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Exploring the Use of Flood Early Warning Systems by Communities in England

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ABSTRACT

Involving communities in flood early warning systems (FEWS) is increasingly recognised as an essential component of flood resilience. FEWS is considered to be integrated systems of flood forecasting and warnings, impact assessment, communication and preparedness which enable stakeholders to take appropriate actions to reduce the impacts of flooding. In the United Kingdom, voluntary, community-based flood groups can play an important role in local flood resilience, adding value to the work of Flood Risk Management Agencies including the Environment Agency, Local Authorities and Water Companies. However, little literature has examined how community-based flood groups use FEWS to help their local communities. In this paper we explore the use of FEWS by communities in the broadest sense, covering the use of any flood forecast or monitoring information and how this is used by flood groups to take action in the local community. We worked with 10 flood groups in England and found they used combinations of official and community-led information: (i) official information on flood warnings, weather forecasts, river-level observations and rain gauges and (ii) community-led bespoke warning systems at local hotspots including telemetry and video. Some of the Flood Groups were considerably advanced in how they analysed and presented this information, developing accessible dashboards and/or trigger points and alerts to support actions in the community. Five of the Flood Groups felt that their use of this information had recently prevented or reduced the impacts of flooding in their local community. However, the Flood Groups faced a range of challenges including technical and funding support for FEWS and wider governance challenges which should be addressed by State support. Support is particularly important in areas of significant flood risk and where community-led FEWS could complement and be integrated with state flood warnings. For example, where official flood warnings do not cover locations in sufficient detail or for key flood sources (e.g., surface water). In addition, the Flood Groups had mainly developed in affluent areas and appropriate interventions are also required in more disadvantaged communities. The study makes a strong case for State support for voluntary flood groups.

1 | Introduction

Approximately 90% of all natural hazards worldwide are water-related, with floods accounting for over half of these (Perera et al. 2019). Between 2001 and 2018, floods were responsible for almost 100,000 deaths and USD 500 billion in economic losses globally (EM-DAT 2019) and flooding is increasing in both frequency and severity due to ongoing global

climate change (Allen et al. 2019). Accordingly, several billion dollars have been spent on flood mitigation measures (Perera et al. 2019). In recent decades, there has been a shift in focus away from structural mitigation measures such as hard engineered flood defences towards non-structural measures, such as natural flood management, land use regulation, public information campaigns, flood early warning systems (FEWS) including flood forecasts and warnings and building flood resilience in communities (UNDRR 2018; Forrest et al. 2019; Perera et al. 2019). However, the effectiveness of FEWS hinges on both (i) technical aspects such as hazard monitoring and forecasting and (ii) communication and preparedness-response components. While significant progress has been made in the former, challenges persist in effectively communicating risk information and triggering appropriate responses. Community involvement emerges as a crucial factor in this regard, facilitating knowledge exchange, increasing local understanding of flooding processes and enhancing preparedness and response capacity. However, there are few published examples of community use of FEWS—where communities develop their own flood warning information and/or use official State-provided FEWS.

This article focuses on exploring the development and use of FEWS by local communities, which is increasingly recognised as a promising component of supporting community flood resilience (Dewa et al. 2023). Here, we define FEWS in the broadest sense, covering the use of any flood forecast or monitoring information and then how this information is used to take action in the local community.

2 | The Role of FEWSs in Supporting Community Flood Resilience

Early warning systems are formally defined as 'an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enable individuals, communities, governments, businesses and others to take timely actions to reduce disaster risks in advance of hazardous events' (UNDRR 2017). Typically, early warning systems are comprised of four interrelated components: (1) Disaster Risk Knowledge, (2) Forecasting and Warnings, (3) Dissemination–Communication and (4) Preparedness–Response (Chahinian et al. 2023; WMO 2010). In areas where it is unfeasible to minimise flooding risk through flood defences, FEWS can be effective tools to increase resilience if each of these components is developed (Baudoin et al. 2014; Chahinian et al. 2023; Sukhwani et al. 2019).

Over the last few decades, there has been an increase in the use of FEWS across both developed and developing countries. Substantial progress has been made in the effectiveness of FEWS, particularly, in the first two components of (1) Risk Knowledge and (2) Forecasting and Warnings (Cools et al. 2016; Perera et al. 2019; Kuller et al. 2021). However, whilst there has been significant technical progress in Components 1 and 2, key challenges remain when it comes to effectively communicating risk information and triggering suitable response actions (Components 3 and 4) (Cools et al. 2016; Kuller et al. 2021). To achieve this FEWS must be tailored for local conditions and hazards and risk warnings need to be appropriate and relevant for at-risk communities (Baudoin et al. 2014; Cools et al. 2016; Perera et al. 2019).

In terms of communication and dissemination (Component 3) it is argued that many FEWS are underdeveloped (Perera et al. 2020, 2019). Flood warnings to the local community are an essential component of communication and to be effective, warnings must reach relevant people, be clear and understandable, contain all the relevant information required, increase individual flood risk perception and willingness to take preventative action. Trust is an essential aspect—individuals must trust the source of the information if they are to follow recommendations (Environment Agency 2007; Chahinian et al. 2023; Wachinger et al. 2013). It is also argued that false alarms negatively impact public trust and response (Barnes et al. 2007; Mckie and Aitken 2025). In general, there is good support for the efficacy of written warnings issued by State agencies, however face-to-face warnings from 'trusted intermediaries' such as flood groups can help two way information exchange and are preferable for some groups such as the digitally excluded and older people (Parker et al. 2009).

The preparedness and response element of FEWS (Component 4) refers to activities for a community to react to a flooding event (Acosta-Coll et al. 2018). In addition to the ineffectiveness of warnings, inadequate responses can be caused by people misunderstanding their own individual flooding risk and/or their capacity to mitigate this risk (Morss et al. 2016; Shreve et al. 2016). To facilitate increased preparedness and response capacity, the participation of at-risk communities in FEWS is essential (Yasmin et al. 2023). Local communities typically have knowledge of local conditions and hazards (Mckie and Aitken 2025) and so their input is required to ensure that FEWS are tailored to local community needs. Furthermore, community involvement often facilitates knowledge exchange, thus increasing local understanding of flooding processes and thereby increasing preparedness.

A key challenge is that most FEWS are science and expert driven, and can be disconnected from local realities and needs (Baudoin et al. 2014). FEWS must move away from a top-down approach, towards an approach centred around two-way communication and knowledge co-production between at-risk communities, authorities and experts (Hermans et al. 2022; Ping et al. 2016). Parker and Handmer (1998) identify the need to integrate official flood warnings and the use of local knowledge, and this was supported by the Pitt Report (2008) which proposed measures to reduce the impacts of large-scale surface water flooding.

One approach to increase community engagement is to support the role of civil society actors to facilitate knowledge exchange, circulate in-person warnings, mobilise volunteers to respond to flooding and fundraise (Forrest et al. 2019). For example, Mckie and Aitken (2025) conducted case study research into a flood-affected community in England and described that the community 'actively used local groups or social media sites during flooding to act as warning systems for the community'. Rayhan et al. (2024) focus on a case study

in Bangladesh and 'found that rather than official forecasting, communities rely on indigenous knowledge such as cloud patterns, wind flow, atmospheric changes in hilly areas, sudden water temperature drops to serve as early warning signs of impending flash floods, allowing residents to plan ahead of time'.

In the United Kingdom, community-led (C-L) flood groups are examples of civil society actors and have started to develop in approximately 250 locations (as explored below), but they have not been fully integrated into flood risk management by the State. Flood groups have also not developed globally. For example, in the Netherlands, flood risk management is viewed as a governmental task and a lack of recent flooding has resulted in an absence of a flood volunteer structure (Koers et al. 2024). In addition, some authors caution that responsibility should not be entirely transferred to non-state actors due to a number of challenges including long-term sustainability of civil society contributions, inequalities between locations relating to social capital and local resources (e.g., relating to the availability of skilled volunteers) and the potential to confuse official flood warnings and information (Baudoin et al. 2014; Forrest et al. 2019; Perera et al. 2020).

3 | UK Context

3.1 | Flood Risk Management Agencies (RMAs), Flood Groups and Flood Wardens

In England, a number of government agencies, public bodies, local authorities and in some cases water companies have responsibility for flooding and are referred to as RMAs. Please see explanations of the roles of statutory organisations, RMAs and support for flood groups in Appendix A. The Environment Agency (EA) is a public body with responsibility for main river (fluvial) and coastal flooding (Birch et al. 2021; Speight et al. 2025), providing flood alerts and warnings for both these types of flooding. However, lead local flood authorities (LLFAs) have responsibility for surface water (pluvial) flooding (Birch et al. 2021; Speight et al. 2025) but do not issue warnings to the public. Surface water flooding is caused by intense rainfall, prior to water entering natural or human-made drainage networks or main watercourses (Speight et al. 2021).

In addition, the Flood Forecasting Centre (FFC), a joint enterprise between the Met Office and EA, supports the provision of flood warning information. The FFC produces daily Flood Guidance Statements that provide general guidance information at regional levels for surface water, river, groundwater and coastal flooding, though this information is not available to the public. The Met Office also provides weather warning information on its website: Red, Amber and Yellow warnings to reflect different severity levels of severe *weather* hazards, including heavy rainfall. Weather and flood warnings received from this range of sources can present a confusing picture to local communities who do not always see a clear difference between surface water and fluvial flooding and are not always aware that surface water flooding is not covered by EA flood warnings (Ramsden 2021).

Flood groups can play an important role in supporting flood resilience in local communities, working in a gap between RMAs and local communities. This role can include supporting FEWSs by translating flood warnings into information that can be understood by the local communities and translated into action (Ping et al. 2016; Forrest et al. 2017; Mckie and Aitken 2025). The number of flood groups in the United Kingdom has increased significantly since major flooding in 2007 and 2013/2014 and approached approximately 250 by 2017 (Forrest et al. 2017). In the absence of a clear definition of flood groups, Forrest et al. (2017) developed a working definition*:* 'A flood group is made up of a group of individuals with a personal interest in local flood issues who frequently meet with one another in specific flood group meetings to discuss flood-related issues in a specific geographical area'. Practically, Flood Groups usually contain a number of flood wardens who focus on a specific location, taking action to reduce the risk of flooding and communicating with residents. However, flood wardens can also operate in isolation, for instance in locations with low levels of population or where there are not enough flood wardens to develop a group. Both Flood Groups and Flood Wardens can receive support from the EA although this is not a statutory responsibility and is variable across locations.

3.2 | Exploring the Use of FEWS by Communities in England

In research conducted in 2023 and 2024, we aimed to investigate community use of FEWS. As stated earlier we were open in our definition of FEWS and were interested in where communities used flood forecast or monitoring information through: (a) official flood forecasting and warnings and real-time monitoring information, provided by UK Government agencies such as the EA and the Met Office and/or (b) developed or tailored by the communities themselves such as by working with the private sector. We then explored if and how this information was used to take action in the local community.

4 | Methods

4.1 | Participants

We contacted a range of experts/stakeholders to find examples of the use of FEWS by communities in England. These included:

- Regional stakeholders/RMAs such as the West Yorkshire Flood Innovation Programme, the EA and its Flood Resilience Team which supports Flood Groups in Yorkshire.
- National stakeholders and experts including through the 2024 Surface Water Flood Forecasting and Real-Time Communication Symposium (Speight et al. 2025)
- Existing contacts within flood groups who signposted other flood groups using FEWS
- Private companies providing FEWS to local communities

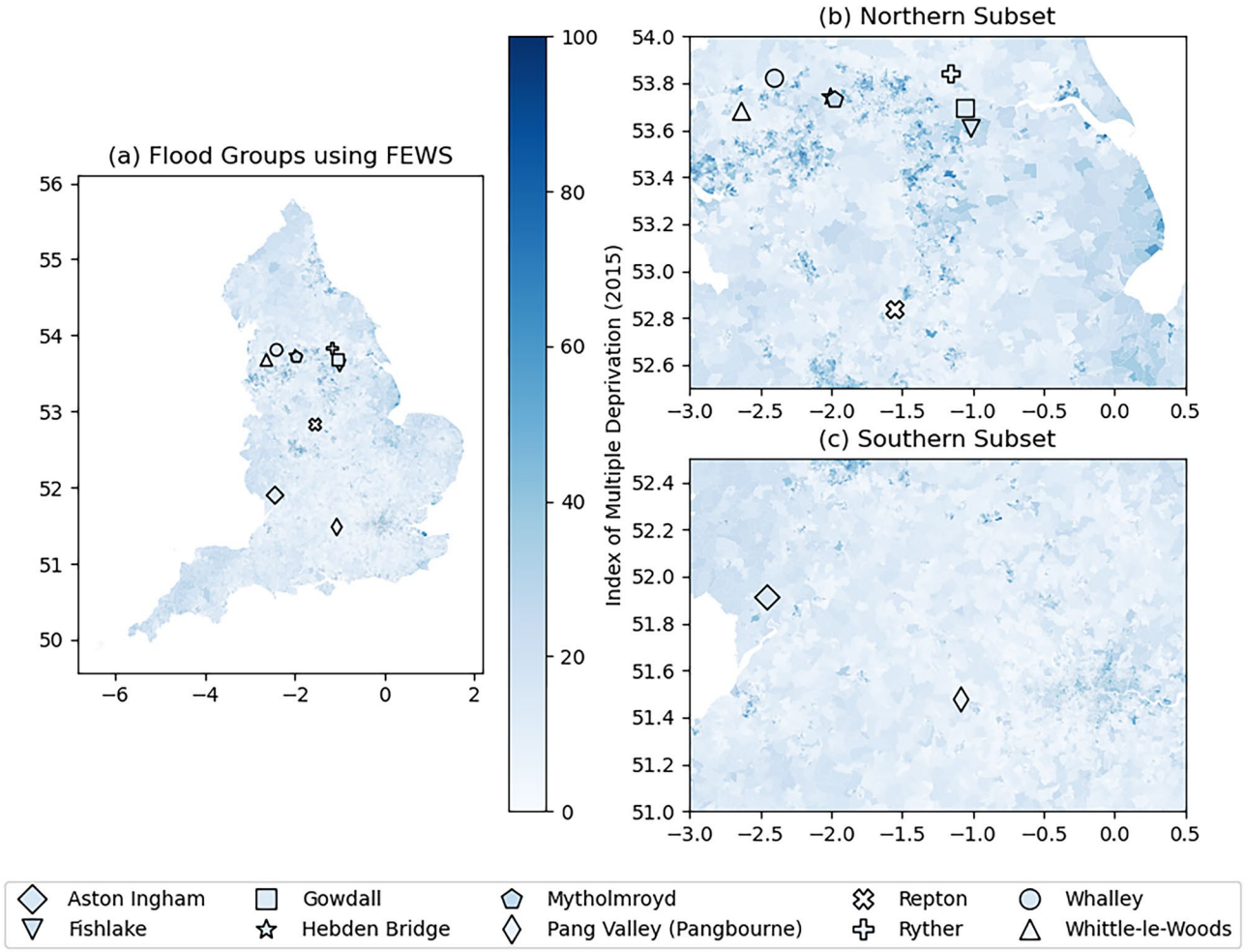

FIGURE 1 | Map of Flood Groups using FEWS and the Index of Multiple Deprivation.

We contacted 14 community representatives. Of these, 12 were flood groups, one was a community group and one was a parish council.

From the 14 we contacted, 10 were actively using FEWS and were selected for this study—these were all Flood Groups (Figure 1 and Table 1). The remaining four groups were not actively using FEWS, but we discussed some of the challenges they faced.

Figure 1 and Table 1 show that the case study locations were mainly located across Yorkshire and Lancashire, potentially reflecting the use of our local networks to identify them. With the background literature also indicating that civil society actors were more likely to develop in more affluent locations, we also mapped these locations on the Index of Multiple Deprivation (IMD) which is a UK government measure of deprivation at a local level using a range of social, economic and environmental indicators—a higher score indicates higher levels of deprivation.

The 10 Flood Groups featured as case studies were mainly located in villages and small towns and are located in areas with above-average levels of affluence. Of the 10 case studies, only one—Mytholmroyd—is above the mean IMD, with an IMD score of 26.1 compared to the mean for England of 21.7. Fishlake was the next most deprived location with an IMD score of 21.5.

The case study Flood Groups and background information is contained below. The type of flood warning information used has been split between official information provided by the EA such as river-level telemetry and C-L information such as telemetry installed by private sector companies.

4.2 | Interview Schedule

We conducted semi-structured interviews with flood group leads/flood wardens from the 10 flood groups. Eight semi-structured interviews took place during a walking tour of the location which included key community assets (including a school), flood hotspots and any local FEWS equipment. These walking tours were led by the flood group lead/flood warden. Two other semi-structured interviews were conducted remotely.

We explored the following questions:

1. *What FEWS Information is being used?* For example, Local monitoring (rain and rivers), EA river level information, rainfall nowcasting/forecasting, flood guidance statements.
2. *Who is providing the information?* For example, EA and RMAs, private sector, local community.

TABLE 1 | Case study flood groups.

Flood group	Flood cause	PopN	IMD	FEWS Info: EA	FEWS Info: C-L	Interviewed (recorded and transcribed)	Date of interview
Aston Ingham	Local streams	400	15.7	Not specific to location	Yes	Visit, FG meeting and email (r&t)	25 and 26 July 2024
Gowdall	River	320	13.6	Yes and IDB	No	Visit (r&t)	19 July 2024
Fishlake	River	680	21.5	Yes	No	Visit (r&t)	13 Sep 2024
Hebden Bridge (Calderdale)	River	4500	15.8	Yes	No	Visit (notes)	12 Mar 2024
Mytholmroyd (Calderdale)	River	4000	26.1	Yes	No	Visit and school (notes), plus remote interview (notes)	12 Mar and 12 Dec 2024
Pang Valley Flood Forum	Combination	10,000	6.1	Yes	Yes	1× remote interview (r&t) and 1× email info	09 Sep and 13 Nov 2024
Repton	River	2867	2.9	Not specific to location	Yes	Remote interview (notes)	17 May 2024
Ryther	River	250	9.6	Yes	No	Visit (r&t) and email	20 May 2024 and 5 Feb 2025
Whalley	River	3700	15.5	Not specific to location	Yes	Visit (r&i) and email	16 Nov 2024 and 5 Feb 2025
Wittle-le-Woods	River	5500	3.6	Not specific to location	Yes	Visit (r&i) and email	10 Sep 2024

Note: The case study flood groups and background information is contained below. The type of flood warning information used has been split between official information provided by the Environment Agency (EA) such as river-level telemetry and Community-led (C-L) information such as telemetry installed by private sector companies.

3. *Who receives the information?* For example, trusted Intermediaries such as flood wardens/groups.
4. *What actions do communities take after receiving flood warnings through FEWS?* For example, help vulnerable people, close roads, prepare emergency shelters
5. *What are the challenges and lessons learned?* For example, sustainability, funding, liability.

We also conducted additional meetings with three private companies providing FEWS equipment. Interviews were either recorded and transcribed or noted in detail and then thematic analysis was used to pick out themes around the flood groups' use of FEWS, as well as key challenges.

Ethical approval was granted by the University of Leeds in October 2023. We have named the Flood Groups in good practice examples but have kept flood groups anonymous where they reported challenges, complying with the ethical approval and informed consent. The Flood Groups that we contacted who were not using FEWS also remain anonymous. Note that the 10 case studies were selected during the research period and do not (nor were intended to) form an exhaustive list of flood groups using FEWS within the UK.

5 | Results

5.1 | Background and Governance

The Flood Groups were developed by the local communities after flooding incidents (e.g., Whalley and Billington in 2015, Aston Ingham in 2020). Calderdale (i.e., Hebden Bridge and Mytholmroyd) and Fishlake are older and more established flood groups but have increased in size after more recent floods. In contrast to the other Flood Groups, Pang Valley Flood Forum (PVFF) is a forum of small flood groups/wardens from 10 villages across the catchment.

For example, the chair of Whalley and Billington Flood Group outlined their background:

> We set up after we flooded badly in 2015, so it was Boxing Day, so it was like early hours of the morning, and there was a massive flood in Whalley and Billington. So I think there were about three hundred and fifteen homes and businesses that were flooded, and I hadn't really been involved in it before that ... But I was the president of the Lions [Lions Club International is an International Organisation with local chapters and volunteers helping local communities across the UK] at the time, so we had a group of about twenty Lions and we managed the flood incident.

All the Flood Groups consisted of local volunteers. We found many of these volunteers are experienced, often retired professionals, with diverse and advanced technical skills, such as engineers, hydrologists, academics, teachers and IT experts. For

example, the PVFF dashboard has been developed by a volunteer with high-level IT skills. Groups had considerable expertise in organising meetings, understanding flood mitigation measures, understanding RMA technical reports and holding RMAs to account.

All the Flood Groups had considerable knowledge on flooding issues affecting their community. Many meet regularly and inspect and resolve any potential issues. The Flood Groups are mainly focused on fluvial flooding (e.g., where river-level monitoring equipment exists or can be fitted). However, the causes of flooding can be complex, including combined fluvial and surface water flooding. For example, Calderdale is increasingly facing surface water flooding issues, Aston Ingham has three small streams/tributaries flowing from hills and agricultural land, while Pang Valley also includes groundwater flooding concerns.

The more recently formed Flood Groups (between 2015 and 2020) received assistance in establishing themselves including some seed funding from the EA, local authorities or, in one case, the University of Chester. For example one Flood Group member stated that the EA provided support on the condition that they had community support and a formal structure:

> Look we can give you fifteen grand towards, you know, driven resilience but you must do it formally and make sure you've got the will of the village behind you

Two Lancashire groups highlight strong support from the County Council in initial stages. At least seven groups have strong connections to local parish councils which are the first tier of local government in England and Wales and limited local responsibilities focused on upkeep and maintenance—there are around 10,000 parish councils, they are not present in all areas and mainly exist in rural areas (Jones 2020). The formal structure of parish councils can provide credibility, access to decision making structures, insurance cover and access to small amounts of funding. However, this relationship can be complex and two other Flood Groups have more sensitive relationships with their parish councils.

All our case study examples of communities using FEWS are Flood Groups and are solely dedicated to flooding. This finding suggests that it may require dedicated flood groups to use FEWS and tackle flooding issues (e.g., some flood groups report separating out of the parish council) and to formally access EA and other support. For example, we did not find examples of more general civil society organisations using FEWS that focused on other community-level activities as well as flooding.

Many of the Flood Groups are well-established: for instance, Fishlake has 30 flood wardens including the chair of the parish council. Calderdale has a number of very active flood groups including Mytholmroyd and Hebden Bridge through the valley which take actions around FEWS, communication and actions to reduce flood risk. However, most of the Flood Groups contacted faced challenges impacting their long-term sustainability around governance, support from RMAs and funding—a more detailed analysis of these issues is contained later in this section.

5.2 | Use of Flood Early Warning Information

5.2.1 | EA Monitoring Information

Six groups analyse publicly available EA river-level monitoring data to monitor and assess the risk of flooding: Calderdale (Hebden Bridge and Mytholmroyd), Fishlake, Gowdall, PVFF and Ryther. Gowdall also uses river-level information from the local Internal Drainage Board (IDB). Some groups were able to increase FEWS provision in critical locations from the EA after floods. For example, in Fishlake:

> After consultation with the Environment Agency after the flood of 2019, we managed to negotiate to get a new gauge put in, it gives us water levels in parts of the Ings, the low area the surrounds the village. (Fishlake FG co-lead)

Five Flood Groups also access Environment Agency information from specific locations further up catchments (e.g., Fishlake looks at Sheffield: 8–10 h' notice; Gowdall—Malham: 12 h, Ryther—Kettlewell: 24 h). For example, in Fishlake:

> We can pick up all the Don gauges all the way up the Don above Sheffield so we know what's coming. (Fishlake FG co-lead)

Mytholmroyd Flood Group in Calderdale receives council emergency notices for the Calder valley which tend to be the first specific warning information received. Hebden Bridge in Calderdale also has informal connections with Flood Groups in Lancashire track issues over the Pennines.

5.2.2 | Local Community-Led Monitoring

For four locations, EA river level monitoring information (and subsequent warnings) was not felt to be sufficiently local to be of use and Flood Groups in these areas have implemented bespoke river level telemetry with support from private sector providers: Whalley and Billington monitor a trash screen on a small tributary; Aston Ingham monitors three small streams running from agricultural land on hills surrounding the village and rain levels; Repton and Wittle-le-Woods also monitor river levels on local tributaries. In addition, PVFF uses a combination of EA and local monitoring to collect data on river levels, rain gauges, groundwater levels (boreholes) across its catchment which brings together 10 parish councils. PVFF combines this information on a publicly available online dashboard alongside the latest EA flood warnings.

Two further groups using EA information are also considering establishing more local telemetry to monitor more local information: Ryther currently has visual measuring/scale boards in the local river hotspot but is considering installing e-monitoring

equipment; and Gowdall is considering installing telemetry and vision equipment at a tipping (low) point on a river bank which the flood wardens have identified as a particularly vulnerable point for flood inundation of the village.

Three of these flood groups have also developed formal threshold/trigger points which they monitor against. Whalley and Billington has worked with its private provider to develop a trigger point on a culvert directly near a trash screen and receive an email warning to alert them of the need to clear debris and they report that this has prevented flooding several times. PVFF has developed its own trigger level/warning system. Aston Ingham is working with its private sector provider to develop threshold points and trigger email flood warnings. PVFF, Whalley and Billington and Aston Ingham have carefully considered the placement of monitoring/FEWS to provide timely warnings. The two other groups are using the telemetry but are reviewing whether the monitoring equipment could be placed further upstream to provide useful early warnings.

The three private sector companies contacted during the study have viewed their interventions/support as both helping the community and developing products, credibility and contacts. Three of the four groups using these systems do not pay for the monitoring information with the private companies using the work to develop their products, and in one example showcase their work. If groups were paying full market price for monitoring equipment and support, this could cost approximately £100–£1000 (equivalent to $136–$1360, respectively, in USD) per individual monitoring gauge/sensor and up to £1000 in support costs per year including maintenance and continued access to software and information Although many flood groups in the United Kingdom are heavily involved in local fundraising, this could be out of reach, as they do not receive regular funding. In addition, some of the Case Study Flood Groups anticipate future problems if they are not able to access funding on a continuous basis—for example obtaining continued help with repairing monitors or accessing software.

In the case studies, funding for monitoring equipment has been received from a variety of sources including local councils and the EA. For Aston Ingham, the University of Chester provided direct funding for FEWS and work with the private contractor—this support was provided at a crucial time with the flood group questioning its future without this support.

5.2.3 | Weather and Flood Warnings

The Flood Groups use weather forecast information. This is mainly publicly available Met Office information and in particular Amber or Red National Severe Weather Warnings for rain. No additional specialist nowcasting or other forecasting websites were strongly recommended by the Flood Groups.

Flood Groups assess, but do not fully rely on EA flood alerts and warnings. Flood Groups are monitoring the potential for local flooding even if there is not a specific flood warning for their location. EA flood alerts and warnings are not always seen as sufficiently specific (in location) or timely by all the Flood Groups interviewed, but are used as part of a range of information to assess the risk of flooding. Most groups do not use the Flood Guidance Statements due to two main reasons: (1) lack of access (individuals have to register to receive them) and (2) they are not specific local warnings. The FFC is currently trialling a more localised Rapid Flood Guidance service that may be more useful (see Appendix A) but it will be important that flood groups are kept up to date and participate in developing advances in forecasting/nowcasting that could benefit their location.

5.3 | Actions in the Community

The Flood Groups assess the FEWS information and take a combination of actions on receiving warnings including:

- inspecting and clearing problems at source (e.g., Whalley and Billington clearing a trash screen on culvert),
- checking/enhancing local flood defences,
- alerting other wardens and RMAs,
- assess alerting the wider community, attending and monitoring key or dangerous roads, distributing sandbags and other supplies and helping vulnerable people if required.

For example, the flood groups in Calderdale have a flood siren, attend to roads, deploy equipment from containers, have strong links to local schools and have places of safety (e.g., Hebden Bridge Town Hall). The Calderdale flood groups also have extensive ongoing contact with the local community, making effective use of social media primarily Facebook, with many members of the local community responding favourably to this local interaction.

Overall, most of the flood groups featured (eight) state they have accurate information to help them understand the imminent risk of flooding. One of these flood groups is actively working to improve their information, with three others reviewing potential options to improve accuracy.

Five Flood Groups identify that they have used combinations of FEWS information and monitoring to prevent flooding or reduce the impacts of flooding in the local area. These include Whalley and Billington which have used their own bespoke river-level telemetry and camera to alert them to remove blockages from a trash screen and the Calderdale, Fishlake and PVFF groups who have used warning and monitoring information and to prepare flood wardens to take action in the local community. Three of the other flood groups believe their use of FEWS will help them in the future. The other two are reviewing their use of FEWS, including the location of their own telemetry equipment.

5.4 | Challenges Faced by Flood Groups

A small number of flood groups feel they have achieved as much as they can in terms of building flood resilience in their local community unless they receive additional RMA support around improving flood defences. In addition, climate change and increasing housebuilding could provide additional stress on

existing systems. Most locations visited are relatively small and rural and are not prioritised for larger flood defences (e.g., see Jones et al. 2025), which leads to disagreements with RMAs over the criteria used for prioritising flood defences. For instance, one flood group reported that an RMA had described to them:

> There's about twenty-six villages like you that need lots of money and we can't afford it.

Calderdale is an exception, where towns including Mytholmroyd and Hebden Bridge are prioritised for large scale flood mitigation work and defences.

Many flood groups (but not all) report declining contact with RMAs and see this as a risk in the event of a future flood. For example:

> And yeah, I think that sort of like whole relationship building, we've lost that now and I think that's a big risk because if something happens we don't have those contacts that we can just reach out to get boots on the ground a couple of days after the event.

Frustration over lack of flood defences is a significant reason but not the only cause of declining contact with RMAs. Many Flood Groups feel that RMAs have become less responsive recently (e.g., since Covid-19) and some flood groups have lost day-to-day communication with key contacts. Others find that they have good contacts with one RMA team but not others. For example, in Yorkshire, Flood Groups welcome ongoing support from the EA Flood Resilience Team—a dedicated team to provide training and support, but may not have good contacts within technical teams focused on flood defences. Some Flood Groups report a lack of response from RMAs on key local issues such as land and asset ownership if they need to address a specific problem (blockages, overgrowth). Four groups report not being given access to technical reports such as cost benefit options for flood defences. For example one flood warden stated:

> So in a way the EA, they're trying to hide behind the fact they've got complex reports and complex kind of system, computer systems and, yeah, and you lot won't understand it.

However, many groups have experienced volunteers with technical skills within their Flood Groups.

The Flood Groups also identify that RMAs should be more responsive on FEWS specifically. Issues reported include: wanting to provide feedback on existing FEWS; discussions over where new river level monitoring/rain gauges could be placed and support for accessing funding if they require private sector provision. In addition, some of the measures put in place by RMAs to improve FEWS or flood defences are 'temporary' and may be removed by RMAs (e.g., rain gauges, non-return gates between river and drain).

> And that's over there, the gauge has been put in there, it's temporary gauge, so we'll keep fighting to keep it.

> I don't think we'll have a problem keeping it, but we'll have to fight if we do.

The Flood Groups also described a range of other key challenges:

1. Long-term funding (e.g., for installation and maintenance of FEWS); software for dashboard development, trigger points and email alerts; as well as equipment to respond to flooding (e.g., health and safety equipment, clearance equipment, flood barriers/sandbags).
2. Fear of being taken to court by members of the public (e.g., if taking measures in the community or providing advice).
3. Diminishing interest and support from the community during periods where there is no flooding.
4. Hostility from some members of the community if wanting to take measures (e.g., road closures).
5. Insurance cover for actions—wading through water, clearing drains, attending to roads.
6. Extent of roles and responsibilities (e.g., road closures).
7. Reliance on sandbags instead of more expensive specialised flood barriers.

A small number of groups could be considered fragile, relying on one or two key volunteers (sometimes working full time, with caring responsibilities and/or impacted by ill health), having to manage conflicts, finding it difficult to organise meetings, losing contacts within RMAs and losing momentum. As one participant described:

> So I think we're not doing this as a hobby, you know, we're doing it because we have flooded, we want to avoid flooding in the future, so any time that we spend we need to make sure it's the investment that's worth our time.

6 | Discussion

Given increasing climate change and the risk of flooding, difficulties predicting the timing and location of flooding and limited resources in public services and RMAs, there is an increasing emphasis placed on communities to increase their resilience to flooding (Forrest et al. 2019; Rayhan et al. 2024; Twiddy and Ramsden 2024). Our research finds that flood groups use formal and C-L FEWS to understand the imminent risk of flooding and take action to reduce its impacts, which adds value to the work of RMAs (Forrest et al. 2019; Perera et al. 2020; Koers et al. 2024).

Overall five Flood Groups identify that the use of FEWS has allowed them to prevent flooding or reduce the impacts of flooding in the local area, with three of the other Flood Groups describing how the FEWS will help them in the future. These groups state that they obtain accurate information to understand an imminent risk of flooding (although they are still looking for ways to improve information). The other two Flood Groups are reviewing their use of FEWS including the location of their own

telemetry equipment; although one group is struggling to find a way forward due to governance issues.

Eight of the Flood Groups have shaped and developed their own community-appropriate FEWS, particularly, focusing on flood forecasting and warning information, combining formal EA information (including from publicly available sources), bespoke private sector monitoring information and local knowledge. However, questions remain regarding how C-L FEWS information can be integrated with formal FEWS systems as recommended by the literature (e.g., Parker and Handmer 1998).

One potential way forward would be to create mechanisms for knowledge exchange between flood groups and RMAs which focuses on: (1) feeding local knowledge into the development of formal FEWS; (2) supporting communities in developing reliable local flood warning information in terms of purchasing, training and maintenance/support; (3) flood groups should also be kept up to date on the latest developments in forecasting/nowcasting and provided with training/support to best use them. There could also be the potential for co-production if reliable C-L FEWS information could then be linked to the EA website related to Flood Alerts and Warnings. For example, the EA could work with the PVFF to review its Dashboard and then support other flood groups to develop similar dashboards. Wider integration could lead to better flood warnings for the wider population who are not aware of the work of flood groups or who may not think it is reliable compared to official warnings.

However, as well as supporting flood groups develop the use of FEWS, it is also important to address the wider challenges cited, with flood groups requiring more State support in the following areas:

1. Providing named key contacts in RMAs who can provide continuous support.
2. Providing small amounts of funding (e.g., for flood response equipment, insurance, training).
3. Help with organisational support (e.g., insurance and resolving internal/external conflicts).
4. Support for actions in the community (e.g., clarity over road closures and sandbags).

Long-term state support will also be essential to develop flood groups in new areas. The Flood Groups involved in this research were mainly located in small towns and villages and generally in more affluent areas (see Figure 1). In addition, they were mainly comprised of older participants, in line with the findings of Jones et al. (2025). Establishing new groups in more disadvantaged areas (across both rural and urban areas and in areas of more ethnic diversity) could be very challenging (Baudoin et al. 2014; Forrest et al. 2019; Perera et al. 2020). For instance, some local communities will not have local volunteers with the type of skills that prove important (e.g., retired engineers, hydrologists, software engineers) and different solutions may be more appropriate, such as exploring links to existing charities or faith-based groups.

More in-depth research is likely to be beneficial in making a stronger case for state support in the following areas: (1) Quantitative and qualitative research to build a clearer picture of the number of flood groups in England, the different formal and C-L FEWS being used, how effective this FEWS is and what additional support could be required. It will be important to find case studies where the use of FEWS has been tested during a flood event and what lessons can be drawn. This should also include analysis of the perceived limitations of official state-issued forecasts and warnings. (2) Map existing community use of FEWS against areas of flood risk and coverage of official FEWS to identify priority areas. (3) Qualitative research to unpick the position of RMAs towards flood groups and also that of local communities.

7 | Conclusion and Recommendations

This article focuses on exploring the use of FEWS by voluntary, community-based flood groups in England. From the 10 Flood Groups featured, eight are using a combination of flood forecasting and warning information to take action and build flood resilience in their local communities. This forecasting and warning information includes formal RMA flood warning information, C-L private monitoring equipment and local knowledge. Five flood groups identify that this use of FEWS has enabled them to prevent flooding or reduce the impacts of flooding in the local area.

Therefore, the research found that the use of FEWS is helping local communities achieve aspects of effective FEWS outlined in the literature: (1) Disaster Risk Knowledge, (2) Warnings, (3) Dissemination–Communication and (4) Preparedness–Response (WMO 2010; Chahinian et al. 2023). For example, many of the Flood Groups featured use local knowledge to interpret and add value to official flood warning information and have built teams of volunteers to disseminate information to the local community and provide support where required.

However, some of the Flood Groups were facing significant challenges, in terms of continued organisational and technical support from RMAs and long-term sustainability including funding challenges and community participation. From this research, we recommend that RMAs in England could develop and support flood groups in the following ways:

- *Support the use of formal and C–L FEWS* including: (a) feedback on existing official FEWS information and discussion on the installation of new monitoring equipment; (b) funding support for private sector local monitoring equipment and (c) technical support including interpreting information from FEWS and establishing trigger levels and warnings.

  Support should also be extended to support flood groups use and understand the latest nowcasting and radar information. This joint working and support would also provide a platform for more effective integration of official and C-L FEWS.

- *Provided with continuous governance support* including key contacts in RMAs; organisational support for roles and

responsibilities; insurance cover; internal and external conflict resolution; support for actions in the community

Support for flood groups and use of FEWS is particularly important in high-risk areas, where communities rely on local resilience rather than flood defences and when developing new flood groups in more deprived areas or in countries where there is a limited history of developing community-level flood groups. However, there would need to be increased joint working between the State (RMAs in the UK context) and Flood Groups to achieve these recommendations and help further empower communities to adopt flood resilience activities.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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Appendix A

See Table A1

TABLE A1 | Flood Risk Management Agencies and areas of support for flood groups.

Organisation	Acronym	Explanation
West Yorkshire Flood Innovation Programme	WYFLIP	A partnership of RMAs in West Yorkshire, plus the West Yorkshire Combined Authority and University of Leeds.
Flood Risk Management Agency	RMA	The Department for Environment, Food and Rural Affairs (Defra) is the policy lead for flood and coastal erosion risk management in England. Government policies are delivered by Risk Management Authorities (RMAs) which are • Environment Agency • Lead Local Flood Authorities • District and Borough Councils • Coast protection authorities • Water and sewerage companies • Internal Drainage Boards • Highways authorities. Local Government Association (2025)
Lead local flood authority/ local authorities	LLFA/LA	LLFAs are county councils and unitary authorities (also referred to as Local Authorities). They lead in managing local flood risks (i.e., risks of flooding from surface water, ground water and ordinary (smaller) watercourses). This includes ensuring co-operation between the Risk Management Authorities in their area (Local Government Association 2025).
Environment agency	EA	The Environment Agency has a strategic overview of all sources of flooding and coastal erosion (as defined in the Flood and Water Management Act 2010). It is also responsible for flood and coastal erosion risk management activities on main rivers and the coast, regulating reservoir safety and working in partnership with the Met Office to provide flood forecasts and warnings (Local Government Association 2025).
The Met Office		The Met Office is the United Kingdom's national weather and climate service.
Flood Guidance Statement and rapid flood guidance service	FGS/RFGS	The Flood Guidance Statement (FGS) is a 5-day risk-based product for England and Wales, produced by the Flood Forecasting Centre (FFC) (jointly supported by the Environment Agency and Met Office) which: • shows the forecast level of flood risk for the coming 5 days for surface water, river, groundwater and coastal flooding, • uses a detailed risk matrix approach, based on a combination of likelihoods and impacts, • forecasts at a local authority scale, • provides a summary forecast for the 6 to 10 day period where necessary. Flood Forecasting Centre (2022). A rapid flood guidance service is currently being developed: a trial ran in 2024. The service provides short notice updates for England and Wales to supplement the Flood Guidance Statement (FGS) and is aimed at responders who make decisions within 0 to 3 hours. The service made use of new convective weather forecasting (nowcasting) capability from the Met Office's Expert Weather Hub combined with information from the FFC's hydrometeorologists. Flood Forecasting Centre (2025).
Flood group (or flood action group)		A flood action group is a voluntary group of local residents, who meet on a regular basis, to work on behalf of the wider community to help to try and reduce the impact of future flood events. Groups can focus on emergency planning, flood resilience, warning and informing and local issues, whilst providing a voice for the community to communicate ideas and queries to others (The Flood Hub 2018).
Parish council		Parish councils are the first tier of governance and are the first point of contact for people concerned with a community issue. Parish councils have a wide range of powers including looking after community buildings, planning, street lighting, allotments. They also have the power to raise money through council tax. (Jones, 2020).