here; yet, in the BUI context, other forms of capital seem overlapping or hardly applicable. Political capital resembles institutional capital, as the procedures carried out by democratic governments correspond to the political will of their constituents. Economic capital is closely related to human capital, as individual capabilities include financial standing (Abramson et al. 2015). Natural capital, in the sense of ecosystem exploitation, obviously influences natural hazards, for example, in forest cultivation on mountain slopes or in watershed management, but does not play directly into the formation of BUIs. Still, our analysis focuses on the separate impacts of institutional, social and human capital on BUI acceptance. Future studies could analyse the effects if different forms of capital coincide—for example, whether high inter-community trust and personal skills in natural hazard preparedness have not just additive, but multiplicative effects on BUI participation.

It should be kept in mind that the willingness for BUI engagement stated in Fig. 1 refers to behavioural intentions. Although the survey materials were designed and pre-tested to describe the potential roles and functions of BUIs realistically, presumably most respondents had an idealised picture of BUIs as they had never personally experienced or considered being part of BUIs before taking the survey. Similarly, most workshop participants had previously encountered BUIs only as temporary protest movements or not at all. Presumably, the stated intentions for continuous collaboration will only be realised partially, especially if BUIs compete against other options for civic engagement in natural hazards management or in other policy fields.

As a further limitation of the study, the survey sample might be biased from respondent self-selection. In a more representative sample, we would expect higher negative correlations with institutional capital, as the volunteers in emergency and rescue services present in our sample are less likely to criticise the institutions they are part of. We would also expect less pronounced correlations with social and human capital, as volunteers themselves contribute to social capital and have a wider skill set than the general population.

Further case studies would help to address these limitations, could expand the framework for BUI formation presented here, and could illustrate the actual contribution of BUIs to local disaster risk management. We would welcome case study research that not only targets full-fledged, established BUIs, but also looks at small-scale movements struggling in their beginnings, or at temporary BUIs that disbanded after a short time, in order to avoid a skewed perspective on the transformative potential of BUIs.

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Appendix A

Table A1
Sample characteristics.

Characteristic	Categories	Sample	Population
Gender	Female	33.2	50.1
Age (years)	20–40	16.6	36.1
	41–60	37.1	37.0
	61–89	46.3	26.8
	< 1,200	8.0	ca. 25
Monthly net household income (Euro)	1,200–1,800	21.3	
	1,800–2,900	34.5	ca. 25
	2,900–4,400	20.7	ca. 25
	4,400–6,000	13.2	ca. 25
	> 6000	2.3	
Tenancy	Homeowner	85.6	53.8
Volunteering in emergency and relief services	Yes	20.4	5
Hazard experience	Floods, heavy rainfall	29.2	n.a.
	Landslides	12.0	n.a.
	Avalanches	8.1	n.a.
	Rockfall	5.7	n.a.
	Other	5.1	n.a.
Risk zone	None	58.4	n.a.
	Yes	20.2	n.a.

All values given in percentages. Income categories refer roughly to quartiles in the Austrian income distribution. For correlation analysis, income is converted into a metric scale using the respective category midpoints. Some respondents stated multiple hazard experiences; thus, percentages add up to more than 100%. Risk zone = return period of any natural hazard of 300 years or less. Population data refer to the Province of Tyrol (Statistics Austria 2017), except volunteering referring to entire Austria (BMASK 2013).

Statistics Austria (2017). Microcensus Labour Force and Housing Survey, EU-SILC Community Statistics on Income and Living Conditions. Federal Ministry for Labour, Social Affairs, Health and Consumer Protection BMASK (2013). Voluntary Engagement in Austria 2012.

Table A2
Questionnaire item wordings and descriptive statistics on BUI engagement.

Indicator	Item	N	Mean	SD	α
Co-design and flood warden activities	How willing are you to participate in a citizen group in your hometown that...				
	... communicates information on natural hazards and preventive measures to households at risk.	208	3.20	1.14	.85
	... creates public pressure for built protection.	207	3.14	1.22	
	... prepares plans for risk zones, protective structures and emergency situations.	206	3.00	1.29	
	... monitors slopes, creeks and protective structures.	207	3.17	1.32	
Emergency response activities	... conducts emergency drills.	206	3.71	1.08	
	... helps to bring people, livestock and property to safety.	210	4.50	0.74	.85
Other activities	... helps to clean up damage.	210	4.44	0.76	
	... provides machinery and tools in case of an emergency (e.g. tractors, pumps).	206	3.40	1.35	n.a.
	... supports in applying for donations and public damage compensation or in claiming insurance benefits.	209	3.90	1.07	
Preventive BUI format	In a preventive citizen group, I would ...				
	... pay close attention to the group's activities.	210	3.77	0.93	.84 (member)
	... attend meetings.	208	3.41	1.07	
	... regularly assist with selected tasks.	209	3.52	1.06	
Participatory BUI format	... act as chairperson or person in charge of a specific field of activities.	209	2.45	1.21	-(leader)
	In a participatory citizen group, I would ...				
	... pay close attention to the group's activities.	205	3.80	0.96	.88 (member)
	... attend meetings.	205	3.29	1.10	
Collective efficacy of a preventive BUI	... regularly assist with selected tasks.	205	3.33	1.10	
	... act as chairperson or person in charge of a specific field of activities.	205	2.20	1.19	-(leader)
	Collective action in a preventive citizen group would improve natural hazard protection.	207	3.88	0.82	.83
	Through collective efforts, a preventive citizen group would achieve progress in natural hazard protection.	205	3.67	0.93	
Collective efficacy of a participatory BUI	A preventive citizen group would improve natural hazard protection, even if it meets resistance or difficulties.	204	3.78	0.89	
	Collective action in a participatory citizen group would improve natural hazard protection.	203	3.75	0.85	.86
	Through collective efforts, a participatory citizen group would achieve progress in natural hazard protection.	200	3.60	0.90	
	A participatory citizen group would improve natural hazard protection, even if it meets resistance or difficulties.	201	3.68	0.98	

Five-step response scales with endpoints labelled 1 = definitely not and 5 = definitely yes (activities and formats) or 1 = fully disagree and 5 = fully agree (collective efficacy). SD = Standard deviation. α = Cronbach's Alpha. All original items were in German and translated for this paper.

Table A3
Questionnaire item wordings and descriptive statistics on forms of capital.

Form of capital	Indicator	Item	N	Mean	SD	α	
Institutional capital	General institutional capital	Generally speaking, in my hometown, everybody may take part when important decisions are made / ... selected few decide over all others	214	-0.40	1.13	.79	
		... a compromise is pursued when important decisions are made / ... selected few push their own interests	214	0.06	1.11		
		... politicians and authorities act in a fair way according to their best intentions / ... politicians and authorities favour certain people	213	-0.20	1.14		
	Reliance on public protection	Public natural hazard protection in my hometown makes me feel safe.	215	3.73	1.05	.70	
		I trust in good natural hazard protection in my hometown.	216	3.91	0.93		
	Perceived injustice	I can entirely rely on public protection from natural hazards in my hometown.	209	3.75	0.97		
		Public protection from natural hazards in my hometown does not protect me as well as I am entitled to.	216	2.22	1.15	.79	
		I feel angry when thinking about public protection from natural hazards in my hometown.	214	2.08	1.10		
		I am disadvantaged by public protection from natural hazards in my hometown.	215	1.91	1.14		
	Social capital	General social capital	Generally speaking, in my hometown, ... most people can be trusted / ... you can't be too careful when dealing with others	213	0.55	1.18	.83
... most people try to be fair / ... most people take advantage of others if they get the chance			213	0.30	1.16		
... many people are engaged in formal associations or churches / ... only a few people are engaged			213	0.83	1.19		
... people try to make the town a better place to live / ... people hardly bother about the town			215	0.55	1.08		
... people care for each other / ... people primarily consider their own needs			214	0.04	1.21		
Reliance on social support			In a natural hazard event, many people would stand by me. Many people would help me during a natural hazard event.	215	3.82	1.05	.80
Human capital		Technical competencies	In a natural hazard event, I can count on support by others.	215	3.80	0.96	
			Various skills are necessary to implement natural hazard protection alone or as part of a citizen group. How skilled are you in ...	211	3.87	0.89	
		Social competencies	... understanding technical planning documents?	211	0.22	1.27	.69
			... manual workmanship?	212	0.42	1.19	
... working together in a group? ... motivating others?	212		1.14	0.74	.72		
Political competencies	... acquiring new knowledge and skills?	211	0.91	0.82			
	... approaching politicians and authorities in a confident manner?	210	0.83	0.90			
	... identifying and leveraging legal options?	210	0.41	1.17	.79		
	... appraising and accounting for expenditures?	210	0.12	1.06			
	... writing texts for the general public?	212	0.36	1.07			
Self-efficacy	My knowledge and skills suffice to implement natural hazard protection by myself.	212	0.08	1.21			
	I can set up natural hazard protection on my own, even if it is costly and difficult.	216	2.87	1.18	.69		
	I am capable of protecting myself from natural hazards.	214	2.83	1.16			
			211	2.71	1.12		

Five-step response scales with endpoints labelled +2 = positive statement and -2 = negative statement (general institutional and social capital), +2 = very well and -2 = very badly (competencies), and 1 = fully disagree and 5 = fully agree (all other indicators). SD = Standard deviation. α = Cronbach's Alpha. All original items were in German and translated for this paper.

Table A4
Factor analyses of willingness to engage in a BUI by activity.

Item	Factor	Factor
	Co-design and flood warden activities	Emergency response activities
How willing are you to participate in a citizen group in your hometown that...		
... communicates information on natural hazards and preventive measures to households at risk.	.71	.26
... creates public pressure for built protection.	.79	
... prepares plans for risk zones, protective structures and emergency situations.	.85	
... monitors slopes, creeks and protective structures.	.83	
... conducts emergency drills.	.59	.45
... helps to bring people, livestock and property to safety.		.88
... helps to clean up damage.		.91
... provides machinery and tools in case of an emergency. #	.48	.46
... supports in applying for donations and public damage compensation or in claiming insurance benefits.	.33	.58
#		
Eigenvalue	4.25	1.45
Explained variance	47.2%	16.1%
Item	Factor	Factor
	Member in a preventive BUI	Leader in a preventive BUI
In a preventive citizen group, I would ...		
... pay close attention to the group's activities.	.91	
... attend meetings.	.78	.43

(continued on next page)

Table A4 (continued)

Item	Factor Member in a preventive BUI	Factor Leader in a preventive BUI
... regularly assist with selected tasks.	.74	.42
... act as chairperson or person in charge of a specific field of activities.	.21	.95
Eigenvalue	2.63	0.68
Explained variance	65.9%	17.1%

Item	Factor Member in a participatory BUI	Factor Leader in a participatory BUI
In a participatory citizen group, I would ...		
... pay close attention to the group's activities.	.92	
... attend meetings.	.78	.50
... regularly assist with selected tasks.	.77	.49
... act as chairperson or person in charge of a specific field of activities.	.21	.95
Eigenvalue	2.83	0.64
Explained variance	70.8%	16.1%

Principal component analyses with varimax rotation. Factor loadings < .20 omitted. # Item not included in indicator indices.

Table A5
Factor analysis of competencies.

Item	Factor Technical competencies	Factor Social competencies	Factor Political competencies
Various skills are necessary to implement natural hazard protection alone or as part of a citizen group.			
How skilled are you in ...			
... understanding technical planning documents?	.68		.57
... manual workmanship?	.90	.23	
... working together in a group?		.83	.32
... motivating others?		.81	.21
... acquiring new knowledge and skills?		.63	.34
... approaching politicians and authorities in a confident manner?			.81
... identifying and leveraging legal options?			.80
... appraising and accounting expenditures?	.39		.68
... writing texts for the general public?		.32	.68
Eigenvalue	1.14	1.37	3.72
Explained variance	12.7%	15.2%	41.3%

Principal component analyses with varimax rotation. Factor loadings < .20 omitted.

Table A6
Intercorrelations between forms of capital.

	Rel. publ. prot.	Perc. injustice	Gen. soc. capital	Rel. soc. support	Volunteer	Tech. comp.	Soc. comp.	Pol. comp.	Self-efficacy	Income
General institutional capital	.29*	-.31*	.64*	.24*	-.08	-.07	-.08	.08	.03	.14
Reliance on public protection	1	-.53*	.29*	.36*	-.03	.05	-.01	.03	.14*	.03
Perceived injustice		1	-.38*	-.26*	-.01	-.03	-.02	-.04	.01	-.14
General social capital			1	.35*	-.05	-.04	.05	.02	.03	.16*
Reliance on social support				1	.10	.23*	.23*	.12	.28*	.14
Being a volunteer (dummy variable)					1	.28*	.12	.17*	.15*	.01
Technical competencies						1	.37*	.47*	.42*	.04
Social competencies							1	.45*	.32*	.10
Political competencies								1	.26*	.23*
Self-efficacy									1	.14
Income										1

Pearson correlation coefficients. * p < .05.

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