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Anticipatory action to manage climate risks: Lessons from the Red Cross Red Crescent in Southern Africa, Bangladesh, and beyond

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ABSTRACT

Anticipatory action (AA) is a growing area of climate and disaster risk management that emphasizes the use of climate services and risk analyses to predict where crises might strike and enable action to prevent or mitigate impacts before disasters occur. Based on interviews with stakeholders involved in Red Cross Red Crescent (RCRC) AA programs in 18 countries, we identify common benefits and challenges associated with AA programs. We find that RCRC AA programs have built capacity within National Societies, leading to more proactive operations and expedited humanitarian response. Initial investments in AA can also develop key partnerships and facilitate later scaling-up by other organizations. AA can also overcome common challenges in climate services by providing a framework and decision-making and resources for early action. Despite these benefits, AA practitioners struggle with challenges common to climate services, development, and humanitarian aid, including local project ownership, capacity and infrastructure, integration with existing systems, data availability, forecast uncertainty, and monitoring and evaluation. Given these challenges, we reflect on how AA might be able to address challenges of ownership and capacity building and what donors can do to facilitate shifts toward longer-term capacity building.

1. Introduction

Climate change is increasing the frequency and intensity of some extreme hydrometeorological events (IPCC, 2021). Concurrently, scientists are continually improving their capacity to model and predict hydrometeorological (and other) hazards (Bierkens, 2015; Towner et al., 2019) and to improve the value of associated climate services for early warning systems and other efforts to reduce climate-related risks (Ficchi et al., 2021; Nauman et al., 2021; WMO, 2021). In conjunction with these trends, anticipatory (humanitarian) action (AA) has emerged as a risk mitigation strategy that attempts to bridge the gap between development, longer-term disaster risk reduction and post-disaster humanitarian response.

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Table 1
Overview of Red Cross Red Crescent AA programs consulted for this study.

Country (EAP Hazard)	Program status by time of publication	Early Actions
Bangladesh (Cyclone)	Activated May 2020	Assist people with evacuation – Help people move livestock/animals and assets to safety Provision of first aid at evacuation sites and shelters Distribution of food at evacuation sites/shelters Provision of artificial light at evacuation sites/shelters
Bangladesh (Riverine floods)	Activated June 2020	Cash transfer Activate and send volunteers to communities to reinforce early warnings and advise residents on activities
Ecuador (El Nino)	EAP approved but not yet activated	Sensitize communities in WaSH, First Aid, & other public health practices Support assessments and facilitate cooperation to secure additional funds and scale up as necessary Unconditional Cash Transfer
Ecuador (Volcanic Ash)	Activated September 2020	Distribution of individual water purification supplies (chlorine, tablets, drops, filters) Distribution of health-protection kits Unconditional Cash Transfer
Ethiopia (Riverine floods)	EAP approved but not yet activated	Distribution of livelihood protection kit Activate and send volunteers to communities to reinforce early warnings and advise residents on activities Disseminate early warning messages Distribution of individual water purification supplies (chlorine, tablets, drops, filters) Assist people with evacuation Assist people with evacuation - Help people move livestock/animals and assets to safety Clearing/digging drainage (from crop land and around homes)
Kenya (Riverine floods)	EAP approved but not yet activated	Dissemination of early warning messages on critical services likely to be affected and/or disrupted Support Physical Evacuation Placement of flood markers Activation of mobile health teams Prepositioning of mobile health equipment and emergency medical supplies, FA and PFA Referrals for women in labor Supporting physical evacuation Prepositioning & distribution of shelter and WASH non-food items Vaccination of people at risk, emergency medicines Vaccination and Treatment of livestock - this would address the risk associated with livestock
Kenya (Drought)	EAP in development	TBD
Lebanon (Winter storms)	EAP in development	TBD
Lesotho (Drought)	EAP approved but not yet activated	Early warning messages Unconditional cash transfers
Lesotho (Cold wave)	EAP in development	TBD
Mozambique (Cyclone)	Activated December 2020	Reinforce/protect housing, schools, or other infrastructure (Floods) - sandbags Distribution of individual water purification supplies (chlorine, tablets, drops, filters) TBD
Malawi (Riverine floods)	EAP in development	TBD
Mali (Riverine floods)	Activated September 2022	Assist people with evacuation Distribution of individual water purification supplies (chlorine, tablets, drops, filters) Filling sandbags to build dykes and protect critical infrastructure
Mozambique (Riverine flood)	Activated January 2022	Distribution of individual water purification supplies (chlorine, tablets, drops, filters) Activate and send volunteers to communities to reinforce early warnings and advise residents on activities Protect documents Disseminate early warning messages Distribute Insecticide-treated bed nets
Namibia (Drought)	EAP in development	TBD
Nepal (Floods)	EAP in development	TBD
Niger (Riverine floods)	Activated August 2022	Filling sandbags to build dykes and protect critical infrastructure Identify evacuation sites Assist people with evacuation Distribution of individual water purification supplies (chlorine, tablets, drops, filters) Millet and cowpea seed distribution Replenishment of Cereal Banks' reserves Cash transfer (vouchers)
Niger (Drought)	Activated April 2022	Unconditional Cash Transfer Sensitize communities in WaSH, First Aid, & other public health practices
Perú (Flood)	EAP approved but not yet activated	Provision of animal care kits (veterinary kits)
Perú (Cold wave)	Activated June 2018	Distribution of herder protection kits Distribution of warm clothing

(continued on next page)

Table 1 (continued)

Country (EAP Hazard)	Program status by time of publication	Early Actions
Peru (El Niño)	EAP approved but not yet activated	Assist people with evacuation Distribution of shelter insulation kits Distribution of tarps and tools kits to shelter livestock Sensitize communities in WaSH, First Aid, & other public health practices Install community water points Sensitize communities in WaSH, First Aid, & other public health practices Unconditional Cash Transfer Support assessments and facilitate cooperation to secure additional funds and scale up as necessary Support and reinforce health services Distribution of individual water purification supplies (chlorine, tablets, drops, filters)
Philippines (Typhoon)	Activated October 2022	Reinforce housing Cash for Work Help people evacuate their animals Help people to harvest key crops early
Philippines (Riverine floods)	EAP approved but not yet activated	Help people evacuate their animals Cash for Work Temporary relocation of vulnerable businesses Help people to harvest key crops early
Togo (Riverine floods)	Program paused	Radio spots and live interviews Water purification tablets Preparation of evacuation sites Protection of vital documents
Uganda (Riverine floods)	EAP approved but not yet activated	Community awareness Cash transfer Distribution of shelter kit Distribution of water purification supplies
Uganda (Drought)	EAP in development	TBD
Vietnam (Heatwave)	EAP approved but not yet activated	Sensitize communities in WaSH, First Aid, & other public health practices Unconditional Cash Transfer Cooling buses Community Cooling Shelters
Vietnam (Typhoon)	EAP in development	TBD
Zambia (Drought)	EAP in development	TBD
Zambia (Riverine floods)	EAP activated July 2021	Community sensitization and dissemination of forecast information, early warning and early action messages to communities Assess the status of evacuation routes and safe havens to be used as evacuation centres in elevated areas such as schools, clinics, places of worship Pre-position and distribution of non-food items Mobilization of communities to divert flood water by digging trenches/embankments Procure and distribute waterproof plastic bags for safe keeping of key documents Pre-position and distribution of WASH items Distribute materials on proper IEC hygiene, and sanitation Assess the pre-identified potential water sources and sanitation facilities at the evacuation centers Community sensitization and dissemination of early warning information on the early harvesting of flood threatened crops and on proper food storage and preservation in anticipation of floods Pre-positioning and distribution of food storage bags

AA—also called anticipatory humanitarian action, forecast-based financing (FbF), forecast-based action (FbA), early action, early warning early action, or risk-informed early action depending on the actor and the context—builds upon climate services (Hansen et al., 2022) to forecast extreme events and their impacts and to facilitate action. AA is different from previous uses of climate services for disaster risk management (DRM) in that 1) it has been driven largely by humanitarian actors, and 2) it pre-defines triggers and actions and allocates funding automatically when thresholds are reached. When an extreme event is forecast, AA systems fund the implementation of actions in the window between the forecast and the predicted disaster with the aim of preventing or reducing a hazard's impact on people's health, livelihoods, and property (Coughlan de Perez et al., 2014). While humanitarian organizations take different approaches to AA, most share three common characteristics: actions are agreed in advance; actions and locations are chosen based upon forecasts; and funding is guaranteed in advance (Hub, 2022). Fig. 1 outlines the development and approval process for RCRC FbF/FbA Early Action Protocols (EAPs), the term used for RCRC AA plans.

Through the development of FbF, the RCRC was a pioneer in and champion of the rapid expansion of AA. Since RCRC AA pilots began in five countries in 2015, 39 National Societies have taken up AA (IFRC, n.d.a). The International Federation of Red Cross and Red Crescent Societies (IFRC) has committed to dedicating 25 percent of funds dispersed through one of its main funding mechanisms for emergency response—the Disaster Response Emergency Fund (DREF)—to AA by 2025 (IFRC, 2020). Fig. 2 provides an overview of the structure of the RCRC and how its AA programs are developed and financed.

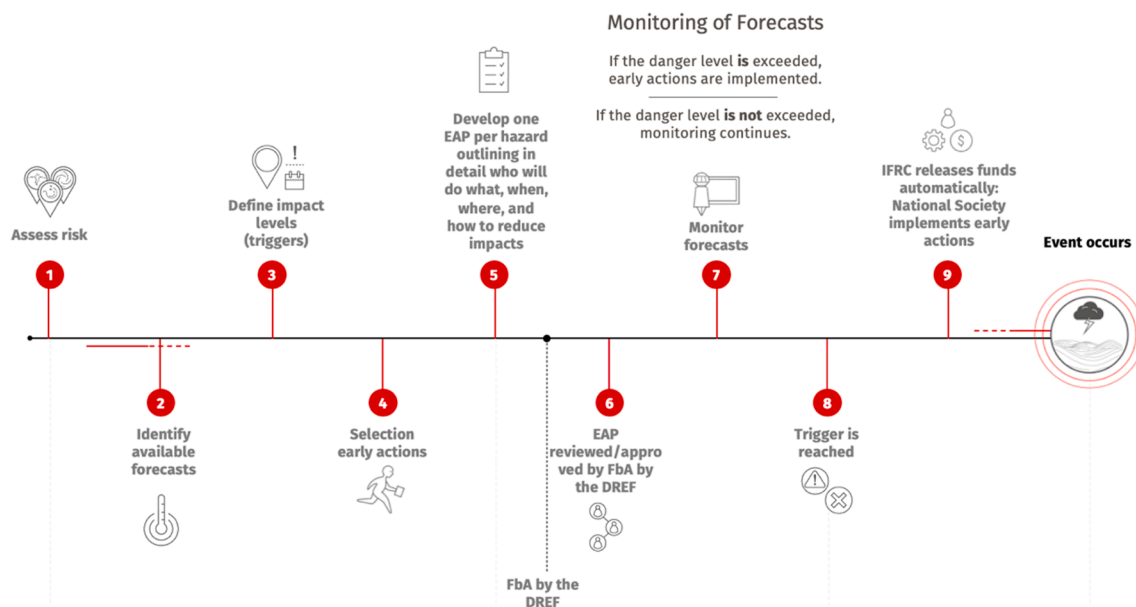


Fig. 1. Overview of RCRC development and approval process (Source: adapted from German Red Cross materials). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Growth in AA initiatives is not limited to the RCRC. Including AA programs by United Nations (UN) Agencies and non-governmental organizations (NGOs) like the World Food Programme (WFP) and the Start Network, over two million people in 57 countries are currently covered by AA plans (REAP, 2022). The Risk-informed Early Action Partnership (REAP) seeks to increase the number of people covered by AA to one billion by 2025 (Ibid.). Save the Children, the UN Food and Agriculture Organization (FAO), and the Government of Ireland are among other actors that have pledged to increase the share of their humanitarian funding allocated to AA from 15 to 25 percent (UNOCHA, 2021).

In the face of increased investment—and because AA is a newer approach to managing climate and disaster risks—there is a need to study and document lessons learned “across the full value chain of risk-informed early action” to improve existing systems and direct investments to where they will have the greatest impact (REAP, 2022, 6). Only through continued study will practitioners be able to ascertain the extent to which AA and other forms of risk-informed early action are meeting the promise of reducing response times, impacts, and financial costs, and of protecting development gains (ibid.).

Until now, much of the research on AA has focused on the development of forecast products and systems to support and trigger AA (Coughlan de Perez et al., 2016; Emerton et al., 2020; Centre, 2021; Lala et al., 2021; MacLeod et al., 2021a; MacLeod et al., 2021b; Nauman et al., 2021; Boulton et al., 2022). Studies have also attempted to demonstrate the benefits of AA compared to other forms of action (FAO, 2018a; FAO, 2018b; FAO, 2019; Gros et al., 2019; Bischiniotis et al., 2020; Gros et al., 2020; Weingärtner et al., 2020; Pople et al., 2021). Others draw lessons from specific cases (Tanner et al., 2019) for specific hazards (Levine et al., 2020), multi-hazard contexts (Tozier de la Poterie et al., 2021), or have examined how to scale-up and mainstream AA (Wilkinson et al., 2018; Wilkinson et al., 2020). Aside from an evaluation of the Start Network’s Crisis Anticipation Window (Turnbull et al., 2020) and internal reviews (Roots, 2021)—the latter being inconsistently available to the public—there are few studies that seek to evaluate and identify lessons from efforts to develop and implement AA systems more broadly. This is despite many AA systems requiring years of research, coordination, finance, and human-resource investment to set-up, and the fact that they introduce new concepts and challenges to the humanitarian system (Van den Homberg et al., 2020).

Critical reflection on experience thus far is essential to improving existing systems and investments going forward. Drawing on interviews with practitioners working on RCRC AA programs around the world, this research builds on the knowledge and experience of RCRC AA practitioners and partners around the world to identify lessons from practice. In doing so, it answers the following questions:

- What opportunities and challenges do RCRC actors and partners encounter when designing and implementing AA programs?
- Which of these findings are unique to AA and which reflect challenges common to international aid systems?
- How could AA practice be improved going forward?

As governments, donors, and humanitarian organizations seek to expand their investments in AA, lessons identified from eight years of RCRC practice can help both National Societies and others move forward more effectively.

We set the stage for our analysis by reviewing existing literature pertinent to our findings. After describing our methods and study limitations, we outline the primary co-benefits and challenges stakeholders in RCRC AA programs have encountered. We show that, as

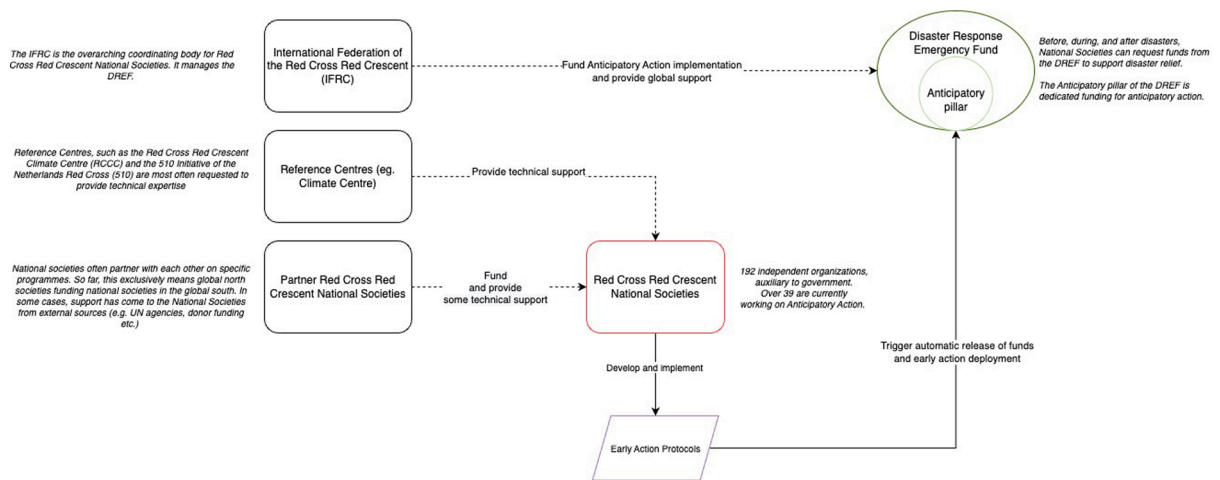


Fig. 2. Overview of the Red Cross Red Crescent network and AA funding.

an approach to aid that uses climate services to bridge the gap between disaster risk reduction (DRR) and humanitarian aid, AA overcomes some challenges of climate services but still suffers from many challenges associated with each modality. We conclude with a discussion of how AA may overcome these challenges and, through donor advocacy, become a catalyst for larger changes in international humanitarian assistance.

2. Background: The context for anticipatory action

Advocates of AA position it as a means of improving the effectiveness, efficiency, and dignity of humanitarian aid (AATF, 2022; Hub, 2022). We demonstrate that in using climate services to fill gaps between longer-term DRR and traditional humanitarian response, AA practitioners confront previously-documented challenges associated with climate services, longer-term development, and humanitarian aid. Here we highlight relevant discussions surrounding these kinds of aid to provide context for the results and discussion that follow.

2.1. Challenges in international aid

While their concepts overlap and many have called for greater integration across fields (Schipper, 2009; Hinds, 2015; Kelman et al., 2015; Thomalla et al., 2018) development, DRR, climate change, and humanitarian response often operate in silos and with separate funding streams and systems (Schipper et al., 2016; Raikes et al., 2021). No matter which silo is at work, international aid is informed not purely by need, but by donor's geopolitical priorities (Atmar, 2001) and recipient government's agendas (Tozier de la Poterie et al., 2018). It is distributed through political systems characterized by power imbalances and indirect accountability chains (Stiglitz, 2003; Wenar, 2006; Winters, 2010; Renzio, 2016). Aid programs are often designed and implemented by foreign actors with limited knowledge of local contexts and based on donor schedules (Ferguson and Lohmann, 1994; Basher, 2006; Chambers, 2008; Gaillard and Mercer, 2013; Baudoin et al., 2016), factors that preclude ownership, hinder sustainability (Theisohn and Lopes, 2003; Gibson et al., 2005) and undermine local capacities (Ali et al., 2021).

Over the decades, scholars and practitioners have advanced appropriate technologies (Murphy et al., 2009), participation (Chambers, 1994; Twigg et al., 2001), ownership (Poulligny, 2009), capacity building (Nightingale, 2012), and localization (ICVA/ODI, 2016) as means of overcoming these challenges. Although these concepts have been variously enshrined in international agreements (OECD, 2005; Nations, 2015; Bargain, 2016; Pörtner et al., 2022), meaningful reforms are difficult to institute in practice (Roepstorff, 2020; Frennesson et al., 2022). "Lessons" often remain unlearned (Berg, 2000; Cornwall, 2008; Glantz et al., 2014) and concepts are co-opted, repackaged, and recycled (Williams, 2004; Cornwall and Brock, 2005; Leal, 2007).

2.2. Challenges with climate services

Despite optimism that climate services can improve decision-making, thereby reducing the need for aid and bettering aid outcomes (Cane et al., 1994; Haile, 2005; Braman, 2008), extensive research has documented the technical, political, and socio-economic challenges of realizing these benefits. Precipitation forecasts often do not provide sufficient detail regarding the timing, intensity, or distribution of rainfall to facilitate agricultural, fishery (Broad et al., 2002; Patt and Gwata, 2002; Patt et al., 2007) or humanitarian decisions (Tozier de la Poterie et al., 2018; Bazo et al., 2019). Communication channels (Pfaff et al., 1999; Vogel and O'Brien, 2006), trust in forecasts (Callahan et al., 1999), community power dynamics (Carr and Onzere, 2018), politics (Betsill et al., 1997), and the resources to act (O'Brien et al., 2000; Lemos and Dilling, 2007; Tozier de la Poterie et al., 2018), are among the factors that constrain individual and humanitarian responses to climate services. Similarly, when forecast skill is uncertain, humanitarian actors may be

reluctant to act (Bazo et al., 2019) as the political repercussions of acting in vain outweigh incentives to wait (Bailey, 2012). As a result, climate services may exacerbate inequalities (Lemos and Dilling, 2007; Haines, 2019; Nost, 2019).

Echoing the emergence of participation and other “buzzwords” in development, co-production—defined loosely as a process by which users and producers jointly define, develop, deliver, and evaluate (climate) services (Vincent et al., 2018)—is increasingly accepted as essential to developing effective climate information and services (Cash, 2006), disaster risk reduction, and climate change adaptation programs (Daly and Dilling, 2019). In practice, like other buzzwords, effective coproduction remains challenging, political (Ibid.; Haines, 2019). It is against these challenges that AA emerges on the aid scene.

3. Methods

The findings of this study are based on interview data from what began as four separate studies of RCRC AA initiatives: reviews of RCRC investments in AA in Bangladesh and Southern Africa (Namibia, Lesotho, and Mozambique), a global study of successes and challenges experienced by stakeholders supporting RCRC activities in 18 countries (Table 1), and an evaluation of lessons learned from cyclone EAP development and (test) activations in Mozambique. These studies are grounded in problem-oriented policy analysis, in which research questions are driven by policy objectives rather than theory (Weiss, 1972). The goal of policy-oriented research is to help decision-makers improve their programs through context-specific reflections on what is and is not working in their programs (Schneider, 1986).

Although originally separate studies, data collection and analysis for each study was led by the first author with support from co-authors, who conducted in-person semi-structured interviews in Mozambique and Bangladesh. Because the objective of each study was the same—to learn from experience thus far—each informant was asked to respond to the same core questions, describing without prompting the primary successes and challenges of developing and implementing AA programs (see Annex 1).

In each case, the team produced a list of initial informants in consultation with German Red Cross AA staff, based on their knowledge of established AA programs as of 2020. Informants in Table 2 were selected because of their role in implementing, managing, supporting—or funding in the case of a few donors—RCRC AA programs. We used snowball sampling to identify additional informants and countries, continuing until we reached saturation.¹ For the studies listed in Table 3, we endeavored to include all stakeholders with a role in developing or implementing RCRC AA, including representatives from other humanitarian organizations, government agencies, and national hydrometeorological services. The research team followed strict ethical guidelines to protect informant’s identities. All informants provided their informed consent to be recorded and have their anonymous responses contribute to program evaluations and subsequent publications.

Altogether the research team conducted, transcribed, and qualitatively coded interviews with 139 informants.² The lead author used qualitative coding software to analyze the transcripts according to the questions in the interview guide, developing codes grounded in the data as themes emerged (Walker and Myrick, 2006; Corbin and Strauss, 2008). Interview data are further supported by published and non-published reports, when available. Through this analysis, we observed reoccurring themes across contexts and combined the results to provide a more comprehensive picture of the lessons identified from RCRC experience with developing and implementing AA.

3.1. Limitations

The benefits and challenges presented below are based upon key informants’ perceptions rather than systematic measurement of the phenomena in question (e.g., improved response times, capacities built). These informants also do not include the recipients of forecast-based support and therefore cannot speak to the relevance or benefit of early actions themselves. Nevertheless, they are based on the expert judgement of informants with extensive experience in humanitarian operations.

Because of the lead author’s affiliation with the RCRC, it is possible informants were hesitant to provide critical feedback, thereby positively skewing the results. To promote candid responses, the lead author framed the research as a learning exercise intended to improve policy and practice. The second and third authors, who were unaffiliated with the RCRC outside this research, conducted interviews in Bangladesh and Mozambique. All informants were assured that no one beyond the interviewer and the lead author would have access to identifiable data, that all written reports and studies would contain only aggregated or anonymized data, and that their responses would not affect prospects for program support. It is impossible to know whether informants withheld details, but we found participants eager to discuss the challenges they face in the interest of improving programs.

Finally, at the time of most of the global interviews (late 2020), the majority of RCRC experience was with fast-onset hazards. Since that time, the RCRC and partners have begun working on slow-onset hazards. Evidence from Namibia and Lesotho was added in 2022 to begin to address this challenge, but as they have not yet implemented their protocols, challenges with slow-onset hazards may not be fully captured.

¹ Informants from Lebanon were added in 2022 in response to informants who suggested their more recent experience would be valuable.

² Because these were originally four studies, and because data was collected after three separate activations in Mozambique, some informants were interviewed multiple times. Each informant is counted only once in this total.

Table 2
Informants for country-specific studies.

Country	Partner National Societies	National Society	Red Cross Red Crescent Reference Centers	IFRC	Donors	Total informants per country/category
Donors	–	–	–	–	3	3
International support	1	–	–	2	–	3
Ecuador	1	–	–	–	–	1
Ethiopia	1	–	1*	–	–	2
Kenya	–	–	1*	–	–	1
Lebanon	1	2	–	–	–	3
Malawi	1	–	1*	–	–	2
Mali	4*	–	–	–	–	4
Nepal	2*	–	–	–	–	2
Niger	2*	–	–	–	–	2
Perú	1	–	–	–	–	1
The Philippines	2*	–	1*	–	–	3
Togo	1	–	–	–	–	1
Uganda	–	–	1*	–	–	1
Vietnam	1*	–	–	–	–	1
Zambia	2*	–	–	–	–	2
(Unique informants)	(18)	(2)	(2)	(2)	(3)	32 (27)

* Informants were involved with, and hence provided information for, multiple countries.

4. Results

To identify lessons, each informant elaborated the successes and challenges they encountered in their work on AA. Here we review the primary themes that emerged across these conversations.

4.1. Achievements and benefits of AA programs

Our interviews revealed that through investments in planning, preparedness, training, coordination, and simulation, RCRC AA programs often affect positive changes that go beyond AA. These *co-benefits* of developing AA systems, include fostering a more proactive approach to disaster risk reduction, expedited funding and response, better collaboration with partners, and gradual progress toward the institutionalization and scaling up of AA. We describe each co-benefit below.

4.1.1. Building broader capacities

Our interviews suggest that the benefits of AA go beyond the direct benefits to assisted communities. Forty-nine percent of our informants cited RCRC capacity building as a primary benefit of setting up AA systems. For example, anticipatory cash transfers are a key component of Bangladesh Red Crescent Society's (BDRCS) EAPs. The "*readiness work that BDRCS has done with the response department and their DRM department for [AA] has obviously helped in broader response readiness*" (KII_B32), particularly with respect to managing and distributing funds. In Mozambique, emphasis on advance procurement and prepositioning represented "*an advantage for [Mozambique Red Cross (CVM)] and for the entire logistical system*" (KII_M01). These results indicate that process of developing anticipatory structures and procedures builds capacities within the National Society, thereby improving response operations.

Our informants further indicated that AA strengthens local capacity by helping to overcome limitations to contingency plans that cause them to become "stuck on a shelf" (Choularton, 2007). These include inadequate training or practice (Perry and Lindell, 2003), insufficient funding, a reluctance to allocate substantial resources to low-probability events (McConnell and Drennan, 2006; Mabaso and Manyena, 2013; Tozier de la Poterie et al., 2018), and poor connection to vulnerability analyses or to early warning systems to set them in motion (Mabaso and Manyena, 2013). By setting triggers, establishing procedures for monitoring forecasts and selecting beneficiaries, and providing funding for preparedness, training, and simulation, as well as the early actions themselves anticipatory funding mechanisms overcome these challenges. Within the RCRC, the Anticipatory Pillar of the DREF outlines a process for continual updates and revisions. As one informant described, AA is like the "*2.0 of contingency plans. In the past National Societies obviously had contingency plans, but they were really quite general,*" whereas with FbF "*you need to have a budget...and have everything planned out*" (KII_G_14). The above findings suggest that AA can contribute positively to humanitarian efforts to strengthening local capacity.

4.1.2. Shift in mentality from reaction to anticipation

Although *preparedness* has been a concept in DRM for some time (Hémond and Robert, 2012), humanitarianism remains largely reactive (Levine et al., 2020; Chavez-Gonzales et al., 2022). RCRC staff in Bangladesh, Mozambique, Lesotho, Togo, Mali, and Niger believe that a shift from reactive response to approaches based on prepositioning and planning was a core achievement of AA: "*[AA] work has really built a much more proactive attitude and way of working within the national societies*" (KII_G09). This was evident in Mozambique, where prior to AA, CVM "*was accustomed to acting 72-hours after the occurrence of a disaster*" rather than 72-hours before (KII_M09). In Bangladesh, 58 percent of informants echoed the sentiment that "*[AA] changed the mindset of BDRCS not to be a response-*

Table 3

Informants for the global lessons study.

Country (year consulted)	National Society Headquarters	National Society branches	IFRC & Partner National Societies & Climate Centre	National University partners	UN & NGO partners	Hydrometeorological partners	National Government DRM stakeholders	Regional Government DRM Stakeholders	Donors	Total informants per country
Bangladesh (2020 & 2021)	4	13	11	–	5	–	3	5	–	41**
Lesotho (2022)	4	–	7*	1	1	1	2	–	–	16
Mozambique (2020, 2021 & 2022)	21	7	12*	1	3	4	3	8	–	59**
Namibia (2022)	2	–	7*	1	1	1	3	–	1	16
(Unique informants)	(31)	(20)	(21)	(3)	(10)	(6)	(11)	(13)	(1)	132 (116)

* Informants were involved with, and hence provided information for, multiple countries.

**Two informants in Bangladesh and two in Mozambique were also interviewed for the global study.

oriented organization anymore. [The National Society] is thinking ahead of time, and now the response department and DRM department, they are working together” (KII_B32).

This shift extends beyond National Societies. Overall, 50 percent of our informants—including government, UN, and NGO partners—mentioned that AA has changed humanitarian attitudes in their country. As a result of RCRC and UN engagement with government actors, governments in Bangladesh and the Philippines have begun allocating local funds for action in advance of extreme events (Tozier de la Poterie, 2021a; Tozier de la Poterie, 2021b). Evaluations of other AA projects support the finding that changing mentalities is a critical aspect of setting up anticipatory systems (Gettliffe, 2021b). Our informants believe this shift improves humanitarian response beyond the execution of AA by increasing the culture of planning and preparedness.

4.1.3. Expedited response

While quantitative assessment of reductions in logistical costs have yet to be done, there is broad consensus among RCRC staff and external stakeholders that by mapping activities and responsibilities in advance, pre-positioning items, and providing automatic funding, AA contributes to faster response (KII_SA01, G07, 14, 17, 19, M02, 03, 07, 10, 12–16, 19, 20, B19). After cyclone Idai in Mozambique in 2019, CVM and IFRC surge personnel drew on the analysis in the cyclone EAP to develop and submit their response appeal “in record time” (KII_M04): the day the cyclone made landfall. Before cyclone Ana, CVM again used the knowledge and experience acquired through AA to secure response funds—additional to anticipation funds—rather than waiting until after impacts were felt to conduct assessments. Stakeholders in Bangladesh report a similar AA-driven impact on response and logistics: “Now National Societies can do response activities immediately. [AA] has reduced the cost of our logistics, and it has reduced the loss and damage a lot comparing to the past scenario” (KII_B31). These sentiments echo the findings of a qualitative evaluation in Mongolia (Carthy and Tuvendorj, 2021) and an evaluation of non-RCRC AA in Senegal (Start Network, 2020) that also find AA expedites traditional response. These results suggest that the capacity building and shift in mindset facilitated by AA can translate into more efficient and speedier National Society humanitarian response.

4.1.4. Better collaboration with partners

Setting up AA systems requires National Societies to collaborate and coordinate closely with National Disaster Management Agencies, hydrometeorological services, and other key stakeholders. Informants in 11 countries,³ including government officials in Bangladesh, Lesotho, and Mozambique noted increased communication between National Societies and national forecasting and disaster management agencies because of AA projects. In Vietnam, AA-collaboration led to the development of new, tailored forecast products. In Mali, relationships built through monthly AA meetings with government ministries facilitated joint simulations and later enabled coordination during response to the pandemic (Tozier de la Poterie et al., 2021). Informants from the UN, NGO partners, and the Government in Bangladesh (KII_B02, 06, 21, 25, 26, 28, 31, 34, 35, 39) cited increased collaboration as a factor in the inclusion of AA in Bangladesh’s Standing Orders on Disaster (SOD), the policy document that governs disaster management in the country (Bangladesh, 2019). This set the stage for the creation of a National Government Taskforce on AA in 2021 to coordinate and expand AA across the country (KII_B39). Inter-organizational collaborations between national actors are essential to strengthening implementation capacity and expansion long-term.

4.1.5. Laying the groundwork for scaling up

Stakeholders across the board agree that AA must reach more people if it is to make a substantial dent in humanitarian impacts (KII_B01, 03, 12, 15, 22, 27, 31, 32, M01-03, 07, 09, 13, 20, G04, 07, 09, 10, 12, 14; ERC, 2021; Roots, 2021). RCRC investments in AA systems have enabled other organizations and donors to establish and scale up their own anticipatory mechanisms relatively quickly. In Bangladesh, the World Food Programme (WFP) adopted BDRCS triggers in their flood AA plans, and the two organizations collaborate significantly on targeting recipients to prevent duplication and reach additional households (KII_G03; Tozier de la Poterie, 2021b). Further capitalizing on the risk analysis, triggers, early actions, and relationships built by the RCRC, in 2020 an AA pilot funded by the United Nations Central Emergency Relief Fund (CERF) was able to reach 220,000 people before they were affected by flooding (Seppo, 2020; Gettliffe, 2020). CERF built similarly upon trigger development work done by RCRC to quickly scale up early action in the Philippines (FAO 09 July 2021).

RCRC efforts have also catalyzed government interest and investment in AA. In addition to Bangladesh including AA in its national disaster plans, at least two local governments in the Philippines have allocated government preparedness funding for typhoon shelter reinforcements and livestock evacuation, early actions identified by the PRC. Local governments will use PRC’s typhoon forecast triggers and rely on the PRC to support training on AA, procurement, and implementation in the hopes of expanding the reach of early action (KII_P01; Tozier de la Poterie, 2021a). These examples demonstrate that through strategic partnerships, investments in anticipatory systems and capacity-building can contribute to rapid scaling of AA by other stakeholders. They also demonstrate that investments in training and procurement improve local DRM in general.

4.2. Challenges

Additional to the benefits outlined above, there are also areas in which RCRC AA programs can be improved. The following section

³ Kenya, Mozambique, Bangladesh, Philippines, Vietnam, Mali, Nepal, Zambia, Ethiopia, Lebanon, and Lesotho. Reports on anticipation programs in Malawi also noted the same.

describes the shared challenges that emerged.

4.2.1. Project approach & National Society ownership

As often encountered in development projects (Gibson et al., 2005), the most significant challenge facing National Societies is a lack of National Society ownership of AA development processes and systems. Informants representing projects in eight countries specifically cited lack of ownership as a primary concern (e.g., KII_N02, G03, 18, 19, SA02, 54, M01-03, 06, 07, 15, 17, MCH19, 20, 24). Most RCRC AA protocols and systems are developed through “projects,” designed and supported by Partner National Societies and other external technical experts and managed primarily by new hires at National Society headquarters. External support is particularly critical when it comes to risk analysis and trigger development. In many instances, this results in “*protocols designed at the top level, but when it comes to activation, [National Societies] want the involvement of the province and the district, which were not involved in their conception*” (KII_MI07). Regional and branch staff are “trained” on protocols developed at national headquarters, reinforcing perceptions among existing National Society and government staff that AA is yet another project conceived by foreigners or newcomers to the National Society. These challenges are not specific to RCRC AA: process evaluations from recent UNOCHA activations note the need for greater training at the local level and for clearer delineation of roles and responsibilities (Gettliffe, 2020; Gettliffe, 2021a; Gettliffe, 2021b).

Informants link this lack of ownership to the top-down, externally driven, project approach to RCRC AA initiatives to date and the highly technical, resource intensive process of developing and approving EAPs (KII_G03, N02, 05, M01-03, 06, 07, 11, 15). When project timelines interfere with the development of connections to existing systems, project-based constraints can contribute to AA developing in a silo rather than integrating with existing programs and leveraging existing relationships with the broader DRM system (e.g., KII_L03, L04, L08, N05, M37). They can also lead to pressures for external actors to push the project forward, bypassing local actors and undermining long-term relationship building and buy-in (KII_N02, G29).

Furthermore, building internal understanding of and support for AA takes a long time. Twenty percent of our informants explicitly mentioned the “*need to plan ample time to really ensure that you have the key stakeholders ...and have strong buy-in also internally from [the National Society]*” (KII_G16). Because of funding cycles, no National Societies have been able to plan for long-term engagement from the outset, but National Societies in Bangladesh, Mozambique, and the Philippines have each secured multiple rounds of project funding to build momentum and promote sustainability (KII_G09, G12, G14, MI01, MI14, MCH02, MCH03, MCH21, MCH 22, G12, B25, B27, B32). The need for long-term stakeholder engagement is something also experienced during OCHA AA projects in Somalia, Ethiopia, Bangladesh (Gettliffe, 2020; Gettliffe, 2021a; Gettliffe, 2021b), but such engagement can be difficult to sustain given capacities and funding cycles.

4.2.2. Insufficient local-level and organizational capacity

Similar to other aid programs (Theisohn and Lopes, 2003), a lack of on-the-ground training, ensuing capacity gaps, and a dearth of localized resources to develop or sustain that capacity, are critical challenges facing AA. Over half of our informants—including many from the government—mentioned the need to build local-level capacity through additional trainings and simulations at the regional and community-level. As noted above, protocols are developed nationally, often with limited involvement from regional offices and community stakeholders. Consequently, the concept of AA is still poorly understood by disaster management authorities at the sub-national level (KII_B32, B35, B13, MI04, MI06-09, MI11, MI14).

Stakeholders with activation experience observe that quick, effective implementation depends upon the knowledge and ability of regional and local staff and volunteers that is often lacking. As explained by a government representative in Mozambique, “*What is the point of activating the protocol without first ensuring training for the communities that are the first responders to disasters? The part that has failed in these protocols is the involvement of the communities*” (KII_M11). These findings are corroborated by post-activation reports from Mozambique, Bangladesh, Ecuador, and the CERF pilot evaluation from Ethiopia (Gettliffe, 2021a), all of which note the importance of local training, preparedness, and simulations whilst acknowledging difficulties of scaling-up such methods to all potentially affected communities.

Technological solutions that are not adapted to local context and capacities often fail (Murphy et al., 2009). Similarly, our informants questioned long-term organizational capacity to sustain the protocols. Many were concerned that National Societies would lack the funding or technical expertise to maintain AA systems when external support ends (KII_MCH03, MCH21, MCH23, MCH27, MCH32, MI01, MI07, B02, B04, B06, B08, B09, B12-16, B27, B28, B30-33), a finding supported by an internal review of the Fund’s pilot phase (Roots, 2021). Stakeholders in Bangladesh agreed that additional internal technical capacity would be needed for BDRCS to continue monitoring and interpreting the forecasts and geographic data for the trigger (KII_B01-05, B07, B11, B13, B17, B25, B27-29, B32, B33, B35). These concerns are compounded by constrained budgets, high staff turnover, and the highly technical nature of AA. As noted by one informant, at the end of a project, “*we want to hand over all these [trigger] models that have been developed [externally]... which are way too complicated and complex. We asked [the National Society] to take all this over, but then what? I really think we need to scale down in terms of, ‘what can the National Society really achieve?’*” (KII_G29). Overall, 25 percent of informants representing seven countries expressed some concern regarding sustainability for lack of local capacity.

The importance of local capacity and ownership is further reinforced by experiences in Lesotho and Lebanon. DRM staff in these National Societies described their AA programs as demand-driven and highlighted early stakeholder engagement and buy-in from National Society leadership. Stakeholders with experience supporting AA in multiple countries further emphasized how high staff capacity and leadership at all levels of the National Societies were contributing to rapid integration with existing programs (KII_G19, 26, 28, 29). Unsurprisingly, where initial enthusiasm and capacity for implementation is higher, programs take hold more rapidly.

4.2.3. Alignment with existing systems

Alignment with existing early warning thresholds and warning systems is another point of contention. As a humanitarian mechanism, RCRC AA seeks to mitigate the impact of extreme events rather than localized, perennial events; therefore, IFRC approves funding for events that occur, on average, once in five years (IFRC, n.d.). Community members and government officials may define or experience disasters differently (KII_B32, B35, MI09; Weingärtner and Spencer, 2019). For example, in 2019, Bangladesh's disaster management agency "[expected] some level of activities to happen when flag 1 or flag 2 [went] up," but BDRCS's AA program only triggers for cyclones predicted to have winds above 125 km/hr. Consequently, RCRC staff were "embarrassed" while "sitting [in a meeting with government ministers] who asked suddenly, 'what is BDRCS doing and [BDRCS said], 'Oh! Early Action Protocols were not triggered and that's why we cannot do anything from AA'" (KII_B32). In many countries, essential DRM stakeholders do not fully comprehend how and when AA works and have difficulty describing how AA fits within the DRM continuum. By at times creating tensions rather than synergies with existing systems, these failures to integrate—or at least to clarify the role of AA in overarching systems—complicate implementation, threaten long-term sustainability, and limit scalability (KII_G02, M11, M17, MCH23, B32, B35).

4.2.4. Data availability and sharing

A primary challenge in setting up AA systems has been securing access to quality hazard, impact, and vulnerability data with which to develop reliable forecast triggers and accurately target those most at risk (GRC, RCCC & IFRC, 2020). Informants in eight of the 18 countries covered by this study described challenges procuring at least one, if not all, these categories of data (KII_G04, G08, G14, G17, G18). Detailed hydrometeorological (or other hazard) data often has gaps, must be pieced together from various sources, or has not been digitized and controlled for quality. Impact data is also fragmented, imprecise, or not available at the scales needed for analysis. Without impact data, National Societies "really struggle...to establish the trigger for the different locations" (G04). In at least four countries, relevant data existed, but National DRM, statistical, and hydrometeorological agencies who had hazard, demographic, and impact data refused to share it with the National Society for financial or political reasons despite extensive outreach by the National Society. Furthermore, where national lists are used to identify vulnerable households, they may be outdated, subject to political bias, or exclude the most vulnerable households (KII_B01, B13, B15; Carthy and Tuvdendorj, 2021). Other actors in AA face similar complications (Van den Homberg et al., Forthcoming), resulting in triggers that do not optimally include exposure and vulnerability information. As with climate services more generally, difficulty accessing data reflects global power dynamics and economic considerations (Li, 2019; PMI 22 September 2010; Zillman, 2019; Tozier de la Poterie and Daly, 2022), representing another structural challenge to the development of AA systems.

4.2.5. Urgent implementation vs Logistical challenges

Delays and transportation challenges are not new in humanitarian aid (Long and Wood, 1995; Balcik et al., 2010; Hamed et al., 2012), but in the context of fast onset hydrometeorological hazards, logistical and bureaucratic challenges mean the difference between AA and early response. In keeping with findings from the Fund's internal review (Roots, 2021) and evaluations of non-RCRC programs (Gettcliffe, 2021a), the time required to receive funds from overseas (and the subsequent need to follow strict organizational procedures) are common sources of delay (B24, B25, B28-29, B31, B34, MCH02, MCH23, MCH28, MI04, MI06, MI19, G02, G07, G18). Funds for prepositioning, which are meant overcome this challenge, are often insufficient to overcome financial challenges, especially for under-resourced National Societies.

The challenges practitioners face in assisting the most vulnerable through climate services (Vogel and O'Brien, 2006; Bailey, 2013) persist with AA, but manifest differently than with other climate services. Instead of vulnerable households being unable to act on climate information, organizational capacity, bureaucracy, and poor infrastructure emerge as barriers preventing humanitarians from reaching those most at risk. As noted by a Mozambican informant, "one of the greatest challenges CVM faced was how to get [to communities]" (KII_M14). Because of poor infrastructure, long distances, and limited funds for prepositioning and warehouse capacity, some vulnerable areas in Bangladesh and Mozambique remain beyond the National Societies' reach within the short AA window (KII_M01, B08, B11, B31). Mozambique's EAP explicitly notes "CVM operational capacities and readiness to support the early action operation at district level (e.g., existence of trained CVM volunteers, logistical feasibility, and access to at-risk communities) will be taken in consideration in the identification process of the districts of intervention" (CVM, 2021). Indeed, on several occasions, National Societies in Bangladesh and Mozambique have been unable to reach the full number of target recipients because of transportation challenges, lack of personnel, and events that make landfall earlier than predicted (KII_MCH03, MCH07, MCH20). Even without trying to reach the most remote areas, transport challenges (KII_B02, B14, B15, B29, B32, MCH02, MCH25), electricity, and connectivity issues (KII_M09, MCH25, B09, B12, B13, B14, B15, B16, B17, B31) before or during extreme weather events can cause delays, jeopardize staff and volunteer safety, and complicate early action. These problems are compounded by weak regional capacity and training, meaning that headquarters staff must travel to manage activations rather than delegating implementation to local branches (KII_MCH03, MCH07, MCH14, MCH13, MCH19).

4.2.6. Forecast skill, uncertainty, and scale

Our results also indicate that AA is not immune to challenges related to forecast skill, uncertainty, and scale that are well documented for other climate services. Just as seasonal forecasts often do not provide sufficient detail regarding the timing, quantity, or distribution of rain throughout a season or region to facilitate livelihood decisions (Broad et al., 2002; Patt and Gwata, 2002; Patt et al., 2007), it remains difficult for humanitarians to determine where to initiate AA based within the short window for action. Short lead-times have major implications for the kinds of actions that can be implemented, especially when combined with the logistical challenges above. For example, the uncertainty inherent to cyclone forecasts—which may be compounded by low forecast skill—can make

it difficult to accurately predict where in a country to act. Before cyclones Iдай and Chalane in Mozambique, the National Society began preparations in one province but had to shift to another before cyclones or intense rainfall began. Similarly, hazards that peak earlier than forecasted have meant that National Societies are unable to reach all intended recipients before impact (e.g., cyclones Chalane and Ana in Mozambique). Rapid intensification has meant National Societies do not activate for what eventually becomes a major event (e.g., typhoons Goni and Odette, the Philippines). Phased triggers (e.g., Bangladesh) can extend total activation time by allowing low-cost, low-regrets preparations before a full activation, but they do not overcome all the challenges of forecast uncertainty. Our results reiterate that forecast limitations, while not unique to AA or under the control of National Societies, must be considered when selecting the hazards and locations in which to develop AA programs.

4.2.7. Documenting impact

Finally, National Societies are also caught between the need to produce resource-intensive, quantitative evidence of impact for donors and their focus on ensuring recipient satisfaction, overcoming operational challenges, and improving service delivery. The RCRC approach to AA seeks to be grounded in science and evidence-based decision-making, and National Societies are encouraged to evaluate activations using quantitative impact studies derived through comparisons of impact between recipient and non-recipients of early action (GRC, RCCC & IFRC, 2020). Because it is impossible to predict where an activation will take place, National Societies cannot establish a baseline before an activation. Instead, they must attempt to identify non-recipient households with similar living conditions and socio-economic characteristics as AA recipients who also experienced the event with the same intensity and then compare outcomes. The newness of AA, small sample sizes for RCRC programs, and uncertain medium and long-term intervention effects pose additional challenges for ensuring statistical power. Together, these factors mean that collecting reliable data is a costly and highly technical process that is mismatched with National Society funding, and staff and volunteer expertise. In at least three countries, unsuccessful attempts to navigate these tensions led to failed evaluations and missed opportunities for learning. For example, following cyclone Chalane, CVM hired an external consultant to lead RCRC volunteers in quantitative data collection and realized only during data analysis that neither had understood key components of AA or the importance of research protocols. Because appropriate screening and sampling protocols were not in place, the data were not usable (personal communications).

5. Discussion

As we have demonstrated in the results above, despite being proposed as a significant change in paradigm and operations within the humanitarian community, AA suffers from a combination of documented challenges from across the development, DRR, humanitarian, and climate service communities. This suggests that, to some extent, the AA community might improve their programs by researching and internalizing lessons repeatedly identified by other climate services and DRR programs. Given the intractability of many of these challenges, after noting areas in which AA appears to overcome common challenges to forecast use, we consider how the AA community might overcome perennial challenges in humanitarian practice. Finally, we reflect on how changes in AA funding could contribute to changing problematic dynamics and suggest research to support improvements in AA going forward.

5.1. Overcoming climate service challenges

In several respects, AA systems appear to overcome known challenges with climate services. Perhaps most critically, by providing resources for action, AA overcomes resource constraints that have previously limited forecast utility for those most in need (Broad et al., 2002; Luseno, 2003; Vogel and O'Brien, 2006; Lemos and Dilling, 2007; Braman, 2008) and for humanitarian organizations (Tozier de la Poterie et al., 2018). Secondly, by automating decision-making and putting the decision to act in the hands of technical experts based on pre-determined criteria, AA triggers bypass challenges understanding probabilistic forecasts, which have plagued other climate services (Patt and Gwata, 2002; Lemos and Dilling, 2007; Suarez and Tall, 2010). The use of phased implementation triggers for certain hazards can also reduce documented difficulties with acting in the face of forecast uncertainty (Beven and Hall, 2014; Lopez, 2020) by allowing humanitarian actors and communities to begin with low-regrets actions and increase their investments as forecast certainty increases. Finally, AA has the potential to shift top-down dynamics in climate services (Cash, 2006; Garcia and Fearnley, 2012; Tozier de la Poterie, 2017) by fostering horizontal relationships between National Societies, local hydrometeorological services, and other DRM actors.

5.2. Adapting to the existing system

Given constraints of the current system, AA practitioners can do the following to improve AA programs.

5.2.1. Attention to assessing and strengthening local capacity

Adequate, sustainable local capacity is critical to maintaining any program after external support disappears. If AA is to be accessible to lower-resourced countries or organizations, programs must devote more attention to capacity strengthening. Supporting in-country capacity is in line with the approach taken by WFP in several contexts (G19, L01, 03, 04, M38, SA02), but many RCRC AA programs “focus on the development of the EAP and not so much on the capacity strengthening” (KII_G29, echoed by N02). Therefore, one of the first steps in any AA program should be assessing organizational capacities to sustain AA and creating and funding plans to develop and retain missing capacities. Where capacity is so low that minimum capacities are unlikely to be sustained long-term or policy changes and better enabling environments are needed to facilitate high-impact early action (e.g., legalization of cash transfers or

building networks of evacuation shelters), investments may be better channeled to these activities than to early action. As suggested in other evaluations, this focus on comprehensively assessing and strengthening capacities can begin with feasibility studies (Roots, 2021).

Where the necessary capacities cannot be sustained, it may also be possible to develop more flexible, less technical AA systems that lower barriers to entry. The Start Network's more collaborative approach to AA triggers and simplified procedures for accessing RCRC AA funds (simplified Early Action Protocols) are among existing models that allow organizations to operationalize AA using existing organizational and forecasting capacities without the stringent requirements currently imposed by the RCRC AA Fund.

5.2.2. Moving toward ownership

Ideally the decision to adopt AA programs would be demand-driven, but in a funding landscape where funding and geopolitical priorities exert significant influence on who gets what when, this is unlikely to always occur. Nevertheless, experience suggests there are ways to support local leadership in development of AA systems to overcome issues of ownership and sustainability outlined above.

The provision of on-going regional technical support rather than country-specific projects is one model that holds promise. Latin American National Societies interested in developing AA systems have access to regional materials and support, allowing them to explore AA, assess feasibility, secure internal commitment, and develop protocols at their own pace. Partner National Societies or the RCRC Climate Centre are available to provide technical support, but the process is led by existing staff with buy-in from National Society leadership. The approach also encourages multi-country workshops and exchange between and among national societies and technical agencies so that they can learn from each other. This approach is still focused on a single organization rather than multiple humanitarian agencies, and it has not yet been tested in other regions, where National Society capacity and context may be lower. Nevertheless, this approach represents a step toward decentralizing control of AA development away from the global North, thereby addressing challenges of ownership and sustainability produced by top-down, time-bound projects.

Increasing flexibility and reducing technical burden may be another way to shift the locus of control to national or local actors. More flexible, less technical trigger requirements would reduce reliance on external technical consultants and help actors account for differences in data quality and availability across countries and hazards. Designating a percentage of AA budgets 'flex' funds or granting local actors the ability to revise pre-planned early actions more easily could strengthen and increase local capacities and ownership, enabling local organizations or community actors to adapt to unforeseen situations and select solutions based on their context. Collectively, more flexible approaches will likely be essential to moving beyond proof-of-concept to enable scalability and expanding to non-weather hazards such as displacement, pests, disease outbreak, and conflict, and to anticipation of multi-hazards scenarios (Tozier de la Poterie et al., 2021).

5.3. Pushing the envelope: Toward systemic change

Beyond humanitarian practitioners, donors can have a major role to play in encouraging longer-term collaboration, as reflected in calls from the humanitarian community of practice (Montier et al., 2019; AATF, 2021). Our informants, other practitioners, and scholars have called for National AA frameworks in which stakeholders delineate organizational roles and responsibilities at various action thresholds and allow government and humanitarian partners contribute to a coherent plan according to their resources, priorities, and capacities (KII_G02, 24, B01, B14, B19, B20, B21, B24, B26, B27, B31, B32, B34, B35, N01, 02, 04–07, SA02, 11 52, 54, L05-06, M07, 22, 25; Montier et al., 2019). The shift from a top-down, siloed, project-based approach to AA (and other aid) to the coordination needed to produce sustainable systems and shift DRM paradigms requires funding designed to support long-term system development and capacity building rather than short-term projects.

5.4. Future research

Building National Society or local capacity is an ongoing challenge within the RCRC as well as humanitarian work as a whole (Poulligny, 2009), yet capacities are essential to sustainability and impact. Our research suggests that AA has a positive influence on risk management systems, but no research to date systematically tracks or measures capacity building and systematic or procedural improvements made possible by investments in AA. Likewise, there has been no consideration of the minimum capacities needed for AA programs to be successful. If the full value and contribution of AA to humanitarian action is to be understood and realized, organizations need to invest in measuring AA-related capacity strengthening and in comparing it to the benefits of investing in general preparedness. Future research should focus on understanding of the prerequisites for successful AA programs and the relative benefits and drawbacks of shifting to anticipation, allowing donors and practitioners to make informed decisions on how best to catalyze long-term capacity development for humanitarian action.

6. Conclusion

Our findings highlight the potential benefits of AA and the challenges that need to be overcome to realize these benefits, many of which are endemic international aid. By focusing their efforts on strengthening local capacity and ownership, AA may be able to incrementally improve outcomes related to these persistent challenges. By being aware of how power dynamics and project-based approaches hinder outcomes and by pushing for reforms that address these, perhaps AA practitioners will contribute to a shift in the dynamics of aid.

Declaration of Competing Interest

Several authors of this paper are employed by or are consultants for the Red Cross Red Crescent. This affiliation has been disclosed at all stages of the research and every effort has been made to reduce bias in the findings.

Data availability

The authors do not have permission to share data.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.crm.2023.100476>.

References

- Aatf, 2021. *Enabling anticipatory action at scale policy brief for donor governments*. Anticipatory Action Task Force, Berlin.
- Ali, T., et al., 2021. Facilitating sustainable disaster risk reduction in indigenous communities: Reviving indigenous worldviews, knowledge and practices through two-way partnering. *Int. J. Environ. Res. Public Health* 18, 855. <https://doi.org/10.3390/ijerph18030855>.
- Atmar, M.H., 2001. Politicisation of humanitarian aid and its consequences for afghans. *Disasters* 25, 321–330.
- Bailey, R., 2012. *Famine early warning and early action: The cost of delay*. Chatham House, London.
- Bailey, R., 2013. *Managing Famine Risk: Linking early warning to early action*. The Royal Institute of International Affairs, London.
- Balcik, B., et al., 2010. Coordination in humanitarian relief chains: Practices, challenges and opportunities. *Int. J. Prod. Econ.* 126, 22–34. <https://doi.org/10.1016/j.ijpe.2009.09.008>.
- Bangladesh, G.O., 2019. *Government of the People's Republic of Bangladesh Standing Orders on Disaster 2019*. Government of Bangladesh, Dhaka.
- PMI (22 September 2010) 'No.gen/pmi/gfcs12010' Permanent Mission of India to the United Nations Offices, Geneva.
- Bargain, G. (2016) *The grand bargain—a shared commitment to better serve people in need*. Inter-Agency Standing Committee, Istanbul. 12 December 2022.
- Basher, R., 2006. Global early warning systems for natural hazards: Systematic and people-centred. *Philos. Trans. A Math. Phys. Eng. Sci.* 364, 2167–2182. <https://doi.org/10.1098/rsta.2006.1819>.
- Baudoin, M.-A., et al., 2016. From top-down to “community-centric” approaches to early warning systems: Exploring pathways to improve disaster risk reduction through community participation. *Int. J. Disaster Risk Sci.* 7, 163–174. <https://doi.org/10.1007/s13753-016-0085-6>.
- Bazo, J., et al., 2019. Pilot Experiences in Using Seamless Forecasts for Early Action: The “Ready-Set-Go!” Approach in the Red Cross. Elsevier, In *Sub-Seasonal to Seasonal Prediction*, pp. 387–398.
- Berg, E., 2000. Why aren't aid organizations better learners. *Learn. Develop. Co-Operation*.
- Betsill, M.M., Glantz, M.H., Crandall, K., 1997. Preparing for ei niño what role for forecasts. *Environ. Sci. Policy Sustain. Dev.* 39, 6–29. <https://doi.org/10.1080/00139159709604775>.
- Beven, K., Hall, J. (Eds.), 2014. *Applied uncertainty analysis for flood risk management*. Imperial College Press, London.
- Bierkens, M.F.P., 2015. Global hydrology 2015: State, trends, and directions. *Water Resour. Res.* 51, 4923–4947. <https://doi.org/10.1002/2015wr017173>.
- Bischiniotis, K., et al., 2020. A framework for comparing permanent and forecast-based flood risk-reduction strategies. *Sci Total Environ* 720, 137572. <https://doi.org/10.1016/j.scitotenv.2020.137572>.
- Boult, V.L., et al., 2022. Towards drought impact-based forecasting in a multi-hazard context. *Clim. Risk Manag.* 35, 100402 <https://doi.org/10.1016/j.crm.2022.100402>.
- Braman, L., 2008. Early warning, early action: an evaluation of IFRC West and central Africa zone flood preparedness and response. International Federation of the Red Cross Red Crescent Societies, Geneva.
- Broad, K., Pfaff, A.S.P., Glantz, M., 2002. Effective and equitable dissemination of seasonal-to-interannual climate forecasts: Policy implications from the peruvian fishery during el niño 1997–98. *Clim. Change* 54, 415–438.
- Callahan, B., Miles, E., Fluharty, D., 1999. Policy implications of climate forecasts for water resources management in the pacific northwest. *Policy Sci.* 32, 269–293.
- Cane, M.A., Eshel, G., Buckland, R.W., 1994. Forecasting zimbabwean maize yield using eastern equatorial pacific sea surface temperature. *Nature* 370, 204–205.
- Carr, E., Onzere, S., 2018. Really effective (for 15% of the men): Lessons in understanding and addressing user needs in climate services from mali. Carr, ER, and SN Onzere 82–95. <https://doi.org/10.1016/j.crm.2017.03.002>.
- Carthy, A., Tuvendorj, Z., 2021. *Anticipatory Action in Mongolia 2020: A qualitative evaluation*. Internal report commissioned by FAO and IFRC, Geneva.
- Cash, D.W., 2006. Countering the loading-dock approach to linking science and decision making: Comparative analysis of el nino/southern oscillation (enso) forecasting systems. *Sci. Technol. Hum. Values* 31, 465–494. <https://doi.org/10.1177/0162243906287547>.
- Centre, R.C.R.C.C., 2021. *Evaluation report of ocha's anticipatory action trigger: Ethiopia*. United Nations Office for the Coordination of Humanitarian Affairs, New York.
- Chambers, R., 1994. Participatory rural appraisal (pra): Challenges, potentials and paradigm. *World Dev.* 22, 1437–1454.
- Chambers, R., 2008. *Revolutions in Development Inquiry*. Earthscan, New York.
- Chavez-Gonzales, J. et al. (2022) 'Suffering as a matter of principle? Reflections on the ethics, policy, and practice of humanitarian action', *Unpublished manuscript*.
- Choularton, R., 2007. *Contingency planning and humanitarian action: A review of practice*. Humanitarian Practice Network at ODI, London.
- Corbin, J., Strauss, A., 2008. *Basics of qualitative research: Techniques and procedures for developing grounded theory*, 3rd edition. Sage publications.
- Cornwall, A., 2008. Unpacking 'participation': Models, meanings and practices. *Community Development Journal* 43, 269–283. <https://doi.org/10.1093/cdj/bsn010>.
- Cornwall, A., Brock, K., 2005. What do buzzwords do for development policy? A critical look at 'participation', 'empowerment' and 'poverty reduction'. *Third World Q.* 26, 1043–1060. <https://doi.org/10.1080/01436590500235603>.

- Coughlan de Perez, E., et al., 2014. Forecast-based financing: An approach for catalyzing humanitarian action based on extreme weather and climate forecasts. *Nat Hazards Earth Syst Sci Discuss* 2, 3193–3218. <https://doi.org/10.5194/nhessd-2-3193-2014>.
- Coughlan de Perez, E., et al., 2016. Action-based flood forecasting for triggering humanitarian action. *Hydrol Earth Syst Sci Discuss* 1–22. <https://doi.org/10.5194/hess-2016-163-RC2>.
- Cvni, 2021. Forecast-based financing early action protocol tropical cyclones. Mozambique Red Cross, Maputo.
- Daly, M., Dilling, L., 2019. The politics of “usable” knowledge: Examining the development of climate services in tanzania. *Clim. Change* 157, 61–80. <https://doi.org/10.1007/s10584-019-02510-w>.
- Emerton, R., et al., 2020. Emergency flood bulletins for cyclones idai and kenneth: A critical evaluation of the use of global flood forecasts for international humanitarian preparedness and response. *Int. J. Disaster Risk Reduct.* 50, 101811 <https://doi.org/10.1016/j.ijdrr.2020.101811>.
- Fao, 2018. Horn of Africa: Impact of Early Warning Early Action. Food and Agriculture Organization, Rome.
- Fao, 2018. Mongolia Impact of Early Warning Early Action: Protecting the livelihoods of herders from a dzud winter. Food and Agriculture Organization, Rome.
- Fao, 2019. Colombia: Impact of Early Warning Early Action. Food and Agriculture Organisation, Rome.
- Ferguson, J. & Lohmann, L. (1994) ‘The anti-politics machine: development and bureaucratic power in lesotho’, *Ecologist (United Kingdom)*.
- Ficchi, A. et al. (2021) ‘Flood forecast skill for early action: Results and learnings from the development of the early-action protocol for floods in uganda’, 10.5194/egusphere-egu21-16169.
- Frennesson, L., et al., 2022. “international humanitarian organizations’ perspectives on localization efforts”. *Int. J. Disaster Risk Reduct.* 83, 103410 <https://doi.org/10.1016/j.ijdrr.2022.103410>.
- Gaillard, J.C., Mercer, J., 2013. From knowledge to action: Bridging gaps in disaster risk reduction. *Prog. Hum. Geogr.* 37, 93–114. <https://doi.org/10.1177/0309132512446717>.
- Garcia, C., Fearnley, C.J., 2012. Evaluating critical links in early warning systems for natural hazards. *Environ. Hazards* 11, 123–137. <https://doi.org/10.1080/17477891.2011.609877>.
- Gettliffe, E., 2020. Process Learning from UN-OCHA 2020 Monsoon Anticipatory Action Pilot in Bangladesh. Centre for Disaster Protection, London.
- Gettliffe, E., 2021. Anticipatory Action Pilot in Ethiopia: Process learning on partnership and design. Centre for Disaster Protection, London.
- Gettliffe, E., 2021. Learning from Anticipatory Action Pilot in Somalia. Centre for Disaster Protection, London.
- Gibson, C.C., et al., 2005. The Samaritan’s dilemma: the political economy of development aid. Oxford University Press, New York.
- Glantz, M.H., et al., 2014. Working with A Changing Climate, not against It. Consortium for Capacity Building, Boulder.
- GRC, RCCC & IFRC. (2020) ‘Fbf practitioners: Manual a step-by-step approach for fbf implementation.’, German Red Cross, <https://manual.forecast-based-financing.org/en/>, accessed 29 June 2022.
- Gros, C., et al., 2019. Household-level effects of providing forecast-based cash in anticipation of extreme weather events: Quasi-experimental evidence from humanitarian interventions in the 2017 floods in bangladesh. *Int. J. Disaster Risk Reduct.* 41, 101275 <https://doi.org/10.1016/j.ijdrr.2019.101275>.
- Gros, C. et al. (2020) ‘The effectiveness of forecast-based humanitarian assistance in anticipation of extreme winters: Evidence from an intervention for vulnerable herders in mongolia.’, *Disasters*, 10.1111/disa.12467.
- Haile, M., 2005. Weather patterns, food security and humanitarian response in sub-saharan africa. *Philos Trans R Soc Lond B Biol Sci* 360, 2169–2182. <https://doi.org/10.1098/rstb.2005.1746>.
- Haines, S., 2019. Managing expectations: Articulating expertise in climate services for agriculture in belize. *Clim. Change* 157, 43–59. <https://doi.org/10.1007/s10584-018-2357-1>.
- Hamed, M., Haghani, A., Yang, S., 2012. Reliable transportation of humanitarian supplies in disaster response: Model and heuristic. *Procedia. Soc. Behav. Sci.* 54, 1205–1219. <https://doi.org/10.1016/j.sbspro.2012.09.835>.
- Hansen, J., et al., 2022. Impact pathways from climate services to sdg2 (“zero hunger”): A synthesis of evidence. *Clim. Risk Manag.* 35, 100399 <https://doi.org/10.1016/j.crm.2022.100399>.
- Hémond, Y., Robert, B., 2012. ‘Preparedness: The state of the art and future prospects’, *Disaster Prevention and Management: An. Int. J.* 21, 404–417. <https://doi.org/10.1108/09653561211256125>.
- Hinds, R., 2015. Relationship between humanitarian and development aid. *Governance and Social Development Resource Centre* 4.
- Hub, A., 2022. How anticipatory action makes a difference. Anticipation hub, Berlin.
- ICVA/ODI (2016) *Localisation in humanitarian practice*. Humanitarian Policy Group, ODI, London. 10 December 2022.
- IFRC (n.d.) *Practical information for national societies on forecast-based financing and funding from the dref*. International Federation of the Red Cross Red Crescent, 08 December 2022.
- Ifrc, 2020. Disaster Relief Emergency Fund: Strategic Ambition 2021–2025. International Federation of the Red Cross Red Crescent, Geneva.
- IFRC. (n.d.a) ‘Forecast-based action by the dref - overview of early action protocols’, International Federation of the Red Cross Red Crescent, <https://public.tableau.com/app/profile/ifrcgov/viz/NEWFBADashboard/Dashboard1>, accessed 29 June 2022.
- IPCC, 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
- Kelman, I., Gaillard, J.C., Mercer, J., 2015. Climate change’s role in disaster risk reduction’s future: Beyond vulnerability and resilience. *Int J Disaster Risk Sci* 6, 21–27. <https://doi.org/10.1007/s13753-015-0038-5>.
- Lala, J., et al., 2021. Optimizing forecast-based actions for extreme rainfall events. *Clim. Risk Manag.* 34, 100374 <https://doi.org/10.1016/j.crm.2021.100374>.
- Leal, P.A., 2007. Participation: The ascendancy of a buzzword in the neo-liberal era. *Dev. Pract.* 17, 539–548. <https://doi.org/10.1080/09614520701469518>.
- Lemos, M.C., Dilling, L., 2007. Equity in forecasting climate: Can science save the world’s poor. *Sci and Pub Pol* 34, 109–116. <https://doi.org/10.3152/030234207X190964>.
- Levine, S., et al., 2020. Anticipatory action for livelihood protection. Overseas Development Institute, London. Working Paper 580.
- Li, G., et al., 2019. Gap analysis on open data interconnectivity for disaster risk research. *Geo-spatial Information Science* 22, 45–58. <https://doi.org/10.1080/10095020.2018.1560056>.
- Long, D.C., Wood, D.F., 1995. Coordination in humanitarian relief chains: Practices, challenges and opportunities. *J. Bus. Logist.* 16, 213–229.
- Lopez, A., et al., 2020. Bridging forecast verification and humanitarian decisions: A valuation approach for setting up action-oriented early warnings. *Weather and Climate Extremes* 27, 100167. <https://doi.org/10.1016/j.wace.2018.03.006>.
- Luseno, W.K., et al., 2003. Assessing the value of climate forecast information for pastoralists: Evidence from southern ethiopia and northern kenya. *World Development* 31, 1477–1494. [https://doi.org/10.1016/s0305-750x\(03\)00113-x](https://doi.org/10.1016/s0305-750x(03)00113-x).
- Mabaso, E., Manyena, S.B., 2013. Contingency planning in southern africa: Events rather than processes. *Jamba: Journal of Disaster Risk Studies* 5. <https://doi.org/10.4102/jamba.v5i1.95>.
- MacLeod, D., et al., 2021. Are kenya meteorological department heavy rainfall advisories useful for forecast-based early action and early preparedness for flooding. *Nat. Hazards Earth Syst. Sci.* 21, 261–277. <https://doi.org/10.5194/nhess-21-261-2021>.
- MacLeod, D., Kniveton, D.R., Todd, M.C., 2021. Playing the long game: Anticipatory action based on seasonal forecasts. *Clim. Risk Manag.* 34, 100375 <https://doi.org/10.1016/j.crm.2021.100375>.
- McConnell, A., Drennan, L., 2006. ‘Mission impossible? Planning and preparing for crisis’, *Journal of Contingencies and Crisis management* 14, 59–70. <https://doi.org/10.1111/j.1468-5973.2006.00482.x>.
- Montier, E., Harris, C., Ranger, N., 2019. Disaster Risk Financing in Concert: how coordinated disaster risk financing can save more lives. Start Network, London.
- Nations, U., 2015. *Paris agreement*. Report of the Conference of the Parties to the United Nations Framework Convention on Climate Change (21st Session, 2015: Paris). Retrieved December 4, 12 December 2022.
- Murphy, H.M., McBean, E.A., Farahbakhsh, K., 2009. Appropriate technology – a comprehensive approach for water and sanitation in the developing world. *Technology in Society* 31, 158–167. <https://doi.org/10.1016/j.techsoc.2009.03.010>.

- Nauman, C., et al., 2021. Perspectives on flood forecast-based early action and opportunities for earth observations. *J. Appl. Remote Sens.* 15 <https://doi.org/10.1117/1.jrs.15.032002>.
- Nightingale, K. (2012) *Building the future of humanitarian aid: Local capacity and partnerships in emergency assistance*. Christian Aid, 08 December 2022.
- Nost, E., 2019. 'Climate services for whom? The political economics of contextualizing climate data in louisiana's coastal master plan', *Climatic Change* 157, 27–42. <https://doi.org/10.1007/s10584-019-02383-z>.
- OECD. (2005) 'The paris declaration on aid effectiveness (2005) and the accra agenda for action (2008)'.
- O'Brien, K., Sygna, L., Næss, L.O., Kingamkono, R., Hochobeb, B., 2000. Is information enough? User responses to seasonal climate forecasts in southern Africa. CICERO Report, Oslo.
- Patt, A., Gwata, C., 2002. Effective seasonal climate forecast applications: Examining constraints for subsistence farmers in zimbabwe. *Glob. Environ. Chang.* 12, 185–195. [https://doi.org/10.1016/S0959-3780\(02\)00013-4](https://doi.org/10.1016/S0959-3780(02)00013-4).
- Patt, A.G., Ogallo, L., Hellmuth, M., 2007. Sustainability. Learning from 10 years of climate outlook forums in africa. *Science* 318, 49–50. <https://doi.org/10.1126/science.1147909>.
- Perry, R.W., Lindell, M.K., 2003. Preparedness for emergency response: Guidelines for the emergency planning process. *Disasters* 27, 336–350. <https://doi.org/10.1111/j.0361-3666.2003.00237.x>.
- Pfaff, A., Broad, K., Glantz, M., 1999. Who benefits from climate forecasts? *Nature* 397, 645–646.
- Pople, A., et al., 2021. Anticipatory cash transfers in climate disaster response. Centre for Disaster Protection, London. Working Paper 6.
- Pörtner, H.-O., et al., 2022. Climate change 2022: Impacts, adaptation and vulnerability. IPCC Sixth Assessment Report.
- Pouligny, B., 2009. *Supporting local ownership in humanitarian action*. 1(09), Humanitarian Policy Paper Series, Berlin.
- Raikes, J., et al., 2021. Linking disaster risk reduction and human development. *Clim. Risk Manag.* 32, 100291 <https://doi.org/10.1016/j.crm.2021.100291>.
- Reap, 2022. Early action: The state of play 2021. Risk Informed Early Action Partnership, Geneva.
- Renzio, P.D., 2016. *Accountability dilemmas in foreign aid*. Overseas Development Institute, London.
- Roepstorff, K., 2020. A call for critical reflection on the localisation agenda in humanitarian action. *Third World Q.* 41, 284–301. <https://doi.org/10.1080/01436597.2019.1644160>.
- Roots, R., 2021. Review of the pilot phase of the Forecast-based Action by the Disaster Relief Emergency Fund (FbA by the DREF) 2018–2020. Internal Report for IFRC, Geneva.
- Schipper, E.L.F., 2009. Meeting at the crossroads?: Exploring the linkages between climate change adaptation and disaster risk reduction. *Clim. Dev.* 1, 16–30. <https://doi.org/10.3763/cdev.2009.0004>.
- Schipper, E.L.F., et al., 2016. Linking disaster risk reduction, climate change and development. *Int. J. Disaster Resilience Built Environ.* 7, 216–228. <https://doi.org/10.1108/ijdrbe-03-2015-0014>.
- Seppo, M., 2020. *Bangladesh rapid response anticipatory action pilot flood 2020*. 20-RR-BGD-44022, United Nations Central Emergency Response Fund, Dhaka.
- Schneider, A.L., 1986. The evolution of a policy orientation for evaluation research: A guide to practice. *Public Administration Review* 356–363.
- Start Network, 2020. Arc replica pay-out senegal 2020: Internal evaluation. Internal Evaluation for Start Network, London.
- Stiglitz, J.E., 2003. Democratizing the international monetary fund and the world bank: Governance and accountability. *Governance Account.* 16, 111–139. <https://doi.org/10.1111/1468-0491.00207>.
- Suarez, P., Tall, A., 2010. *Towards forecast-based humanitarian decisions: Climate science to get from early warning to early action*. Humanitarian Futures Programme, London.
- Tanner, T., et al., 2019. Scaling up early action: Lessons, challenges and future potential in bangladesh. ODI, London. ODI Working Paper 547.
- Theisohn, T., Lopes, C., 2003. *Ownership Leadership and Transformation*. Routledge.
- Thomalla, F., et al., 2018. Transforming development and disaster risk. *Sustainability* 10, 1458. <https://doi.org/10.3390/su10051458>.
- Towner, J., et al., 2019. 'Assessing the performance of global hydrological models for capturing peak river flows in the amazon basin', 10.5194/hess-2019-44.
- Tozier de la Poterie, A.S., et al., 2018. Understanding the use of 2015–2016 el niño forecasts in shaping early humanitarian action in eastern and southern africa. *Int. J. Disaster Risk Reduct.* 30, 81–94. <https://doi.org/10.1016/j.ijdr.2018.02.025>.
- Tozier de la Poterie, A., et al., 2021. Managing multiple hazards: Lessons from anticipatory humanitarian action for climate disasters during covid-19. *Clim. Dev.* 1–15 <https://doi.org/10.1080/10.1080/17565529.2021.1927659>.
- Tozier de la Poterie, A., 2021. How local governments allocated funding for anticipatory action in the Philippines. Anticipation Hub, Berlin.
- Tozier de la Poterie, A., 2021. How coordination between the Red Cross Red Crescent and the World Food Programme in Bangladesh set the stage for scaling-up. Anticipation Hub, Berlin.
- Tozier de la Poterie, A. (2017) *When Does Information Matter? Roles of Knowledge in Disaster Risk Reduction and Climate Change Adaptation Decision-Making* Environmental Studies Ph.D. Dissertation University of Colorado Boulder. 49.
- Tozier de la Poterie, A., Daly, M., 2022. Prediction and Forecasting. In: *The Routledge Companion to Environmental Ethics*. Routledge, New York, pp. 636–651.
- Turnbull, M., Moriniere, L., Tozier de la Poterie, A., 2020. Start fund: Evaluation of crisis anticipation. Integrated Risk Management Associates report for the Start Network, Paris.
- Twigg, J. et al. (2001) *Guidance notes on participation and accountability*. UNOCHA (United Nations Office for the Coordination of Humanitarian Affairs) (20 September 2021) 'Co-chairs' statement: High-level humanitarian event on anticipatory action: A commitment to act before crises', New York.
- Van den Homberg, M.J.C., Gevaert, C.M., Georgiadou, Y., 2020. The changing face of accountability in humanitarianism: Using artificial intelligence for anticipatory action. *Polit. Govern.* 8, 456–467. <https://doi.org/10.17645/pag.v8i4.3158>.
- Van den Homberg, M. et al. (Forthcoming) Bridging the gaps in disaster loss data to support early warning early action. United Nations Office for Disaster Risk Reduction, Geneva.
- Vincent, K., et al., 2018. What can climate services learn from theory and practice of co-production. *Clim. Serv.* 12, 48–58. <https://doi.org/10.1016/j.cliser.2018.11.001>.
- Vogel, C., O'Brien, K., 2006. 'Who can eat information? Examining the effectiveness of seasonal climate forecasts and regional climate-risk management strategies'. *Clim. Res.* 33, 111–122. <https://doi.org/10.3354/cr033111>.
- Walker, D., Myrick, F., 2006. Grounded theory: An exploration of process and procedure. *Qual Health Res* 16, 547–559. <https://doi.org/10.1177/1049732305285972>.
- Weingärtner, L., Pforr, T., Wilkinson, E., 2020. The evidence base on anticipatory action. World Food Programme, Rome.
- Weingärtner, L., Spencer, A., 2019. Analysing gaps in the humanitarian and disaster risk financing landscape. ODI and Start Network, London.
- Weiss, C.H., 1972. *Evaluation research: Methods for assessing program effectiveness*. Prentice-Hall Inc, Englewood Cliffs.
- Wenar, L., 2006. Accountability in international development aid. *Ethics Int. Aff.* 20, 1–23. <https://doi.org/10.1111/j.1747-7093.2006.00001.x>.
- Wilkinson, E., et al., 2018. Forecasting hazards, averting disasters: Implementing forecast-based early action at scale. Overseas Development Institute, London.
- Wilkinson, E., Pforr, T., Weingartner, L., 2020. Integrating 'anticipatory action' in disaster risk management. Overseas Development Institute, London.
- Williams, G., 2004. Evaluating participatory development: Tyranny, power and (re)politicisation. *Third World Q.* 25, 557–578. <https://doi.org/10.1080/0143659042000191438>.
- Winters, M.S., 2010. Accountability, participation and foreign aid effectiveness. *Int. Stud. Rev.* 12, 218–243.
- WMO (2021) *Wmo guidelines on multi-hazard impact-based forecast and warning services part ii: Putting multi-hazard ibfws into practice*. WMO-No. 1150, World Meteorological Organization, Geneva.

- ERC (2021) *Ecuador: Volcanic ashfall final report on early action phase*. Activation Report from Ecuador Red Cross International Federation of the Red Cross Red Crescent, Geneva.
- FAO (09 July 2021) 'Fao meeting # 2 of the thematic sub-working group (tsg) on triggers' Food and Agriculture Organization of the United Nations, Manila.
- Zillman, J.W. (2019) 'Origin, impact and aftermath of wmo resolution 40 | world meteorological organization', World Meteorological Organization, <https://public.wmo.int/en/resources/bulletin/origin-impact-and-aftermath-of-wmo-resolution-40>, accessed 30 June 2022.