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Strong roots, strong women

Women and ecosystem-based adaptation to flood risk in Central Vietnam

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Prepared by:

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ZURICH

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1 Introduction

Flooding is often considered as the most devastating and therefore the most pressing natural hazard to manage through risk reduction strategies (UNISDR, 2011). Between 2011 and 2017 floods accounted for 40% of disaster events, 50% of deaths and 25% of monetary losses from the global impacts of natural hazards[1]. In addition to economic and human losses, floods disrupt livelihoods, communities, businesses and can impact the mental health of those affected (Bubeck et al., 2017). Floods are especially problematic in Asia, where floods and typhoons were responsible for 75% of recorded natural hazard events, 60% of monetary losses, and 50% of recorded fatalities between 1980 and 2014 (Munich Re, 2015). In the future, flood hazards are likely to increase in several regions, including Asia, due to climate change (Hirabayashi et al., 2013; IPCC, 2014).

In addition to the shocks and stresses caused by flood hazards, a number of socio-economic factors commonly aggravate flood impacts in countries of the Global South, such as Vietnam. These factors include the lack of financial means on the part of both individuals and government to handle shocks and stresses (Mirza, 2003), rapid and uncontrolled urbanization putting increasing numbers of people in harm's way (Birkmann et al., 2016), a focus on hard infrastructure, which is often associated with negative environmental and social side effects (Stone, 2016), and the fast disappearance of ecosystems, on which poor and vulnerable people's livelihoods depend (Renaud et al., 2013).

With a great number of people directly depending on ecosystems for their livelihoods and for protection from natural hazards, the Global South in general, and poor and vulnerable groups in particular are likely to suffer disproportionately from environmental and climate change (Mirza, 2003; IPCC, 2012). In addition, investments in flood defences and risk management strategies tend to be guided by benefit-cost decisions, which must often meet or exceed a predetermined ratio (e.g. a project will only go ahead if the benefits are twice as large as the costs). Therefore, when flood risk management strategies are developed they will tend to focus on the more economically developed areas, as the potential impacts will be larger in gross monetary terms, even though the individuals living in these areas may be already more resilient (Mechler, 2016).

The above-listed socio-economic factors indicate that flood impacts are likely to be spread unevenly across society. A group of society that is particularly vulnerable to flood impacts is women (UNISDR, 2008). Their flood resilience (see Box 1) is commonly undermined by disadvantages in social, cultural and political domains, as well as legal status and opportunities (Enarson, 1998; World Economic Forum, 2015; Cutter, 2017; Bubeck et al., 2019). For instance, due to their role as the primary care givers for children, the elderly and sick, women's mobility and ability to seek shelter during a disaster can be reduced. Also, women are more likely to be employed in the informal sector (UNDP, 2013), which is prone to income insecurity and high vulnerability to disasters (Nelson et al., 2002; FAO, 2011), impeding women's recovery after a flood. This gender gap in flood resilience can even result in higher mortality rates among women during severe flood events (Bern et al., 1993; Neumayer & Plümper, 2007).

Box 1: Resilience has become an important guiding principle in disaster risk management and climate change adaptation (Weichselgartner & Kelman, 2015). A commonly accepted definition of flood resilience has not been established due to the complexity of the concept. Definitions of flood resilience commonly build on three interlinked pillars (Thieken et al., 2014): resistance, recovery and anticipatory learning (or adaptive capacity):

- Resistance is the ability to absorb or withstand the impact of a flood;
- Recovery relates to the time needed return to the state before the flood (both physically and mentally);
- Anticipatory learning, or adaptive capacity, refers to the ability to learn about and from (changing) flood events, so that one is better prepared for future flooding.

This is, for instance, embodied in the definition of the US National Academy of Sciences, which defines resilience as „the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events" (The National Academy of Sciences, 2012).

[1] Author's calculation from the data presented in Munich Re Topic Geo reports published between 2012 and 2018. The reports are accessible at: https://bit.ly/2W8dGLu

At the same time, women as important managers of local natural resources and livelihoods have the knowledge and capacity to build community resilience (UNISDR, 2008). Their potential to contribute to disaster risk reduction (DRR) and climate change adaptation (CCA), however, is largely untapped. The urgent need to empower women in disaster risk management (DRM) to reduce the societal burden from natural hazards is also highlighted by the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015). It calls for an all-of-society engagement and partnership to reduce disaster risk, with an inclusive and accessible participation of people disproportionately affected by disasters. With regard to the role of stakeholders, it explicitly states that "women and their participation are critical to effectively managing disaster risk and designing, resourcing and implementing gender-sensitive disaster risk reduction policies, plans and programs; and adequate capacity building measures need to be taken to empower women for preparedness as well as to build their capacity to secure alternate means of livelihood in post-disaster situations" (United Nations, 2015; p. 23). Gender equality is also one of the 17 United Nations Sustainable Development Goals (SDG 5), which aims at ensuring women's full and effective participation and equal opportunities for leadership at all levels of decision making. Moreover, SDG 13 (Climate Action) also calls for action on limiting climate change and its impacts by increasing resilience of the most vulnerable.

In order to increase the resilience of vulnerable communities, integrated risk management strategies that not only focus on reducing flood hazards (the resistance component of resilience), but at the same time also support livelihoods of the most vulnerable and facilitate the participation and empowerment of those disproportionately affected by disasters (the recovery and anticipatory learning components of resilience) are required. Ecosystem-based adaptation (EbA) is such an approach (see Box 2). As EbA is more inclusive and accessible for vulnerable groups of society than hard infrastructure, and because ecosystems support the livelihoods of those directly depending on natural resources, it is also a promising means to strengthen women in DRM (Hagedoorn et al., 2018).

Box 2: Ecosystem-based adaptation

(EbA) can be a cost effective approach compared to structural measures to increase flood resilience of vulnerable communities. According to the Convention on Biological Diversity, EbA "uses biodiversity and ecosystem services in an overall adaptation strategy. It includes the sustainable management and restoration of ecosystems to provide services that help people adapt to the adverse effects of natural disasters and climate change (Secretariat of the Convention on Biological Diversity, 2009)." In the project described in this report, we focused on two community-level EbA measures:

- Restoring and extending mangrove forests in coastal communities of Thua Thien Hue province;
- Restoring traditional urban water bodies and canals in historic centre of Hue City.

Adaptation approaches that address the sustainable management, conservation and restoration of ecosystems are gaining popularity as no-regret options for DRR and CCA. Important international agreements and strategies, such as the Paris Agreement, the Sendai Framework, and the Sustainable Development Goals all highlight the importance of strengthening the link between environmental and natural resource management, DRR, and CCA (United Nations, 2015). At the implementation level, however, ecosystem-based approaches to DRR and CCA are hardly considered by policy makers. For example, the United Nations World Water Development Report 2018 reports that less than 1% of total investments in water resources management infrastructure is spent on nature-based solutions (UN-Water, 2018). One reason for the non-consideration of EbA measures by policy makers, who play a key role in risk assessment and subsequent management (Sjöberg, 2001; Munroe et al., 2012), is that it is often difficult for them to appraise their efficiency.

Here, we report the findings and experiences from a project in flood-prone Thua Thien Hue province in Central Vietnam (see Chapter 2) with the objective to increase the knowledge base on EbA and to strengthen the flood resilience of the most vulnerable. This was achieved by implementing an ecosystem-based approach to disaster risk reduction to enhance community resilience to flooding. The EbA-approach was also used to understand and strengthen the role and participation of women to achieve a more inclusive disaster risk management. The project was part of the Global Resilience Partnership Water Window and comprised the following key activities:

- A literature review of the gender gap in flood resilience (see Chapter 3);
- Implementation of a survey among 1010 flood-prone urban and coastal residents, 500 domestic and foreign tourists and focus group discussions (Chapter 4) to gain insights into the role of ecosystems and flood impacts on individual well-being (Chapter 5), the potential of EbA to support the most vulnerable (Chapter 7), and a cost-benefit analysis of the EbA measures implemented by the project (Chapter 8);
- Implementation of EbA measures in urban (pond restoration) and coastal contexts (mangrove planting) jointly with local communities, the provincial Disaster Management Centre and the Women's Union (see Chapter 6);
- Capacity building of the Women's Union on flood resilience and the importance of ecosystems for enhancing flood resilience (Chapter 6);
- Lively awareness raising events carried out by the Women's Union in urban and coastal communities on flood resilience and the importance of ecosystems, comprising theatre performances and karaoke (Chapter 6);
- Providing training to local women on eco-tourism to create a direct benefit from the implemented EbA measures (Chapter 6).
- Key-informant interviews with local policy makers on the perception of EbA measures (Chapter 9).
- Production of a documentary capturing the perspectives of three women in the project area (see Box 4).

Figure 1: *Local fishing boats in Canh Duong Village, Loc Vinh commune, Phu Loc district (Photo: Duong Quang Tien).*

2 The problem of flooding in Thua Thien Hue province in Central Vietnam

Flooding is a major problem in Vietnam and may account for 50% of the monetary losses due to natural hazards (World Bank, 2010). The high vulnerability of Vietnam results from the fact that 90% of its GDP is produced in areas prone to flooding and 70% of the population lives in coastal areas or low-lying river deltas that are only a few meters above sea-level (Mai et al., 2009, World Bank, 2010).

This project focused on Thua Thien Hue province, which is located on the central Eastern coast of Vietnam (see Figure 2). The province has a population of 1.15 million, of which nearly half lives in urban areas.[2] Hue city was the national capital of Vietnam between 1802 and 1945. Today, it is a UNESCO world heritage site due to its imperial history. The two key hydrological features of the province are the Huong (Perfume) River and the Tam Giang Lagoon.

Both of these water bodies are economically important and nearly a third of the province's residents rely on these ecosystems for their well-being. Approximately 100,000 people rely on them directly as fishing grounds or for water provisioning; while 200,000 rely indirectly on the ecosystem services provided, such as flood protection or coastal agriculture (Van Tuyen et al., 2010).

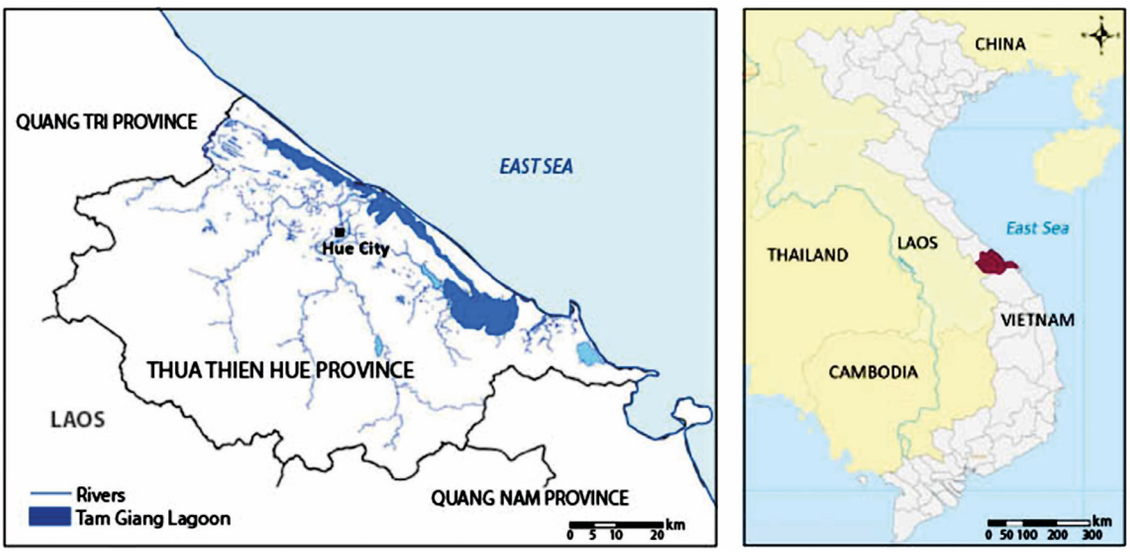


Figure 2: *Map and location of Thua Thien Hue province in Central Vietnam (Adapted from Bubeck et al., 2012).*

The reliance on these ecosystems by a significant proportion of the province's population is also problematic. This is because population growth places increasing pressure on these ecosystem services, while increasing urbanization is promoting the fast disappearance of natural areas across the province (MONRE, 2009). Moreover, the loss of natural areas also increases flood risks due to the loss of natural retention areas and the growing number of people and economic assets in risk prone areas. The rapid urban expansion of Hue city between 1989 and 2017 is depicted in Figure 3. Particularly during the period 2007-2017, urban land uses expanded into low-lying areas along the river and within its meanders. These areas are at high risk of flooding. These problems are likely to be exacerbated by the effects of climate change (IPCC, 2007; MONRE, 2009).

[2] Source: www.thuathienhue.gov.vn, which was last accessed in October 2018.

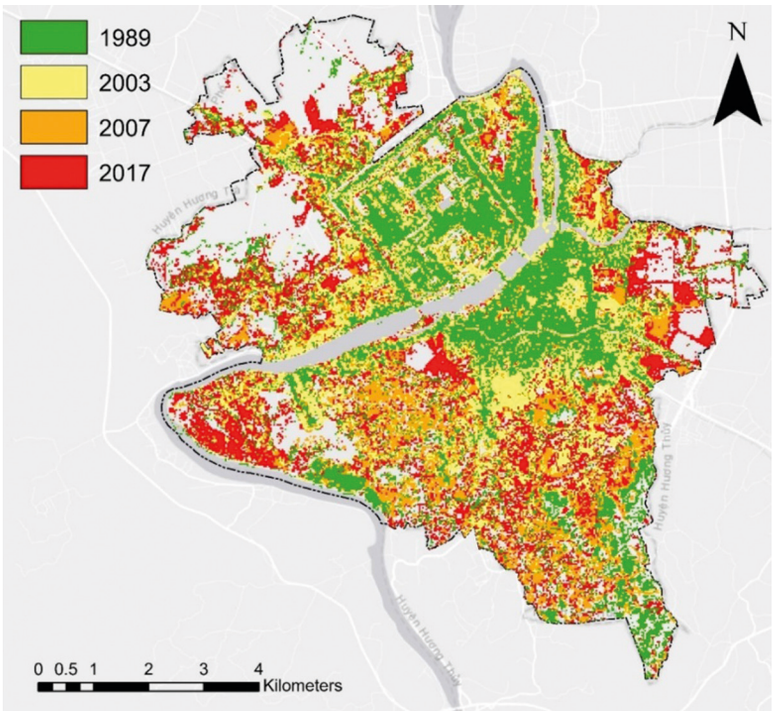


Figure 3: *Expansion of sealed surfaces in Hue city between 1989 and 2017. Image derived from classified Landsat images. Land cover in Hue city was classified into sealed and not sealed. Base-map: Esri, DeLorm, Mapmyindia, OpenStreetMap contributors and the GIS user Community. Source: Dillenardt (2018).*

Thua Thien Hue province is frequently affected by flooding from rivers, heavy rainfall, and the sea. 40 flood events were recorded between 1975 and 2005 (Bubeck et al., 2012). One of the most devastating floods in the recent past occurred in 1999, which inundated 90% of the lowlands and lasted for one week. It killed more than 350 people, washed away 25,000 houses and about 160,000 cattle died (Tran & Shaw, 2007; Tran et al., 2009). The impact this flood had on local communities in urban and coastal areas of Thua Thien Hue province is also captured in the documentary 'All in the same boat' produced in the course of the project (see Box 4). The most recent flood event to affect the province was caused by Typhoon Damrey in November 2017 (see Figure 4). The damage caused by this typhoon in the Philippines and Vietnam resulted in about 110 deaths with a reported total cost of US$650 million in damaged/lost property (Munich Re., 2018).

Figure 4: *Impact of typhoon Damrey in Hue city in October 2017 (Photos: CSRD).*

3 The gender gap in flood resilience

Women in the Global South are disproportionately affected by flooding. They commonly face disadvantages in social, cultural and political domains, as well as legal status and opportunities, affecting all three resilience domains of resistance, recovery and anticipatory learning (see Bubeck et al., 2019 for a more detailed review).

In terms of resistance, which refers to the ability to withstand the danger posed by floodwaters, several studies indicate significant gender differences and report considerably higher mortality rates among women during severe events (Bern et al., 1993; Neumayer & Plümper, 2007; Frankenberg et al., 2011; World Bank, 2012; Frankenberg et al., 2013). Part of these differences may relate to physiological characteristics, such as pregnancy or, on average, the lower body weight of women and thus less stability in flowing waters (e.g. Lind et al., 2004). However, several studies demonstrate that higher mortality rates of women during severe flood events cannot be attributed solely to differences in strength or body size, but are mainly caused by socio-economic and cultural factors (Neumayer & Plümper, 2007). These factors include, amongst others, a reduced mobility during events due to women's traditional role in taking care of children, sick and elderly; women's hesitance to seek shelter in public places due to a lack of privacy and security (Paul, 2009) and that more boys than girls learn how to swim (Hunter et al., 2016).

Also in terms of recovery, which relates to the time an individual needs to return to, or improve, their original pre-flood state, women often face disadvantages. These include unequal access to relief, which may be provided by and to males (Sen, 1988; Ager et al., 1995). Further disadvantages are caused by differences in the division in labour, income and access to resources, hampering recovery. For instance, more women are employed in the informal sector (ILO, 2017), which is characterized by income insecurity and high vulnerability to disasters (FAO, 2011; Ajibade et al., 2013), making recovery more difficult. Moreover, severe flood events can result in increased political and economic instability with negative effects on women's economic and political rights (Detraz & Peksen, 2017).

In terms of anticipatory learning, which refers to the ability of an individual to understand complex information, anticipate, learn and to take appropriate (i.e. risk reducing) decisions (Park et al., 2013; Thieken et al., 2014), women are often systematically disadvantaged due to – on average – lower educational attainment. Globally, it is twice as likely for girls to never start school compared to boys, with girls from poor families having the greatest disadvantages (Filmer, 2005; World Bank, 2018). This disadvantage in anticipatory learning results in higher vulnerability. Striessnig et al. (2013), for instance, conclude that female education is a key explanatory factor of reduced disaster vulnerability.

In the case of Vietnam, a recent study into the role of women in building climate resilience in Thua Thien Hue province confirms the important role that women play in securing the well-being of their families and communities during and after disasters, and, at the same time, their limited influence on DRM decisions (Pham & Lam 2016). Also in the Vietnamese context, women are traditionally responsible for the elderly and children, limiting their mobility during disasters. Their position in the family often means that they are the first to suffer shortages of basic resources such as food, water and electricity (Pham & Lam 2016). Moreover, they are occupied by their domestic duties, and have little room for capacity building or professional development. This hinders them from creating independent financial reserves for managing the impacts of natural hazards in a more resilient way.

But, there is also potential in their position. As caregivers, they appreciate not only their own needs, but also the needs of others within their families and communities. However, while women in Hue play a key role in generating livelihoods, the study also revealed that women do not have a strong role in decision making and are often left out of adaptation and DRM planning. While educational attainment is almost equal in Vietnam, women are considerably underrepresented in political decision making (World Economic Forum, 2017). The reason for this is that women face cultural and educational barriers, and also limited time for community activities. This leads to a male bias in planning and decision-making, resulting in a failure to consider the different needs of women (Pham & Lam 2016). This is also confirmed by the Global Gender Gap Report 2017 (World Economic Forum, 2017), which ranks Vietnam 69 out of 144 countries. Also the Vietnamese National Target Program to Respond to Climate Change does not take gender issues and the high vulnerability of women into account. Accordingly, no funding is allocated specifically for women under the program to enhance their adaptation at the local level. Moreover, existing laws and policies that were developed in Vietnam to promote gender equality are often not translated into gender equitable practice (Pham & Lam 2016).

Figure 5: *Women selling sea food at a local market in Hue city (Photo: René Arnold).*

4 Data collection strategy to inform project activities and to provide evidence-based support for decision making

In order to inform project activities and to be able to provide evidence-based support for policy making, quantitative surveys of 1010 flood-prone households in urban and coastal communities and 500 domestic and international tourists in Hue city were conducted at the start of the project (Figure 6), before the selection and implementation of EbA measures in the area.

The surveys were conducted by local professionals and university students trained by the project team. Pilot surveys were conducted to test the questionnaires, after which the survey was updated and then deployed to the target survey populations. Survey questionnaires were administered using KoBoToolbox[3], which is a freely available mobile device app developed by the Harvard Humanitarian Initiative and the Brigham and Women's Hospital. Kobo Toolbox enables the real-time monitoring of interview responses through a central storage location, which allows for low cost and rapid data collection. The surveys of households were carried out over a period of five weeks between August and September 2017. The questionnaires consisted of five sections regarding: use of resources and quality of life, flood risk perceptions, flood experiences, a discrete choice experiment on ecosystem services, community interactions, and socio-economic data. The survey also offered local households the opportunity to voice their views regarding the EbA strategy that the project was developing in their community. A representative sample of the underlying populations potentially benefiting from the EbA projects was generated by randomly selecting households in the target areas to take part in the survey (each household within a target community had an equal chance of being asked to participate in the surveys). A household was only excluded if the contacted member had already participated in the pilot survey. There was an equal division of respondents across the coastal (total of 505 responses) and urban communities (total of 505 responses). The overall split between male and female respondents is roughly equal in the overall sample. In terms of household size and income the sample matches the overall provincial patterns. More detailed information on the survey set-up and summary statistics are provided in Hudson et al (2019).

The surveys were complemented by a series of more than ten focus group discussions with the local communities, risk managers and policy makers. These workshops were organised around the following objectives:

1. To support communities by raising their awareness and knowledge of existing local ecosystems and their values, as well as the interaction between community activities and the transformation of the ecosystems.

1. To determine the resilience of men and women in the community, regarding floods, in relation to local ecosystems characteristics, individual capacity, existing institutions and the local socio-economic environment.

2. To identify women's role and position in the community decision making process related to DRR and EbA.

In total these focus group discussions and workshops reached a total of 220 local residents, 59 local government officials, and 25 members of the local Women's Union. These workshops used a variety of facilitation techniques in order to achieve the listed objectives. Furthermore, these focus group discussions where complemented with an opening and closing workshop for provincial and local policy makers and other stakeholders to demonstrate and disseminate the results to those in a position to incorporate the findings in planning decisions.

[3] https://www.kobotoolbox.org/

Figure 6: *Implementation of the survey among flood-prone households in Hue city and coastal areas of Thua Thien Hue province (Photos: CSRD).*

5 The impacts of flooding on well-being and the role of ecosystem-based adaptation

Floods impact societies in various ways, ranging from the loss of life, injuries and mental health effects, to the destruction of economic assets (Bubeck et al., 2017). However, despite the growing numbers of people affected by flooding, there is little acknowledgement of the whole range of impacts that can occur (see Box 3), and little is known about the non-physical or well-being impacts of flooding, even though these can be substantial (Hudson et al., 2017). Since the speed of recovery is a key component of resilience, better insights and management of this aspect are especially important for areas in which floods occur frequently, such as Thua Thien Hue province. This is because a slow or incomplete recovery could result in a vicious cycle of negative impacts unless those affected receive suitable help to recover.

Box 3: Societal impacts of flooding

Floods can have a range of societal impacts both physical and non-physical (Bubeck et al., 2017). Both types of impact are important and must be included in the flood risk management process. There are several physical impacts that can occur from flooding. Listed below are several examples that are generally the focus of risk managers:

- The value of assets or property that is lost due to a flood;
- The number of individuals who could or have died during a flood event;
- Impacts to public infrastructure such as roads or railways;
- The disturbance to economic activity due to the flood.

The non-physical impacts of flooding are many fold. Listed below are some examples of such impacts (that are often neglected in the planning process):

- Physical health problems occurring due to the flood (e.g., injuries or illnesses due to contaminated water);
- Long lasting psychological impacts that can persist for years. For example, anxiety and depression are the most common mental disorders reported after flooding. Moreover, floods could worsen pre-existing mental health conditions due to the abrupt increase in stress;
- Floods have adverse impacts on the well-being of the affected population in a more general sense, such as their overall happiness.

An approach for directly examining the impact of flooding on individual welfare is to study their level of self-reported subjective well-being (SWB), which is an individual's overall happiness or welfare (MacKerron, 2011). We used the data from the household survey described in Chapter 4 to study the impact of floods and EbA measures on SWB in Thua Thien Hue province (see Method Box 1). As argued above, the importance of flood impacts can differ across different members of society and women are considered especially vulnerable to flood impacts (see Chapter 3). Therefore, when exploring the linkages between SWB and the flood risk domain we kept the following questions in mind: what are the potential differences between the SWB impacts of flooding and EbA measures on men and women? What is the temporal dimension over which the SWB recovery occurs and are there differences between men and women?

Additionally, the use of the SWB approach allowed us to produce an initial monetary valuation of these intangible impacts. The monetary value is achieved by finding an equivalent value of money that 'compensates' for the change in SWB and is known as the Compensating Value (CV). This can be understood as the value of money needed to compensate the decline in SWB following, in this case due to flood impacts. A more detailed description of the analysis carried out to estimate the impact of floods and ecosystems on SWB is provided in Method Box 1 and in Hudson et al. (2019). A summary of the analysis is also depicted in Figure 7.

Method Box 1: Assessing the impacts of floods and ecosystems on individual well-being

SWB is measured from 0 (very low well-being) to 10 (very high well-being). The measurement of SWB on such a psychometric scale is well-developed in the literature, showing that well-being impacts can be measured accurately by asking respondents to describe their level of SWB (Ferrer-i-Carbonell and Frijters, 2004). To examine the impacts of floods and ecosystems on individual welfare, a series of six SWB scales was used (see Figure 7), including respondents social and family lives and living environment (van Praag and Ferrer-i-Carbonell, 2008). The interconnections between SWB and the flood experiences and perceptions of ecosystems were modelled using a mediation style analysis. This analytic framework is based on a seemingly-unrelated regression (SUR) model of the interlinked relationships, following Hudson et al. (2017).

The established relationships between SWB and flood experiences were also used to value the welfare impacts of a range of variables in monetary terms. This approach has been used widely in industrialized countries to value various life-experiences ranging from terrorism, widowhood or the benefits of an active social life (Blanchflower and Oswald, 2004). The monetary value is estimated by finding an equivalent value of money that 'compensates' for the change in SWB and is known as the Compensating Value (CV). This can be understood as the value of money needed to compensate the decline in SWB following a flood event. The relationship used to estimate the compensation value can be understood as the percentage change in income required to offset the effect of the flood experience. A negative CV represents a welfare loss, while a positive compensation values indicate an increase in welfare. A summary of the analysis carried out to estimate the impact of floods on SWB is summarized in Figure 7. A detailed description of the analysis and findings is provided in Hudson et al. (2019).

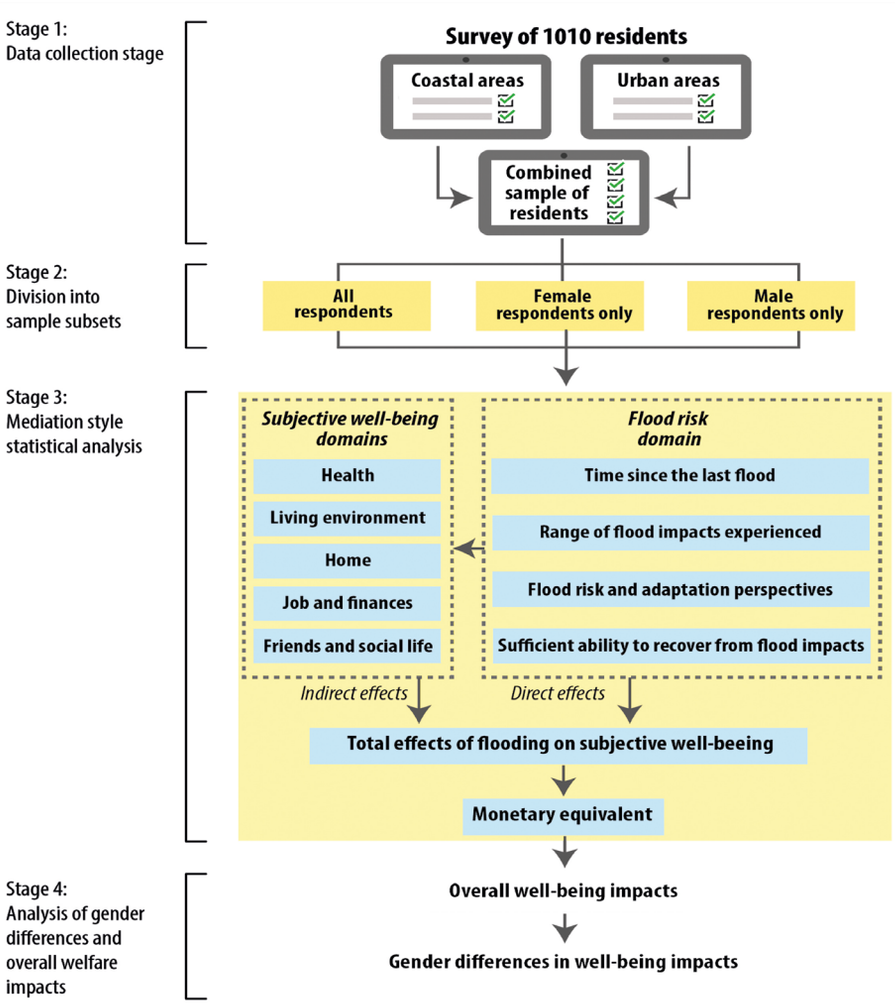


Figure 7: *Methodological steps to study the impact of floods and EbA on subjective well-being (Hudson et al., 2019).*

From the survey responses we produce the results presented in Table 1. It shows the monetary equivalents of SWB impacts due to flooding and local ecosystems in US dollars as well as a percentage of annual income. A negative compensation value represents a welfare loss, while positive compensation values indicate a boost to welfare.

Table 1: The estimated range of monetary equivalents for the Subjective Well-Being impacts in US$

Variables	Sample sub-set	Monetary equivalent (% of annual income)			Monetary equivalent (in $)		
		CORRELATION BETWEEN INCOME AND SWB					
		0.44	**0.3**	**0.21**	**0.44**	**0.3**	**0.21**
Experienced a flood within the last year	All respondents	-132	-193	-276	-2100	-193	-4400
	Only male respondents	-132	-193	-276	-2100	-193	-440
	Only female respondents	-141	-207	-295	-1900	-207	-4000
Experienced a flood within the last five years	All respondents	-30	-43	-62	-480	-720	-1000
	Only male respondents	-27	-40	-57	-420	-640	-880
	Only female respondents	-40	-60	-86	-580	-840	-1200
Importance and quality of the local ecosystem based adaptation mechanism	All respondents	70	103	148	1100	1600	2300
	Only male respondents	64	93	133	1000	1500	2100
	Only female respondents	73	107	152	960	1400	2000

Notes: All values are in US dollars; negative values correspond to a welfare loss, while positive values correspond to a welfare increase.

The initial drop in SWB immediately after a flood event (flood experienced within the last year) is equivalent to up to 276% of annual income in immediate compensation (considering all respondents), depending on the assumed strength of the relationship between income and SWB (Table 1). This indicates that the welfare impact of floods is substantial, as even the smallest value lies at over 100% of annual income in long-term compensation. Table 1 also shows that the initial drop in welfare after a flood event is higher for women, ranging from 141% to 295%, again depending on the assumed strength of the relationship between income and SWB. This supports the notion that floods have a higher impact on women in the project region.

We also find that there is a substantial recovery of SWB over time from the large initial flood impacts. However, despite this recovery, we find that even 5 years after a flood, the welfare impact still equals a loss that is the equivalent of 30% to 62% of annual income in long-run compensation (considering all respondents). Again, the overall welfare losses are substantially larger for women after this period of time (by 20 to 29 percentage points), indicating a gender-gap in recovery. Moreover, when the 'time since last flood' variable was interacted with the female dummy variable we found a positive relationship between time and recovery for men but not one for women. This again indicates that women face more difficulties in recovering from flood events in the project region. Therefore, given the frequent occurrence of flooding in the region, this may result in a situation in which women can be pushed into a vicious cycle. For example, the focus group discussions highlighted how women were expected to care for children and the elderly during a flood, while still being concerned for their own safety.

Moreover, these expectations continued after the flood. In addition, the focus group discussions revealed that especially women in the coastal areas lack access to financial resources such as loans to rebuild their livelihoods after a flood event. Overall, we find that female respondents displayed a ~13% lower recovery of SWB as compared to men, which was associated with a ~36% higher monetized value in the long-run (Hudson et al., 2019). These results indicate that women are more heavily affected by floods than men. This finding was further supported by analyses on self-stated recovery (see Bubeck et al. 2019). Also these analyses revealed that women reported a lower recovery status compared with men.

We also used the SWB approach to assess the impact of ecosystems and their services on individual welfare (see Table 1). We find that ecosystem-based adaptation measures and the various co-benefits they provide have a significant positive impact on SWB of both men and women, ranging from 70% to 148 % of annual income, depending on the assumed strength of the relationship between income and SWB. This indicates that the benefits provided by EbA measures could partly offset the SWB loss from flooding, if the local ecosystems are repaired or are further developed. The positive effect of ecosystems and their services was stronger for women than for men, which corresponds to the notion that especially women could benefit from the implementation of EbA measures.

6 Implementation of EbA measures in coastal and urban areas of Thua Thien Hue province

To enhance the flood resilience of societal groups that are especially vulnerable to flood impacts, the project directly invested in EbA in coastal and urban communities of Thua Thien Hue province.

Planting of mangroves at the Tam Giang Lagoon and Bu Lu river delta

At the Tam Giang Lagoon and the Bu Lu river delta, mangroves were planted jointly with two coastal communities and local stakeholders including the Women's Union and the Disaster Management Centre. Mangroves can considerably lower coastal flood hazards by reducing wave and tidal energy and coastal erosion (Bao, 2011). A recent study of the Nature Conservancy estimated that mangroves reduce annual flooding to more than 18 million people globally (Beck et al., 2018). Without mangroves, flood damage could increase by US$82 billion globally. According to this study, Vietnam is among the countries that receive the greatest benefit from mangroves in terms of avoided flooding of people and damage to property. Despite this important risk reducing function, these important coastal ecosystems are increasingly under pressure in Vietnam due to population growth and economic activities such as shrimp and fish farming.

In addition to reducing wave and tidal energies, mangroves generate multiple social, economic and cultural co-benefits, such as improving water quality and providing important breeding and nursery grounds to many terrestrial and aquatic species. These co-benefits support the livelihoods of poor and vulnerable groups of society. In the context of our coastal study site, livelihoods directly dependent on the lagoon and the health of this ecosystem contributes to the resilience of the communities. For instance, many women in coastal communities engage in on-shore fishing and thus directly depend on sea-food abundance in the lagoon (Figure 8). Results from the household survey showed that the respondents in the study area strongly rely on ecosystem services: 55% of a household's income and a little less than 20% of the household's food consumption, on average, comes from self-caught seafood, showing the importance of this natural resource. An overview of the various ecosystem services that mangroves provide to local communities is summarized in Figure 9.

Figure 8: *Local women prepare for on-shore fishing in the Tam Giang lagoon (Photo: CSRD).*

Provisioning services

- Fish, crusctaceans (e.g. crabs, shrimps) and molluscs (e.g. oysters, mussels)
- Forest products (timber, building materials, fuelwood and charcoal)
- Non-wood forest products such as food (honey, fruits), medicine and fodder

Regulating services

- Shoreline stabilization and erosion control
- Coastal protection from some tsunamis, cyclones, tidal waves, salt water intrusion and floods by attenuating waves and winds through stems, leaves and aerial roots
- Absorption of heavy metals and other toxic substances in effluents
- Regulation of hydrological cycle
- Global climate regulation through reduction of greenhouse gas concentration

Cultural services

- Promotion of tourism, especially through wildlife living in the forest
- Opportunity for recreation and enjoyment of aesthetic value

Figure 9: *Mangrove ecosystem services (Twilley at al., 1992; Mazda et al., 1997; Bandaranayake, 1998; Rönnbäck, 1999; UNEP, 2006; FAO, 2007; Osti et al., 2009; Ravindran, 2012; Mukherjee, 2014; Aheto et al., 2016; Barbier, 2016; Karanja and Saito, 2017, (Photo: Sabina Wolf) Source: Wolf (2018)).*

To ensure appropriate biophysical conditions, potential sites were comprehensively evaluated in terms of tidal regimes, soil properties and salinity before planting. Finally, two sites for mangrove planting and restoration were selected. In Hai Duong commune, mangroves were restored on communal land along the fish ponds of the commune. The latter are a highly important source of income for local communities. In Loc Vinh commune, an existing mangrove area was expanded. Local communities were involved in the selection of the sites, the fencing and planting of mangroves and in setting up local resource management plans (see Figure 10). Before the mangroves were planted, training sessions were provided to local communities on how to plant and nurse mangroves.

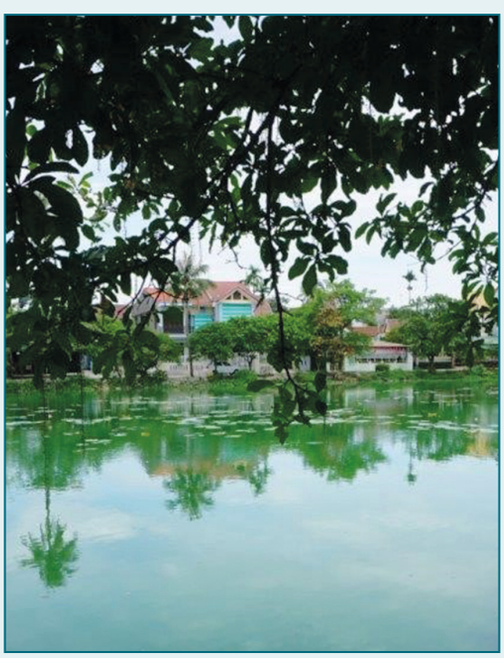
Figure 10a + 10b: *Planting of mangroves in Hai Duong Commune (Photos: René Arnold (left) and Philip Bubeck (right)).*

Restoration of urban water bodies in Hue city

In the historic city centre of Hue, which is a UNESCO world heritage site, traditional urban water bodies were restored in close cooperation with the provincial Disaster Management Centre, urban communities and the Women's Union.

In the past, a dense system of natural rivers, man-made canals and lakes played an important role in facilitating water retention and drainage in the rainy season. Nowadays, water bodies are increasingly blocked by construction, temporary houses and solid waste, leading to a decrease in water flows and retention capacity (see Figure 11).

Figure 11a + 11b: *Urban water bodies in Hue city that are increasingly blocked by uncontrolled urbanization and waste, reducing their water retention capacity and recreational value (Photos: CSRD).*



Provisioning services

- Use for aquaculture
- Source for irrigation to urban aquaculture

Regulating services

- Air purification
- Micro-climate regulation throughout the year
- Mitigation of flooding through rainwater drainage and control of stormwater flow

Cultural services

- Area for recreation, possibilities to play and rest and thus promote physical and psychological well-being
- Aesthetic value
- Traditional and cultural linkages
- Educational value
- Promote social cohesion, neighborhood participation and community ties

Figure 12: *Ecosystems from urban waterbodies (Bolund and Hunhammar, 1989; Anderson and Moss, 1993; Gordon et al., 2000; Gotham and Brumley, 2002; Maas et al. 2009; Lee and Maheswaran, 2011; Papayannis, 2011; TEEB, 2011; Konijnendijk et al., 2013, (Photo: Sabina Wolf), Source: Wolf (2018)).*

In addition, the urban water bodies have an important function for creating pleasant landscapes and reducing urban heat. Many women run small food stalls and cafes in the vicinity of these lakes, selling drinks and other items to domestic and foreign tourists and are thus directly affected from increased flood risk and a loss in recreational values of these areas (Figure 13). An overview of the various ecosystem services provided by mangroves is summarized in Figure 12. The list of ecosystem services in Figure 12 is more extensive than in the cost-benefit analysis provided in Chapter 7, as the assessment in Chapter 7 focuses on the most tangible and important ecosystem services in order to highlight the aspects most relevant for local communities.

Figure 13: *Boys in a small cafe near an urban water body in Hue City (Photo: René Arnold).*

To strengthen flood resilience of urban communities in Hue city, three of these traditional water bodies were restored to increase their retention and drainage capacity and recreational value. Drainage systems and sewers were cleared and re-connected, solid waste was removed and disposed at the municipal landfill, and selected water bodies were dredged to increase their water storage capacity (see Figure 14).

Figure 14: *Cleaning of an urban water body in the historic city center of Hue (Photo: CSRD).*

Capacity building and awareness raising

The implementation of EbA measures was accompanied by communication events to raise awareness on flood resilience and the importance of local ecosystem for flood risk reduction and resilience. These lively events were carried out by the Women's Union at those communities where the EbA measures were implemented. They involved karaoke of flood-related songs, theatre performances demonstrating risk reducing behaviour during floods, and a quiz about resilience and the value of ecosystems (Figure 15). This lively workshop format was chosen because many women usually do not have time to participate in community activities due to their work load. The workshops were attended by more than 700 people, mostly women. To raise awareness beyond the communication events, the project also produced a documentary, capturing the lives, flood experiences and perceptions of EbA measures of three women living in the project areas (see Box 4).

Figure 15a + 15b: *A member of the local Women's Union performs karaoke during a communication event. The events were attended by about 700 women (Photos: René Arnold).*

Box 4: Film as method in flood risk communication - the documentary 'All in the same boat'

The documentary '*All in the same boat*' produced by the project followed a people-centred, transdisciplinary approach in communicating flood risk to at-risk communities, as suggested by the Sendai Framework for Disaster Risk Reduction. The aim was to provide locally embedded and multifocal perspectives on the role of gender in flood experiences and ecosystem-based adaptation in Thua Thien Hue province, by portraying three women living in coastal and urban flood-prone areas. Women are particularly vulnerable to the impacts of flooding, and the reasons for this vulnerability and possible resilience strategies are often not sufficiently communicated to make this knowledge a shared resource. Therefore, we chose a participatory, visual anthropological approach to make our protagonists' flood experiences as well as the EbA measures they are involved in understandable and emotionally accessible to an interested local and international audience.

One of the key methods applied was the creation of flood-diaries: The three protagonists wrote personal narratives in which they reflected topics such as their individual flood experiences, challenges they coped with as women throughout the disaster cycle, gender-related questions in the context of EbA measures and the potential they see in EbA. These diary narratives were recorded and combined with additional footage generated in the context of "video elicitations". Video/photo elicitations are a well-known anthropological method in which audio-visual material serves as a catalyst to shape and facilitate the narration of 'stories behind the pictures'. In our case, each of our protagonists directed the film team to specific spots they described in their diaries and linked their narratives to the specific local contexts they chose.

Figure 16: *Shooting of the project documentary 'All in the same boat' (Photo: Philip Bubeck).*

We think that this approach can be productive in order to communicate flood impacts and the role of gender in EbA in more context-sensitive ways. Further, it can help to strengthen non-scientific perspectives on the role of EbA and, if locally disseminated, holds the potential to serve as an effective means to create identification among those affected by flood risk. Usually, the intention behind film-based outreach efforts in the field of disaster risk reduction is to take advantage of the medium film to transfer scientific knowledge or to motivate certain cognitive/behavioural responses of different target audiences. Albeit this is an important function, this project showed that going beyond this 'deficit-orientation', the medium of film can also be used as a tool to strengthen the collaborative, reflexive and translational dimension of flood risk communication.

Figure 17: *Screenshot of the documentary 'All in the same boat: Women, ecosystem-based adaptation, and flood resilience in Central Vietnam' (Photo: René Arnold).*

Enhancing the sustainability of activities

To enhance the sustainability of the activities, we aimed at policy integration and at creating direct economic benefits to women and local communities from the implemented measures. Following the project's activities, EbA was included in the disaster management plans of four urban communities. Small micro-credit funds administered by the communities themselves were established that can be accessed by women who are involved in mangrove restoration for livelihood activities. In addition, women from the local communities received training on running small-scale eco-tourism activities. The survey among 500 domestic and foreign tourists indicated that tourists are interested and willing to pay for touristic activities around the urban ponds and the mangrove sites. About 50% of the surveyed tourists reported that they would be interested in taking a tour of the ponds in Hue city and the mangroves sites in the lagoon. The mean willingness to pay for a tour among visitors that were interested in the ponds was US$ 4.70 (US$ 5.22 and US$ 4.30 for domestic and foreign visitor respectively). Regarding a tour to the mangroves, the mean willingness to pay among the interested visitors was US$ 8.9 (US$ 10 and US$ 7.6 for domestic and foreign tourists, respectively).

7 EbA as a tool to increase flood resilience of the most vulnerable

EbA is commonly argued to be more inclusive to vulnerable groups, whose livelihoods directly depend on natural resources and ecosystem services. To further examine whether the proposed EbA measures hold up to the promise that they benefit vulnerable groups of society, we assessed people's willingness to pay (WTP) for the ecosystem services provided by mangroves and urban water bodies for different groups of society. For this, we again used the data of the household survey described in Chapter 4, and more specifically the results from the discrete choice experiment (see Method Box 2).

Method Box 2: Willingness to pay for ecosystem services using a discrete choice experiment

Willingness to pay (WTP) for the ecosystem services provided by urban water bodies and mangroves were elicited using a discrete choice experiment (DCE). A DCE is a stated preference valuation method that is used to value goods that are not (yet) sold on the market and is used in many different contexts including cost-benefit analyses, natural resource damage assessments and policy analyses (Kanninen, 2007; Vega and Alpizar, 2011; Campbell et al., 2008; Oleson et al., 2015). The main theoretical underpinnings of the method come from the characteristics theory of value (Lancaster, 1966) and random utility theory (Hanley et al., 1998). The experiment involves making choices between different packages that consist of changes in ecosystem services and a payment for these changes. By observing the trade-offs that respondents make, it is possible to estimate relative values of the goods. In this study the results of the DCE reveal WTP values for changes in the ecosystem services that are affected by the EbA measures implemented by the project (see Chapter 6), which are presented in Figure 18.

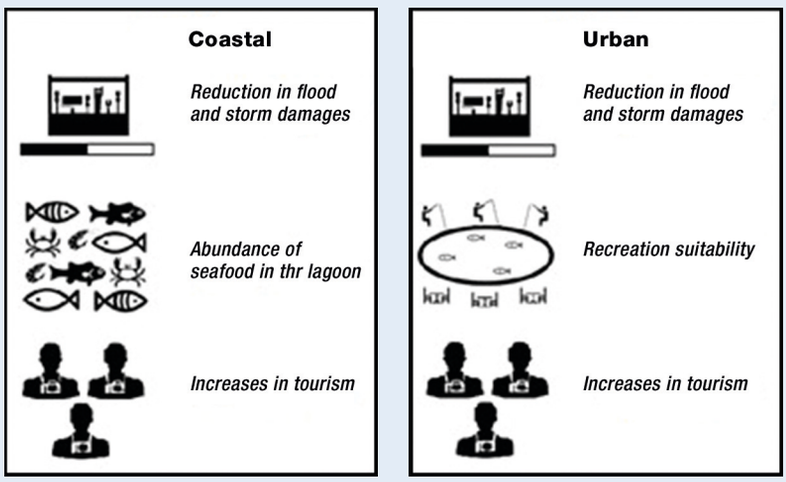


Figure 18: *The ecosystem services affected by the implemented EbA measures in urban and coastal Hue as they were presented on the choice cards of the DCE.*

We find positive WTP values for all ecosystem services. This indicates that the households in both project sites saw benefits from the EbA measures, and that they are willing to contribute to the EbA measures in order to obtain these benefits. At the Tam Giang lagoon, the highest valued ecosystem service change is the increase in seafood abundance due to mangrove planting. A change in recreation suitability, i.e. a cleaner area with more opportunities for recreational activities, is valued most in relation to the urban ponds.

To investigate whether EbA is more inclusive, we divided our sample in two sub-samples according to income and gender differences. Figure 19 shows the estimated WTP value for households above and below the mean income of our sample. It is clear that lower income households are willing to pay more for the benefits from EbA in both urban and coastal areas. While these households have less money to spend, they stand to gain more due to their current vulnerability. For example, less damage to their property means smaller repair costs and an overall safer environment, whereas increases in tourism, or recreation suitability, can lead to better employment and business opportunities. The potential increases in seafood abundance can result in stable livelihoods and food security.

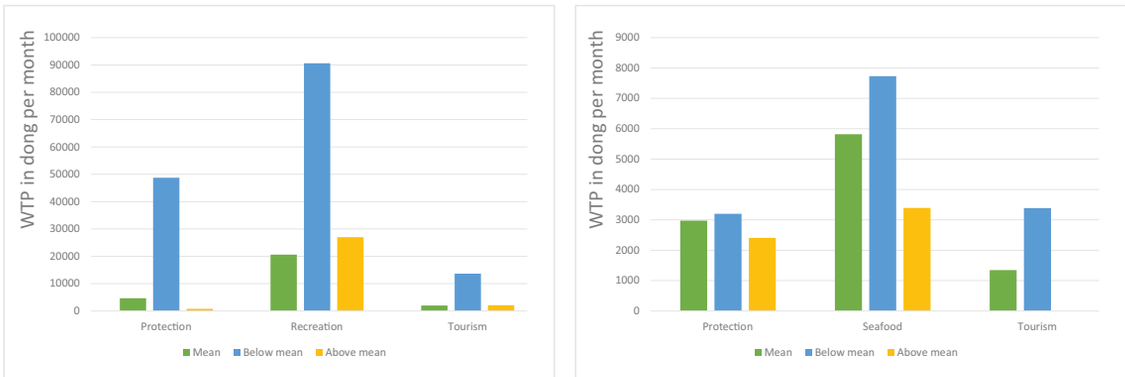


Figure 19: *WTP[4] for protection, recreation and tourism across different income groups in Hue City (left) and WTP[5] for protection, seafood and tourism across different income groups in coastal areas (right).*

Via the gender sub-samples we find higher WTP values for women for all the ecosystem services, except for changes in tourism in Hue city, where WTP values are more or less the same (see Figure 20). An increase in protection from storms and floods not only protects women and their family's lives during a flood, but also means that the work that needs to be done during the flood itself and the aftermath is reduced. Positive changes in seafood abundance and recreation suitability mean a more secure and pleasant environment for the household. The development of tourism provides interesting opportunities for women to increase and stabilize their income, especially in the rural areas where few other job opportunities arise.

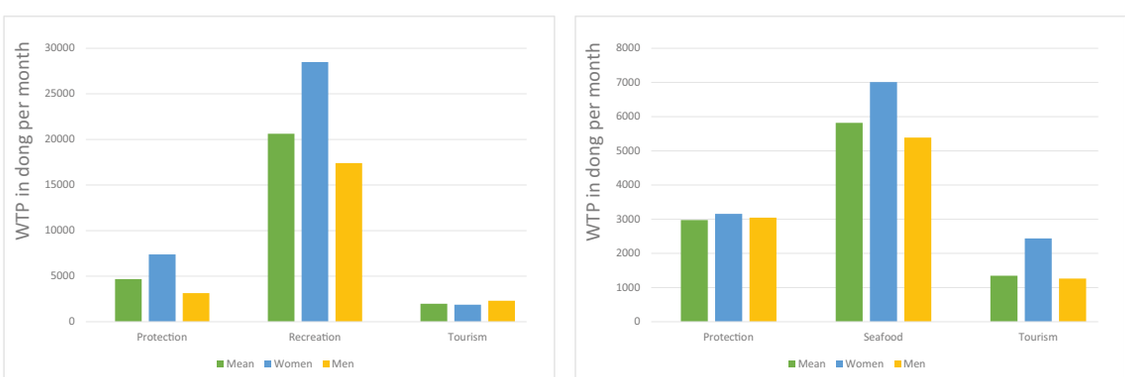


Figure 20: *WTP[4] for protection, recreation and tourism across gender groups in Hue city (left) and WTP[5] for protection, seafood abundance and tourism across gender groups in coastal areas (right).*

In line with the findings on the impacts of ecosystems on SWB (see Chapter 5), the results from the DCE confirm that EbA is a promising means to adapt to climate change and to reduce the risk of disasters while simultaneously increasing the welfare of those that are especially vulnerable to these impacts. Lower income households as well as women, in both our case study areas, hold higher values for the changes that occur due these measures, which not only reduce negative climate change impacts, but also present (new) livelihood opportunities and income security. It is therefore recommended to consider complementing structural measures such as dikes or reservoirs with EbA measures in order to create a more socially inclusive approach for DRR and CCA.

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4 WTP for protection is per 1% decrease in damages due to flood and storms. WTP for recreation is per change in recreation level. WTP for tourism is per 1% increase in tourist numbers in Hue city.

5 WTP for protection is per 1% decrease in damages due to flood and storms. WTP for seafood is per 1% increase in seafood abundance in the lagoon; WTP for tourism is per 100 extra visiting tourists to the mangrove area per year.

8 Economic evaluation of EbA measures

This chapter describes the economic evaluation of the EbA investments in mangroves in Quang Loi commune and urban ponds in Hue city (see Method Box 3). Often such information is lacking, which makes decision making and the implementation of these types of measures difficult (see also Chapter 9). The findings of our project lead to tangible recommendations based on a comprehensive measure of the value of mangroves and urban water bodies to society, including harder to measure impacts such as aesthetics and tourism (see Figure 9 and Figure 12). The intention was to provide economic evidence to local and regional policy makers in support of a shift towards more sustainable and inclusive DRM and CCA. Therefore, the focus of the analysis is on the benefits and costs directly experienced by the communities in question in order to create the strongest policy narrative.

Method Box 3: Cost-Benefit Analysis of EbA investments

Cost-Benefit Analysis (CBA) is a widely used economic method for evaluating investment options by directly comparing the costs and benefits of an investment in monetary terms. This shows the value of EbA measures in a way that is easy to understand and compare to the current management options and the status quo arrangement. An investment represents value for money if the benefits are larger than its costs (Benefits/Costs>1). The benefit-cost ratio (BCR) highlights how each dollar invested returns a certain amount of expected benefits.

Conducting a CBA of the two EbA investments described in Section 6 involves identifying and monetizing (putting a US$ value to) all costs and benefits over a period of time in which the impacts occur. In our project we use a period of 30 years (2018-2047). Costs and benefits that occur in the future are given lower weight using a discount rate of 5% to reflect society's preference for current benefits and delayed costs. The difference between the sum of discounted benefits and costs is known as the Net Present Value (NPV). In this assessment multiple data sources were used including stakeholder consultations, household surveys (n = 1010), tourist surveys (n = 500), flood risk modelling and published scientific literature.

The results of the CBA of mangrove planting are represented in Figure 21. The total costs over 30 years are US$ 38,000 with the main components being the cost of buying seedlings, planting and equipment. The total benefits are US$ 86,000, which is comprised of reduced flood damage, enhanced fish harvest and eco-tourism. The estimated value of reduced flood damage included the role that mangroves play in protecting fishing boats. Fishermen moor their boats in the mangrove during typhoons thereby preventing their destruction. This avoids damage worth US$ 3,000 per boat. The additional benefit of being able to directly continue fishing after a storm has not been included in the CBA, as we were not able to measure the value of this benefit. The NPV is US$ 48,000 and the BCR is 2.3 (i.e. each dollar invested returns 2.3 dollars in benefits). The value of additional carbon stored by the mangroves is estimated to be US$ 35,000 but this figure is not included in the CBA since it represents a global rather than a local benefit.

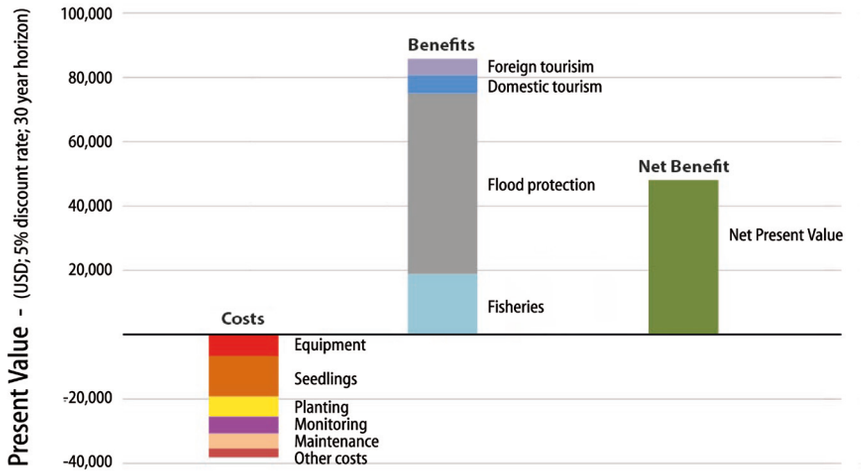

Figure 21: *Costs and benefits of mangrove EbA investment.*

The results of the CBA of restoring urban ponds are represented in Figure 22. The total costs over 30 years are US$ 19,000 with the main components being the labour cost of cleaning the ponds and the cost of waste disposal. The total benefits are US$ 641,000, which is dominated by reduced flood damages. This was quantified using a flood damage model assuming sluice gates are installed between the river and the citadel (displayed as "sluices in place" in Figure 22). Hence, the effect of this EbA measure is far larger if it is combined with an engineering measure. The return on investment is very high with a NPV of US$ 622,000 and a BCR of 34 (i.e. each dollar invested returns 34 dollars in benefits). It is worth noting that when omitting the benefits of flood protection, the additional benefits from only recreation and tourism also exceed the investment costs. Omitting the benefits of flood protection results in a NPV of US$ 22,000 and a BCR of 2.15 (i.e. each dollar invested returns 2.15 dollars in benefits).

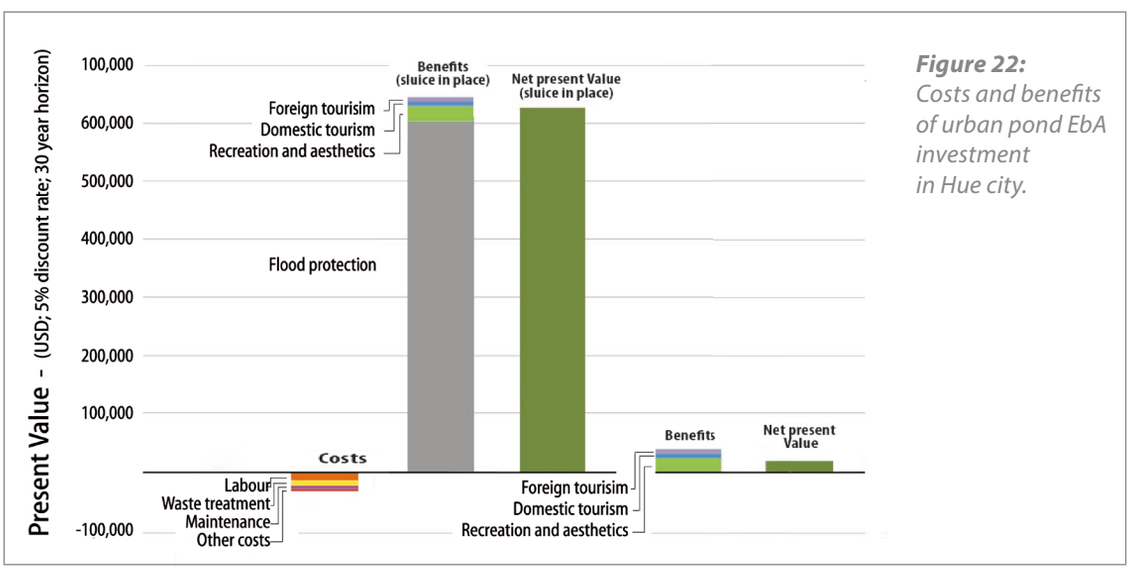

Figure 22: *Costs and benefits of urban pond EbA investment in Hue city.*

The EbA investments to plant mangroves in Tam Giang lagoon and restore urban ponds in Hue City both yield high returns on investment over a 30-year period, reflecting that these adaptation measures are not costly to implement and deliver high benefits to the local communities in terms of reduced flood damage and improved livelihood from fishing and tourism.

We note, however, that the analysis is not comprehensive, particularly in terms of including all identified benefits. It was not possible to monetise and include the emotional/well-being effects of flood protection or the improvement in sanitation and health from pond restoration. Including these additional benefits would further increase the estimated return on these EbA investments. Furthermore, the flood damage models we developed are relatively simple and include several assumptions. Hence, the results have some uncertainty. However, sensitivity analyses showed that the final outcome of a positive benefit-to-cost ratio does not change under alternative assumptions. These findings suggest that there is a strong economic rationale for exploring the potential to scale up such EbA investments in Vietnam.

9 EbA from the perspective of local policy makers

Policy-makers, by setting the institutional context and representing as well as influencing local people's attitudes are key-stakeholders for the feasibility and success of EbA, yet little is known about their perceptions (Vignola et al., 2009). To address this gap in knowledge, we conducted interviews with commune and province level policy-makers in both urban and coastal areas on their opinion of EbA as solution to address the risk from disasters and climate change (see Method Box 5). A more detailed description of the findings is provided in Wolf (2018).

Method Box 4
To elicit policy-makers' perceptions on EbA, 16 semi-structured expert interviews were conducted. Choosing a qualitative research design allowed for a high degree of flexibility in the research process and offered the potential to gain in-depth insight into the experiences, rationalities and understandings of a social group on a particular practice. Participants were respectively one President or Vice-President of the local authorities ('People's Committee') and the Women's Union at the commune or ward level from project sites across coastal and urban areas. Furthermore, the Vice-Chairman of the Disaster Management Centre of the province as well as the Chairman of the provincial Women's Union contributed a high expertise on natural hazards and political action plans. Interviews were conducted in the local language with the support of an interpreter and followed a question schedule, covering the topics risk perception, perception of the project activities, the general attitude towards ecosystem-based management as well as gender. The interviews were subsequently transcribed and thematically coded with the help of the qualitative data analysis software NVivo 12.

With natural hazards striking on a regular basis in central Vietnam, all policy-makers assessed the likelihood of extreme events as high. Experience from severe events, in particular the devastating flood in 1999, and first physical evidence of climate change such as shifts in temperatures, seasons and hazard patterns raised awareness about the importance of further enhancing disaster preparedness.

In terms of EbA, the decision-makers displayed occasional gaps in understanding of EbA as a concept, manifesting in confusions of terms and a lack of knowledge of different EbA solutions. Participation in training or communication events as well as the opportunity to witness the effectiveness of the EbA measures through model projects was reported by policy-makers as major prerequisites for shaping their knowledge on the multiple ecosystem services of mangroves and urban wetlands as well as their role in climate change adaptation.

Policy-makers in coastal areas valued mangroves in particular for their contribution to flood, storm and erosion mitigation and support of local livelihoods based on fishery and tourism. In urban areas, the importance of clear drainage systems from the ponds was stressed as crucial to improve water flows and retention capacity for flood mitigation. Also, the role of ponds for urban agriculture and aquaculture and their aesthetic and cultural value was consistently raised. In both areas, policy-makers recognized further regulatory services including air, soil and water quality improvement and hence the climate-regulating functions of the ecosystems. Disadvantages regarding ecosystem restoration were infrequently raised, involving restriction of fishing grounds, insects living in the mangrove forest potentially infesting crops nearby, and temporary bad smells inflicted by pond drainage.

Policy-makers perceived that the institutional context for planning and implementing EbA in Vietnam has improved. The fact that the EbA measures can be already connected to existing strategies of the government on CCA and DRR was barely recognized, but many policy-makers pointed to linkages to national or provincial plans on economic development and gender equality. They also reported an increasing interest of authorities and non-governmental organizations in similar projects on environmental restoration. However, as authorization for environmental projects needs to be obtained from the provincial level, policy-makers argued in favour of the devolution of decision-making power to ward levels to facilitate the implementation of EbA. Furthermore, it was mentioned that funds for environmental restoration are limited at local governments, which is why many EbA activities cannot be implemented without external support.

The attitudes of local people and in particular their perception of benefits from ecosystems were furthermore identified by policy-makers as crucial components of EbA. Policy-makers perceived that local people's appreciation of ecosystem services was predominately linked to their livelihoods, while the lack of awareness among the people caused the degradation of the ecosystems in the first place. Accordingly, awareness-raising in combination with the introduction and enforcement of laws and regulations regarding access and usage rights of the ecosystems were identified as the main prerequisite for ensuring local support for EbA, preventing repeated degradation and thus the sustainability of EbA. Most of the costs for EbA are therefore related to the time and effort required to develop multi-agency cooperation and connections with the local population which is why EbA was often perceived as cheaper solution compared with engineering solutions.

Some policy-makers also linked the lacking recognition for ecosystem services and environmentally destructive behaviour among local people to recent changes in social norms, which are caused amongst others by economic development. This transformation in values is also apparent among policy-makers themselves. While some policy-makers pointed out that environmental conservation and restoration needs can restrict development and therefore need to be balanced with economic needs, others were of the opinion that the preservation of nature should be prioritized in the face of on-going environmental degradation. These personal beliefs and values indicate the significance of considering the individual cultural context for effective DRM and CCA, addressed in detail for example in Krüger et al. (2015).

All of the policy-makers stressed that the benefits from ecosystem restoration for disaster risk reduction and climate change adaptation outweigh the costs and difficulties of implementation. Many policy-makers however mentioned the long time-frame until the benefits from ecosystem introduction and restoration manifest as well as the limited potential for protection as key challenges of this approach. Accordingly, many policy-makers perceive EbA as long-term solution which needs to be combined with disaster preparedness and hard infrastructure solutions.

All policy-makers were of the opinion that participation of women in EbA is important and needs to be further encouraged based on their role in society and families as caretakers. As they are mobilizing the people to move to safe areas during extreme events, prepare food and support the cleaning of streets and houses after a disaster, policy-makers perceived that women already have an integral part in disaster management. Particularly in urban areas women were moreover identified as an important factor contributing to the degradation of the ponds due to their disposal of plastic bags and packaging materials after grocery shopping for their families at the market. Including women in awareness raising was therefore considered an important tool to improve their knowledge. Even though the division of household chores within families has been reported to have improved in the last years, the lack of time linked with insufficient economic strength still constitutes a major barrier to equal participation in EbA and decision-making. Policy-makers further pointed to a lack of physical strength and constitution to conduct many of the tasks necessary for environmental restoration and conservation.

Women's ability to realistically reflect the opinions and daily life in the community was perceived to be a major contribution to political debates and was the main argument for policy-makers to endorse a strengthening of women's role in the decision-making on EbA and in general. Apart from the lack of knowledge on EbA, caused by insufficient participation in capacity building, a consequential lack in confidence to share opinions on public matters was identified by policy-makers as most important barrier towards effective participation in policy-making. This was linked to a lack of education as well as gender issues, as women have been found to be more inclined to share their opinions in women-only groups and on issues concerning women.

To improve the participation of women in EbA and policy-making, capacity building was therefore considered crucial. To increase the participation of women, proposed solutions include arranging the time of activities and meetings according to the women's schedule (for example in the evenings, on free days or short time spans like half-day workshops) and pointing out the importance of participation to both women and men so that they are willing to organize their time. Leaders of the Women's Union pointed out that the main condition for improving the role of women in EbA and policy-making was gender equality. This means that husbands need to support women's participation in social work by sharing household tasks and childcare. Awareness-raising, for example through theatre plays on work and domestic violence have been found to have major impacts on both genders.

Figure 23: *Fishing boats in Loc Vinh commune (Photo: Duong Quang Tien).*

10 Conclusions

Every year, millions of people globally are affected by floods. This number is likely to increase in many regions in the future due to the effects of global warming, ongoing socio-economic development in risk-prone areas and environmental degradation. Women in the Global South are often disproportionately affected by flood impacts, as they commonly face disadvantages in social, cultural and political domains, as well as legal status and opportunities, undermining their flood resilience.

To enhance disaster resilience and sustainable development, especially of those particularly vulnerable to flood impacts and environmental degradation, the international community identified several priorities. As highlighted in the Sendai Framework for Disaster Risk Reduction, the Sustainable Development Goals and the Paris Agreement, key aspects include enhancing gender equality and a stronger inclusion and participation of women in DRM on the one hand, and the sustainable use and management of ecosystems for risk reduction and livelihood support on the other hand.

In this report, we describe how we integrated both aspects by linking an EbA approach with a strong focus on enhancing women's role and participation in DRM and CCA to enhance flood resilience of urban and coastal communities in Thua Thien Hue province in Central Vietnam. As EbA is more inclusive and accessible for vulnerable groups of society than hard infrastructure, and because ecosystems support the livelihoods of those directly depending on natural resources, it is a promising means to strengthen women in DRM and CCA.

We found that floods indeed have a large and long-term impact on the welfare of those affected. The long-term impact is especially problematic in areas such as Thua Thien Hue province, where floods occur frequently. We also found that flood impacts are larger and longer lasting on women, which highlights the necessity to account for gender differences when designing flood risk management and adaptation strategies. For instance, women in the coastal areas indicated that their recovery is hampered by limited access to loans and support for recovering their livelihood activities following a flood event. Moreover, women face a high burden during and after disasters due to their additional work load and their responsibility to take care of others.

To enhance flood resilience of urban and coastal communities, the project directly invested in the implementation of EbA measures. Jointly with local communities, the Women's Union and various other stakeholders, we restored urban ponds in Hue City and planted mangroves in coastal areas. Both EbA measures help to reduce flood risks and provide various co-benefits, such as providing important nursery grounds for juvenile fish and enhancing the touristic value of the area. Our findings and experiences support the notion that EbA measures are a promising mean to increase the resilience of vulnerable groups of society. We found that ecosystems and their services have a particularly positive effect on the welfare of women. Moreover, women and poorer people placed a higher value on the ecosystem services provided by mangroves and urban water bodies, strongly indicating a larger benefit for them.

A common barrier for the implementation of EbA measures is the difficulty for policy makers to appraise and monetize the various costs and benefits associated with these types of measures. A comprehensive benefit-cost analysis of the implemented EbA measures demonstrated that both measures are efficient solutions. Given the various co-benefits that support local livelihoods, EbA measures should be increasingly considered to complement or replace hard infrastructure measures. Pilot projects and benefit-cost evaluations, such as the ones reported on here, can help to raise awareness among policy makers to support the shift towards more sustainable and inclusive disaster risk management solutions.

Lively communication events carried out by local members of the Women's Union, including theatre performances and karaoke, proved to be a successful tool to actively engage and reach a large number of women, who often do not find the time to participate in capacity building. Such tailored events could help to increase women's participation and to enhance their capacity in matters related to DRM and EbA.

According to our experience, strengthening women through EbA approaches is a promising road forward also towards achieving the targets and goals set in the Sendai Framework and the Sustainable Development Goals. A challenge that remains is the time between implementation (e.g. planting of mangroves) and the moment the ecosystem services (e.g. risk reduction) start to be effective. To increase the sustainability of the implemented measures, we aimed to create direct economic benefits from the implemented measures from the beginning, e.g. by providing training on running small-scale ecotourism to local women. Further insights into when and to what extent the various ecosystem services become effective are still largely lacking. An ecological and socio-economic long-term monitoring of EbA measures could generate such valuable insights. This could further help to overcome the implementation gap in terms of EbA.

Figure 24: *Aerial picture of Hai Duong commune in Thua Thien Hue province (Photo: Duong Quang Tien).*

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Strong roots, strong women

Women and ecosystem-based adaptation to flood risk in Central Vietnam

Prepared by: Philip Bubeck, Paul Hudson, My Pham, Liselotte Hagedoorn, Tien Le, Luke Brander, Tam Tran, Toon Haer, Sabina Wolf, Johanna Ickert, Lisa Dillenardt and Ralph Lasage

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German Committee for Disaster Reduction
Kaiser-Friedrich-Str. 13
53113 Bonn

Phone: +49 (0)228/26 199 570
Email: info(at)dkkv.org
Internet: http://www.dkkv.org

Project Coordinator: Dr. Philip Bubeck, Universität Potsdam, Institut für Umweltwissenschaften
und Geographie, Geographie und Naturrisikenforschung

Cover: U1 Figure top: Planting of mangroves in Hai Duong Commune (Photo Philip Bubeck).
U1 Figure left: Urban water bodies in Hue city that are increasingly blocked by uncontrolled urbanization and waste, reducing their water retention capacity and recreational value (Photos: CSRD).
U1 Figure right: Impact of typhoon Damrey in Hue city in October 2017 (Photos: CSRD).

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Deutsches Komitee Katastrophenvorsorge e.V. |
German Committee for Disaster Reduction
Kaiser-Friedrich-Str. 13
53113 Bonn

Phone: +49 (0)228/26 199 570
Email: info(at)dkkv.org
Internet: http://www.dkkv.org

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