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Disaster risk reduction on stage: An empirical evaluation of community-based theatre as risk communication tool for coastal risk mitigation and ecosystem-based adaptation

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ABSTRACT

The Sendai Framework highlights the need for an all-of-society effort to reduce the societal burden of flooding, with a focus on those being disproportionately affected. In this context, community-based organizations shall contribute to and support public awareness, a culture of prevention and education on disaster risk. Participatory theatre could be a promising means to that end, but quantitative evaluations are currently lacking. We provide a systematic literature review on participatory theatre in the context of natural hazards and disaster risk reduction. Moreover, we quantitatively evaluate to what extent community-based theatre implemented by the Women's Union in Central Vietnam could contribute to public awareness and foster societal engagement. 10 theatre performances in five coastal communes were evaluated using pre- and post-performance surveys among 635 visitors, mainly women. We find that community-based theatre enhanced risk perceptions, perceived flood knowledge, self-efficacy, and the importance of social participation. No significant effect was found on intentions to engage in (collective) risk reducing behavior. We conclude that participatory theatre is an effective risk-communication tool for community-based organizations, which should be embedded in broader activities addressing societal resilience against flooding. Future research should explore the sustainability of the observed increases and the long-term dynamics of behavioral changes.

1. Introduction

While recent research suggests that some progress has been made in reducing human and economic vulnerability to floods over recent decades [23], the societal burden remains high. Between 2000 and 2019, floods killed >100,000 people, caused economic losses of at least 651 US \$ billion, and affected 1.65 billion people [15]. Economic and human losses are likely to be even substantially higher, as for only 35% of all disaster events reported to the EM-DAT database, economic loss figures were provided. Moreover, only events that meet certain threshold criteria, such as ten or more people reported dead, are included in the database [34]. Asia is particularly prone to flood impacts, with a share of >60% in terms of economic losses and fatalities [9]. Also coastal areas are considered hot-spots of flood risk [2,44,58]. On the one hand, they face various types of flood hazards, such as fluvial flood risk in delta areas, pluvial floods, typhoons and storm surges [2]. On the other hand,

coastal zones are commonly characterized by high population density and a concentration of economic activities and human settlements [58], heightening exposure to coastal flood hazards. Small and Nicholls [58] estimated the average population density in coastal areas to be nearly 3 times higher compared with the global average. Moreover, the occurrence and impacts of floods are projected to increase in many parts of the world, and especially in coastal areas due to rapidly changing climatic, ecological, and socio-economic conditions [19,29,32,33,67], potentially jeopardizing achievements in disaster risk reduction and human development [53]. Accordingly, extreme weather and natural hazards are considered among the most likely and impactful risks for humankind in the near future [71], highlighting the urgent need for more resilient societies.

With the Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR), the international community has adopted global policy framework on how to substantially reduce the societal burden of natural

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hazards. The SFDRR aims at a substantial reduction in disaster mortality, the number of affected people, direct economic losses in relation to GDP, as well as damage to critical infrastructure, and disruption of basic services until 2030 [63]. One key aspect highlighted throughout the SFDRR is the unequal distribution of disaster impacts and, consequently, the urgent need for a more inclusive, people-centered disaster risk management that tackles these inequalities. In its preamble, it states that the negative impacts of natural hazards are distributed unequally, specifically mentioning women, children, and people in vulnerable situations as societal groups that are disproportionately affected [63]. This is mirrored in the guiding principles, which emphasize that disaster risk reduction requires an all-of-society engagement and partnership, considering, involving, and empowering especially those that are disproportionately affected. Priority 4 then highlights that women's empowerment to lead and advance gender equitable disaster risk management is key. As far as the role of stakeholders is concerned, it is stated that civil society, including community-based organizations, shall "contribute to and support public awareness, a culture of prevention and education on disaster risk; and advocate for resilient communities and an inclusive and all-of-society disaster risk management [...] ([63], p. 23)."

A promising means in light of the above-mentioned aspects is community-based (or: participatory) theatre.¹ Contrary to conventional theatre performed by professional actors, community-based theatre is produced for and by the community [57]. Being designed by community members who live the issues addressed in the performances, participatory theatre closely links to the social reality, experiences, knowledge and language of the community, making it relevant and easily accessible to the audience and thus an effective means of information exchange and mutual learning [7,22,28,41]. Participatory theatre thus belongs to a group of methods, such as participatory mapping and geographical information systems, community-based early warning systems, and participatory rural appraisal, that all emphasize the importance of the community perspective [28]. Participatory approaches aim to address concerns that external interventions often neglect local voices, memory and indigenous knowledge, imposing external definitions and technical forms of scientific knowledge upon people [5,11]. This, in turn, can have negative implications for disaster risk reduction and resilience, as local knowledge has been shown to be a source of community resilience [2,11,35]. Arts-based approaches, instead, allow for a wider openness towards different ways of understanding that enables communities and participants to build confidence and engagement [12,39].

In the literature, several advantages of community-based theatre are highlighted, as also summarized by Sloman [57]. Among others, community-based theatre enhances the capacity of individuals and the community alike, potentially empowering those involved. As theatre performances are developed jointly by a group of people working together, it can also help to facilitate community cohesion and foster collective capacities for change [28]. By providing a space to express and experiment with different (conflicting) opinions and values, community theatre can help to give a voice to marginalized groups and challenge existing power structures [41]. Community theatre can be fun and entertaining, making it an appropriate tool for audiences that are commonly strongly occupied with sustaining their daily livelihoods [18]. Finally, community-based theatre is considered a powerful tool to support awareness raising and behavioral change, which can also be applied in contexts, in which other communication channels are hampered, for instance, in areas with high rates of illiteracy [41], or lack

¹ In the literature, different terms are used such as participatory theatre, community-based theatre, Forum Theatre and participatory drama. While the terms refer to slightly different concepts and approaches, we use the terms community-based theatre and participatory theatre interchangeably in this article. The use of these terms implies for us that community members themselves are involved in the design and performance of the theatre plays provided to local communities.

of other dissemination channels. While community-based theatre has been applied in a range of contexts such as reducing (gender) violence, ending conflict, and peace-building [1,6,43,46], social work [72], disseminating agricultural practices [41], prevention of HIV/AIDS and tuberculosis [4,48], LGBTQ+ acceptance [51], health care [14,40,59], mental health recovery [62], and education [27,47], it has been rarely applied in the context of natural hazards, disaster risk reduction and resilience, and climate change adaptation (see e.g. [8]). Quantitative evaluations of community-based theatre are largely lacking because the importance of an evaluation is often not recognized, it requires different skills, understandings, and additional human resources [57].

However, given the urgent need to enhance societal resilience, and given the notion that community-based theatre could be a promising means, empirical evaluations are needed and called for in the literature [57]. In this article, we, first, provide a systematic literature review on the topic of community-based theatre in the context of natural hazards, disaster risk reduction and resilience, and climate change adaptation. Moreover, we quantitatively evaluate to what extent community-based theatre carried out by members of the local Women's Union in Central Vietnam can support public awareness, education on disaster risk reduction and ecosystem-based adaptation and foster an all-of-society engagement for more resilient communities, as postulated by the SFDRR. To that end, 10 community-based theatre performances were evaluated using pre- and post-performance surveys among 635 visitors in Thua Thien Hue province, Central Vietnam. Vietnam in general and Thua Thien Hue province in particular are highly prone to floods from different sources such as heavy rainfall, river flooding, and coastal flooding, which frequently cause substantial human and economic losses [49]. The theatre plays focused on various aspects of disaster risk reduction and resilience and ecosystem-based adaptation (EbA), including mangrove restoration and protection. Coastal mangrove forests are one EbA-approach in the area aimed at reducing coastal hazards and extremes. Mangrove restoration was also part of the larger project in which the theatre performances took place and was thus picked up by some theatre groups as one of their topics. Mangrove forests can significantly reduce wave and tidal energy and prevent coastal erosion [16,52,60]. It was recently estimated that, in addition to various other co-benefits such as water and carbon regulation and fisheries, mangrove forests provide global flood protection benefits exceeding US\$ 65 billion per year [42]. Despite these benefits, mangrove forests are under pressure from aquaculture, coastal and agricultural development: the area covered by mangrove forests globally has decreased by 1.04 million hectares between 1990 and 2020, with the good news being that loss rates considerably slowed down in recent years [20].

Our findings provide valuable insights for practitioners and researchers working on capacity building and risk communication not only in the context of natural hazards and climate change adaptation. By providing one of the first quantitative evaluations of community-based theatre in our research domain, we also inform to what extent community-based organizations can employ theatre to contribute to and support public awareness and a culture of prevention and education on disaster risk, as postulated by the SFDRR.

The remainder of this article is structured as follows: [Section 2](#) provides a systematic literature review on community-based theatre in the natural hazards and climate adaptation domain. In [Section 3](#), we describe the quantitative evaluation of participatory theatre in flood-prone Thua Thien Hue province in Central Vietnam, including a case study description (3.1), and a description of the community-based theatre performances (3.2). The survey and research design as well as methods and sample characteristics are provided in [section 3.3](#). [Section 3.4](#) provides results and discussion, followed by overall conclusions in [section 4](#).

2. Community-based theatre in the context of natural hazards, disaster risk reduction, and resilience and climate change adaptation

To understand how community-based theatre is employed in the context of natural hazards, disaster risk reduction and resilience, and climate change adaptation, and to what extent these are empirically evaluated, a systematic literature review was carried out. A search of the Web of Science Core Collection (1900–2023) using the terms ‘community-based theatre’, ‘participatory theatre’, ‘forum theatre’, and ‘participatory drama’ without any thematic restrictions returned 265 articles.² A screening of all titles and abstracts revealed only four journal articles (i.e., 1.5%) directly related to the topics of natural hazards, disaster risk reduction and resilience, and climate change adaptation. Another three articles addressed natural resources management more broadly. To ensure inter-coder reliability, the screening of titles and abstracts of all 265 articles was carried out by two authors independently. Except for two out of 265, all articles were sorted in an identical way. The identified articles, which are summarized in Table 1, were then assessed in greater detail as reported below.

One of the only articles addressing community-based theatre in the context of natural hazards and resilience comes from Brown et al. [8], who report on the contribution of participatory drama and transformative theatre to examine the risk and resilience of coastal communities in Kenya and the United Kingdom (UK). They used participatory theatre as a means to understand what resilience means to different coastal communities across the two cultures and how it can be enhanced. Moreover, it aimed to initiate a dialogue between the two communities in the UK and Kenya and across different stakeholders such as scientists, performers, and governmental agencies [8]. The paper comprises qualitative reflections on the understanding of resilience and the process itself, which were derived from discussions among researchers and actors as well as with stakeholders and communities. Also, the performances themselves were interpreted [8]. As far as the process

Table 1

Articles identified in the systematic literature review on community-based theatre in the context of natural hazards, disaster risk reduction and resilience, and climate change adaptation. It is reported whether these articles provide a qualitative and/or qualitative evaluation of the theatre performances.

Authors	Topic	Region	Evaluation	
			Qualitative	Quantitative
Brown et al. [8]	Coastal hazards	Kenya and UK	yes	no
Fontana et al. [22]	Wildfire impacts on women	Bolivia	no	no
Cole et al. [13]	Wildfire impacts on women	Bolivia	no	no
Schaefer [55]	Climate change impacts	UK	no	no
Pike et al. [50]	Tohoku Earthquake and mental health	Japan	yes	no
Heras and Tàbara [28]	Natural resource management and youth	Mexico	yes	no
Olvera-Hernández et al. [45]	Payments for ecosystem services	Mexico	yes	no
Walsh et al. [69]	Payments for ecosystem services	Mexico	no	no

² The following search-term was entered in the Web of Science on August 28th 2023: ((TS = (“participatory theatre”)) OR TS = (“community based theatre”)) OR TS = (“Forum theatre”) OR TS = (“participatory drama”). The full list of the 265 articles is provided in Annex 1.

is concerned, it was concluded, among others, that telling people’s own stories in their own language was particularly powerful. Another strength observed was that the plays were not limited to cognitive facts but linked to the emotional sphere of the audiences. An empirical (quantitative) evaluation of the performances is not provided.

Fontana et al. [22] and Cole et al. [13] share learnings and materials from a project that used Forum Theatre and social science research in the context of wildfire impacts on women and local communities in Bolivia. They used theatre as a means to gather women’s experiences in the aftermath of wildfires and to initiate a dialogue on the gendered social and cultural politics of wildfires [22]. Interviews with participants, visitors, and community members revealed that women were not only affected by wildfire but also by gendered violence, dispossession, corruption, and extreme inequality in its aftermath [13,22]. A negative effect of natural hazards on the respect for women’s rights was empirically also found by Detraz and Peksen [17]. An evaluation of the theatre plays is not provided by Cole et al. [13] and Fontana et al. [22].

Schaefer [55] provides an analysis of how a community-based theatre company addressed climate change impacts in rural Devon, UK. To that end, Schaefer interprets two pieces (theatre plays) that address climate change, its sources, and potential impacts on local communities. A quantitative evaluation of the theatre performances itself is not provided.

Three more articles did not directly link to natural hazards, disaster risk management and resilience, and climate change adaptation, but addressed natural resource management in a broader sense [28,45,69]. Heras and Tàbara [28] report on the contribution of ‘conservation-theatre’ to support community-based natural resource management of an indigenous community in Mexico with a focus on youth. Based on pre- ($n = 19$) and post-performance ($n = 9$) questionnaires, they provide a qualitative evaluation of the approach, focusing on the perceptions of the participants [28]. Among others, they found that conservation theatre was successful in raising awareness of local conservation issues and “contributed to opening nonconventional, aesthetically rich spaces for new ways of social interaction, diversity recognition, and empathic dialogues ([28], p. 948).” Walsh et al. [69] provide a report on a trans-disciplinary project that combined environmental social science with Forum Theatre methods to explore how rural communities in Mexico understand ‘value’ in relation to payments for ecosystem services. A qualitative evaluation of these activities, based on theatre transcripts and semi-structured interviews carried out one month after the activities were provided by Olvera-Hernández et al. [45]. Among others, they concluded that the emotional connections of the participants with the characters were key to motivating the audience to engage in a dialogue about their own experiences and solutions to problems. Moreover, it allowed the authors to better understand “how values towards nature are inter-connected, shared and constructed in the people’s experiences regarding nature management and environmental decisions ([45], p. 131).” An empirical evaluation of the performances is not provided.

One peer-reviewed article that did not show up in the systematic literature review but was still identified by the authors as relevant comes from Pike et al. [50], who examined a theatre project that was carried out in the aftermath of the Tohoku Earthquake and its cascading impacts. Theatre plays aimed at promoting a discussion and improving the understanding of the mental health impacts of the event, which had killed nearly 20,000 people, displaced 350,000 people, and destroyed 370,000 homes [50]. The plays were developed by community groups, Japanese theatre companies, and mental health professionals and were performed in four locations before professional groups, such as nurses, and individuals affected by the Tohoku earthquake. Each performance was followed by qualitative feedback in a discussion session. Moreover, participants also filled in pre- and post-performance survey forms about their experiences during the event and its aftermath, the relevance of the performance, and their perception of mental health care services and their accessibility. The results from this evaluation are reported qualitatively. Among others, reported outcomes of the performances included

that participants could better understand their own emotional experiences, increased empathy for those affected by the event, and reflected on how to emotionally cope with the experiences. It also revealed existing taboos and discomfort with seeking mental health care. Based on the evaluation, the authors concluded that theatre performances “promoted healing dialogue, healthy coping, and resilience; engendered empathy and understanding of mental health needs among community members; destigmatized help seeking for mental health concerns and assisted people to make connections to local, regional, and national mental health resources ([50], p. 715).”

As the systematic review shows, the application of participatory theatre in the context of natural hazards, disaster risk reduction and resilience, and climate change adaptation is still scarce. A few examples use community-based theatre as a research and risk communication tool [8,13,22]. Quantitative assessments of their effectiveness are not available. The few articles that provide an evaluation do it descriptively and qualitatively. This is in part because the reviewed papers have very different research objectives and purposes which meant that conducting an evaluation was not in line with the authors research design.

3. Evaluation of community theatre as risk communication

To add to the existing literature and to better understand the effectiveness of community-based theatre as a risk communication tool in the natural hazards and adaptation domain, we evaluated theatre plays performed by ten groups in five coastal communes in Thua Thien Hue province, Central Vietnam.

3.1. Case study area

Thua Thien Hue province is a coastal province located in Central Vietnam. It is geographically characterized by mountain ranges to the west, bordering the Lao People’s Democratic Republic, plains, and a coastal lagoon to the East (see Fig. 1). It is frequently affected by severe fluvial, coastal and pluvial flooding and typhoons that cause substantial human and economic losses [49]. For instance, a large-scale flooding in 2022 caused about 56 million USD of economic loss, two people died and four people were injured (Provincial Flood and Storm Control Committee, 2022).³ Key geographic features are the Huong (perfume) River and the Tam Giang Lagoon, whose ecosystem provides important services to >100,000 people directly [65]. In addition to the frequent shocks caused by floods and storms, inequity has generated more vulnerabilities across groups, especially the poor and women who have livelihoods that directly rely on ecosystems [25,31]. Hagedoorn et al. [25] found that lower-income households in both rural and urban areas are facing higher flood vulnerability, exposure, and sensitivity. Also, in this research in Thua Thien Hue, women are considered a particularly vulnerable group to the impacts of flooding ([73]; [31]). Particularly, women experienced higher levels of flood severity, psychological burden and lower recovery rates, as shown by Hudson et al. [31] and Hagedoorn et al. [25].

The community-based theatre performances took place in five different communes (see Fig. 1). Quang Thai commune is located in the northwest of Quang Dien district, occupying a total area of 1811 ha with a population of 5544 people [26]. The main livelihoods of local people are agriculture and aquaculture. This commune is vulnerable to floods, storms, and salinity intrusion that cause damage to properties, livelihoods, and rice fields. Quang Loi commune is located in the northeast of Quang Dien district occupying 3288 ha with a population of 6247 people [64]. This is a low-land area benefiting from the resources of the Tam Giang lagoon, as it possesses an open water surface area. This commune faces flood and storm hazards every year. As an EbA measure, Quang Loi

³ Viet Nam Meteorological and Hydrological Administration [in Vietnamese]; last accessed on 14.12.2023.

commune restored a mangrove ecosystem of about 70 ha. Hai Duong commune has belonged administratively to Hue City since 2021. It is located between the lagoon and the East Sea with a total area of 2513 ha and a population of 6963 people (as of 2020). The residents in this commune have experienced coastal erosion, storms, floods, and drought annually. The commune planted about three ha of mangroves as an EbA measure and set up a nursery site for mangrove seedlings [74]. Phu An commune is located in the northwest of Phu Vang district along the lagoon area with a total area of 1130 ha and a population of 9581 people. This commune often faces losses caused by floods, storms every year. It belongs to the planned new urban area An Van Duong and therefore benefits from upgraded infrastructure. In addition, Phu An has advantages in developing aquaculture as the main livelihood thanks to the large lagoon surface area. Phu Xuan commune is located in the coastal plains in the northeast of Phu Vang district. This commune faces flood and storm hazards. It covers about 3023 ha of land and lagoon surface. The total population of this commune is 7975 people. The main livelihoods in this commune area are agriculture, aquaculture, and fisheries.

3.2. Community-based theatre performances

As part of a larger project focusing on women’s empowerment in disaster risk management and ecosystem-based adaptation, such as mangrove protection and restoration, members of the local Women’s Union at the commune level developed and performed community-based theatre plays jointly with other community members.⁴ A local NGO helped to facilitate the process. The overall communication program aimed to contribute to the capacity building of women in disaster risk management and climate change adaptation and to raise awareness of risk mitigation, climate change impacts, and the importance of local ecosystems for disaster risk reduction and local livelihoods. While the general topics of disaster risk management and the importance of local ecosystems for disaster risk reduction were given, each theatre group could choose their specific focus and develop the content of their play independently, reflecting the very own goal of community-based theatre.

In total 10 groups formed that developed a play. These ten plays were performed in the five coastal communes described above in November 2022. Invitation letters were sent out to members of the Women Union and randomly to households in the respective community, inviting women to visit the theatre performances. Participation was voluntary and free. Men could also join the events. In total, the theatre performances were attended by >700 visitors, mostly women. The plays developed by the ten teams focused on different aspects, including flood impacts, early warnings and evacuation behavior, the importance of (mangrove) forests for flood risk reduction, changes in hazard characteristics due to environmental degradation and climate change, the importance of environmental protection (forests, waste, and pesticides), disaster responses and human safety, as well increased risk of erosion due to sand mining. We argue that, if community-based theatre is an effective risk-communication tool, attendance should enhance risk perceptions, the perceived ability to undertake appropriate risk-reducing actions (i.e. self-efficacy), and the perceived importance of local ecosystems, among others. This is because transferring knowledge on these topics was part of the narrative design of the plays. A more detailed description of each theatre play is provided in Supplement Information 1. Fig. 2 provides several images from the theatre performances and audiences during the performance of the plays.

⁴ The Women’s Union in Vietnam is a socio-political mass organization, which is officially mandated with representing, caring for, and protecting the rights and interests of Vietnamese women. The political structure in Vietnam is organized from top (national) to provincial to district to local (commune) level Waibel and Glück [68].



Fig. 1. Map of Thua Thien Hue province and the four communes, Quang Thai, Quang Loi, Phu An and Phu Xuan, and Hai Duong, where the community-based theatre performances were conducted.

3.3. Survey, research design, methods, and sample characteristics

As highlighted by the SFDRR, disaster risk reduction will require an all-of-society engagement to mitigate impacts [63]. At the community level, where the participatory theatre performances were carried out, the individual and the community level can be directly addressed. Measures taken at the individual level, such as elevating floors, can help to reduce damage from flooding [30]. At the same time, community engagement is needed to implement risk reduction measures at the community level, including EbA measures such as restoring ecosystems [25].

Questions included in a short survey related to factors that are known from the literature to relate to individual protective behavior and community engagement. First, risk perceptions of floods and storms were asked. According to key behavioral theories and empirical studies, a certain level of risk perception is required to make people contemplate about possible response options [38,66,70]. Another factor consistently considered and empirically related to flood protective behavior is perceived self-efficacy, which relates to a respondent's belief to be actually able to implement a protective measure [54,56,66]. According to Protection Motivation Theory (PMT), high risk perceptions need to be accompanied by high coping appraisals such as perceived self-efficacy to result in a protection motivation and ultimately in a risk-reducing response [54]. As far as the motivation for community engagement is concerned, Hagedoorn et al. [24] suggest that the perceived importance of social inclusion plays an important role. Moreover, we elicited the respondent's actual intentions to engage in community activities for

disaster risk reduction (e.g. being part of a task force team, providing emergency relief, or supporting others before or after the flood event) and ecosystem protection and restoration (e.g. clean the neighborhood, plant or protect mangroves, contribute to forest protection, restore water bodies). We also asked about the respondent's intention to implement individual protective measures, such as elevating floors and creating storage capacity under the roof. Finally, a few key socio-demographic characteristics of the respondents were elicited. To ensure that participants can fill in the survey quickly shortly before and after the theatre performances, the questionnaire was kept as short as possible. It was decided that the survey should not be longer than a single double-sided page and should only take a few minutes to fill in. The full questionnaire is provided in Supplementary Information 2. In total, 635 visitors completed in the questionnaire. Variations in the number of observations in the analyses are due to missing values.

To assess the effectiveness of the community-based theatre performances as a risk communication tool, half of the audiences were surveyed before the events, while the other half of the respondents after the events. The assignment of the respondents to these two groups was random, i.e., left and right sides of the community hall, a similarity towards the concept of natural experiments for evaluating the success of policy interventions. We assume that these two groups, i.e., the left and right sides, do not systematically differ in terms of risk perceptions, perceived self-efficacy, and behavioral intentions. Any differences between the 'pre-performance group' and 'post-performance group' are therefore considered as the effect of the community-based theatre performances, due to the absence of individual risk perception baselines for



Fig. 2. Impressions from the theatre plays in the communes in November 2022 © CSRD.

each group.

Differences between the pre-and the post-performance groups were evaluated using a series of separate independent samples *t*-tests. The independent samples *t*-test assesses whether the mean values of the two groups are different. As we apply 10 separate *t*-tests on our data to evaluate the effectiveness of community-based theatre, the familywise error rate increases and thus the probability that we would identify a false positive impact. To account for the familywise error rate, we apply the Bonferroni correction. As we use 10 different tests, we also use $p < 0.005$ as our criterion for significance when discussing our results. Our estimates of significance can thus be considered conservative, but also increasing the chance of identifying a false negative impact.

Given the focus of the project, the leading role of the Women’s Union, and invitation procedures, the majority (87%) of the audience were women from the local communes. The average age of the audience across all performances was 46.27 years, ranging from 18 to 85 years. The coastal rural setting and the majority of women in the audience is also reflected in the professions of the respondents, who reported to be mainly farmers (24.3%), housewife (23.3%), and small business owners (16.1%).

4. Results and discussion

Overall, mean ratings show that flood and storm risk perceptions, perceived importance of local ecosystems, flood knowledge, self-efficacy, and the perceived importance of social participation are high among all participants (Table 2). For instance, with a mean rating of 4.7 on a 1–6 scale, respondents report a high-risk perception. Similarly, high mean ratings are reported for flood knowledge and self-efficacy. All this reflects the high exposure of the study area to floods and storms and thus

Table 2

Overall mean ratings (all respondents) and results from the independent samples *t*-tests, including mean differences between the two groups (before and after), *p* values, and 95% confidence intervals of the difference between the two groups.

Variable	Overall	Mean Difference	<i>p</i> -value	95% confidence interval of the mean difference	
	mean			Lower	Upper
Flood and storm risk perception (n = 621)	4.723	0.493	0.000	0.269	0.717
Perceived importance of local ecosystems (n = 550)	5.333	0.218	0.029	0.022	0.413
Flood knowledge (n = 627)	4.962	0.411	0.000	0.202	0.621
Self-efficacy (n = 623)	4.750	0.720	0.000	0.495	0.944
Social participation (n = 621)	5.008	0.469	0.000	0.259	0.678
Engage in community activity DRR (n = 637)	0.867	0.023	0.3913	-0.030	0.076
Number of days DRR (n = 623)	3.999	0.171	0.6472	-0.561	0.902
Engage in community activity EbA (n = 637)	0.852	0.029	0.2956	-0.026	0.084
Number of days EbA (n = 612)	3.617	-0.218	0.4499	-0.786	0.349
Intention to flood proof (n = 636)	0.728	0.005	0.8992	-0.065	0.074

the experience of how to live with such situations. Even higher overall mean ratings are reported for the perceived importance of local ecosystems and the importance of social participation. The former could relate to the high reliance of the local population of the case study area on local ecosystems. Hagedoorn et al. [25] report that respondents from the same communities largely depend on the ecosystem services of the lagoon for their livelihoods. Also, the perceived importance of social inclusion seems not surprising in the context of Vietnam, which places a high value on collective identity. This is also reflected in a high willingness to contribute to community activities on DRR and EbA. About 87% and 85% of all participants are willing to contribute to DRR and EbA activities, respectively. On average, participants indicated that they would be willing to contribute a maximum of 4 days (DRR) and 3.6 days (EbA) to community activities for at least the next six months. A slightly lower number of all participants (73%) indicate that they plan to undertake an individual protective measure, such as elevating the floor or storing food under the roof (Table 2).

The results from the independent samples *t*-test show that the theatre performances were effective in terms of risk communication. Except for the perceived importance of local ecosystems, all perceptual variables show significant differences between the 'before' and 'after' groups even when applying the more conservative significance levels following the Bonferroni correction (see section 3.3). The perceived importance of local ecosystems shows a significant difference when applying the standard criterion of $p < 0.05$ without applying a Bonferroni correction. Respondents, who had watched the theatre performances reported significantly higher levels of flood and storm risk perceptions than those who were asked before attending the theatre performances (mean difference 0.493; $p < 0.001$). As highlighted above, a certain level of risk perception is considered necessary, according to key behavioral theories such as Protection Motivation Theory (PMT) for individuals to start contemplating possible response options [54]. According to PMT and empirical findings in the literature, high risk perceptions need to be accompanied by high coping appraisals, such as perceived self-efficacy, to result in a protective response [21,54,66]. As shown in Table 2, the theatre performances also increased the perceived self-efficacy of the respondents significantly. People who had watched the performances reported on average a 0.72 higher rating of self-efficacy, which is the largest mean difference among the significant variables. Following PMT, enhanced self-efficacy will enhance protection motivation and consequently the chance for actual risk-reducing behavior. Also, the knowledge of what to do in case a flood event occurs, which also relates to self-efficacy, increased for the 'after' group. In the context of early warnings, studies showed that people who knew what to do following a warning were more successful in reducing flood impacts [37,61]. Our findings are in line with the few existing literature that studied the effectiveness of community-based theatre as a risk communication tool [28,41]. The positive effect of the community theatre on both risk perceptions, perceived self-efficacy as well and knowing what to do in case of flooding is thus promising according to key behavioral theories and empirical evidence in the research domain [54,66]. Finally, the perceived importance of social inclusion is significantly higher for the group that watched the theatre performances. Many DRR and EbA activities are undertaken at a community level and therefore require a joint effort of and contribution from community members. Hagedoorn et al. [24] highlighted the important role of social capital in this context. They found that the perceived importance of social inclusion related positively to intentions to contribute to community adaptation. The results thus indicate that participatory theatre can also contribute to supporting a perception of social inclusion and cohesion, as it has been also proposed by other studies [57].

We did not find significant differences between the 'before' and 'after' groups as far as actual intentions to contribute to DRR and EbA activities and individual protective behavior are concerned. Also, the time contribution that people would be willing to provide did not increase following the theatre performances. This may relate to the fact

that willingness to contribute is already very high among the participants. This makes it likely harder to further increase that commitment through the theatre performances.

The insignificant result for actual behavioral intentions may also relate to the time it takes for respondents to move from awareness to behavioral change, and is in line with common risk communication theories, such as the hierarchy of effects model [10]. The hierarchy of effects model has been applied in the context of health campaigns since the 1980s [36]. It postulates that exposure to a risk communication instrument may translate into behavioral change following a sequence of becoming aware, increased knowledge and understanding, changed attitudes and social norms, enhanced self-efficacy and intention [10,36]. Kite et al. [36] used the hierarchy of effects model to empirically evaluate a health campaign in Australia using longitudinal data and found a clear progression through the proposed sequential process. Also other key theories aiming to predict behavioral changes, such as Protection Motivation Theory and the Theory of Planned Behavior assume a sequential process from risk communication to behavioral change [3,54].

Also, Sloman [57] highlights that theatre performances cannot work in isolation but need to be embedded in broader community, regional and national development efforts. Another shortcoming relates to the fact that we surveyed in the immediate aftermath of the performance but there was no long-term monitoring. On the one hand, it thus remains unclear to what extent the changes in perceptions are sustainable. On the other hand, other effects might not be immediate and easily measurable and would thus also not be detected in our assessment (see above).

5. Conclusions

As highlighted by the SFDRR, an all-of-society effort is needed to reduce the high societal burden of flooding, with a focus on those being disproportionately affected by disasters, such as women and children. Participatory theatre, developed and performed by community members could be a promising means to raise awareness and risk-reducing behavior. Here, we presented one of the first quantitative evaluations of community-based theatre in the context of natural hazards, disaster risk reduction and climate change adaptation. To that end, 635 participants filled in short questionnaires before and after visiting participatory-theatre plays performed by local community members in highly flood-prone Central Vietnam.

We find that community-based theatre is indeed an effective risk communication tool, increasing risk perceptions, perceived knowledge, perceived importance of social participation, and self-efficacy of the audience. Based on our results, we conclude that community-based theatre is a promising tool "*contribute to and support public awareness, a culture of prevention and education on disaster risk [...]*", as postulated by the SFDRR ([63], p. 23). No significant effect was found for actual behavioral changes, such as engaging in joint disaster risk reduction activities. This could be due to the fact that average willingness to participate in community activities was already high from the beginning. Moreover, based on risk communication theories and other literature, we conclude that it may take more time and broader activities so that changes in perceptions are translated into actual behavioral changes. Our results thus suggest that community-based theatre should best be integrated into broader activities on disaster risk reduction, climate change adaptation and empowerment of vulnerable groups. Longitudinal studies, which follow participants over time, could be a promising future research avenue to better understand these longer-term impacts of community-based theatre. Additionally, it would be interesting to understand whether those actively involved in play development and performance are empowered to take a more leading role in terms of disaster risk reduction in their communities, which was not addressed in our research.

During the preparation of this work the author(s) used Grammarly in

order to improve language and readability. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

CRedit authorship contribution statement

Philip Bubeck: Writing – original draft, Visualization, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Thi Dieu My Pham:** Writing – original draft, Formal analysis, Conceptualization. **Thi Nhat Anh Nguyen:** Writing – original draft, Project administration, Investigation. **Paul Hudson:** Writing – original draft, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

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Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pdisas.2024.100323>.

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