PUTTING THE COMMUNITY INTO TOTAL FLOOD WARNING SYSTEMS

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Abstract

The lead guiding document for the development of the Total Flood Warning System (TFWS) in Australia is 'Manual 21 – Flood Warning' (Attorney-General's Department, 2009). According to Manual 21, the TFWS consists of six components: Prediction; Interpretation; Message Construction; Communication; Response; and, Review.

In a review of these TFWS components in relation to the findings of previous social research and government inquiries into flood warning in Australia, Molino et al. (2011) identified a further six components of a TFWS: Understanding the Flood Risk; Emergency Management Planning; Community Flood Education; Data Collection; Community Participation in the TFWS; and, Integration of the TFWS Components.

The twelve components have since been tested in the assessment of existing warning systems and the development of TFWSs for several communities across Australia.

This paper provides a summary of the findings from these projects with a particular emphasis on the successes and challenges involving the more community-related TFWS components such as Understanding the Flood Risk, Community Flood Education and Community Participation. For example, the TFWS assessments found that:

- Up to 20% of people living in floodplains were unaware of their flood risk
- Community flood education tended to rely on the provision of information
- There was little community participation in flood warning systems.

The findings demonstrated the need to engage with communities about all twelve TFWS components and this paper concludes by explaining how this could be best done using tailored techniques.

Introduction

'Managing the floodplain: a guide to best practice in flood risk management in Australia' (the Guide) (Australian Institute for Disaster Resilience, 2017) provides a framework to understand and manage flood risk and its consequences to the community. The Guide identifies flood warning as a measure to modify response, rating it (page 46) as a 'medium' option for safety, a 'low' option to reduce damages, and a 'medium' option to manage residual risk to the community.

The concept of 'total flood warning systems' (TFWS) is embraced in Australia. The lead guiding document for the development of the TFWS in Australia is 'Manual 21 – Flood Warning' (Attorney-General's Department, 2009). According to Manual 21, the TFWS consists of six components:

1. Prediction - Detecting changes in the environment that lead to flooding, and predicting river levels during the flood.
2. Interpretation - Identifying in advance the impacts of the predicted flood levels on communities at risk.
3. Message Construction - Devising the content of the message which will warn people of impending flooding.
4. Communication - Disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood.
5. Response - Generating appropriate and timely actions from the threatened community and from the agencies involved.
6. Review - Examining the various aspects of the system with a view to improving its performance.

Manual 21 (page 1) states that 'the purpose of a flood warning is to provide advice on impending flooding so people can take action to minimise its negative impacts". It promotes community participation in the design, implementation and review of TFWS. "To ensure the relevance of flood warning systems and to encourage local ownership of them, community members should be involved in developing the warning systems which will generate the warnings." (page 8)

The need for a participatory, community-driven approach to early warning systems is stressed by the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015):

> "Invest in, develop, maintain and strengthen people-centred multi-hazard, multisectoral forecasting and early warning systems, disaster risk and emergency communications mechanisms, social technologies and hazard-monitoring telecommunications systems. Develop such systems through a participatory process. Tailor them to the needs of users, including social and cultural requirements, in particular gender. Promote the application of simple and low-cost early warning equipment and facilities and broaden release channels for natural disaster early warning information." (Clause 33b)

Research and practice also supports this inclusive approach. For example, Mercy Corps and Practical Action (2010) found that in Nepal community-based early warning systems helped communities to reduce their vulnerability to flood risks. Research by Macherera and Chimbari (2016) showed that greater involvement by communities in early warning systems "empowers them to prepare for and confront hazards", thus enabling appropriate response actions.

Some research outlines concerns with the use of a top-down warning 'receiver system' where the people at risk are the last to be involved in the system because it depends on external specifications and experts. These people are not viewed as being supplied with information and knowledge, or endowed with applicable wisdom (Marchezini et al., 2017).

In contrast, in a community-based early warning system, local people should be involved as the central component of the design and operations of the system. To make this system effective, it should be people-centred, ''horizontal'' and participatory (Basher, 2006).

Even though Manual 21 advocates community inclusion in TFWSs, in practice there is a tendency in Australia for the TFWS designers (usually flood consultants) and their managers (usually local councils) to use the top-down, non-participatory approach.

Furthermore, many of the TFWSs are constructed in a linear fashion using Manual 21 i.e. starting with 'Step 1' Prediction and moving then to 'Step' 6 Review. This commonly used end-to-end warning system paradigm has several shortcomings, according to Basher (2006, p. 2172). The shortcomings include: the focus tends to be on the hazard (less emphasis on vulnerabilities, risks, response capabilities); dominance of an expert can lead to difficulties in user appreciation (e.g. of warnings, false alarms); little recognition of the research community and local jurisdictions in providing knowledge; few systematic mechanisms to improve the system (e.g. through local knowledge); and, lack of any sense of ownership in the systems by the users which can lead to mistrust.

This paper outlines an approach which not only enables community participation in the TFWS process, it also provides a broader scope than Manual 21 to cover other community inputs such as aligned community education and awareness of flood risk. The findings of the testing of the approach are then summarised, with lessons learned providing guidance to potential users.

Broader scope

As shown in Figure 1, flood warnings are the central component of a larger system of flood detection, forecasting, warning, and response systems (FFWRS) which resemble a chain of components supported by a number of processes (Parker, 2017).

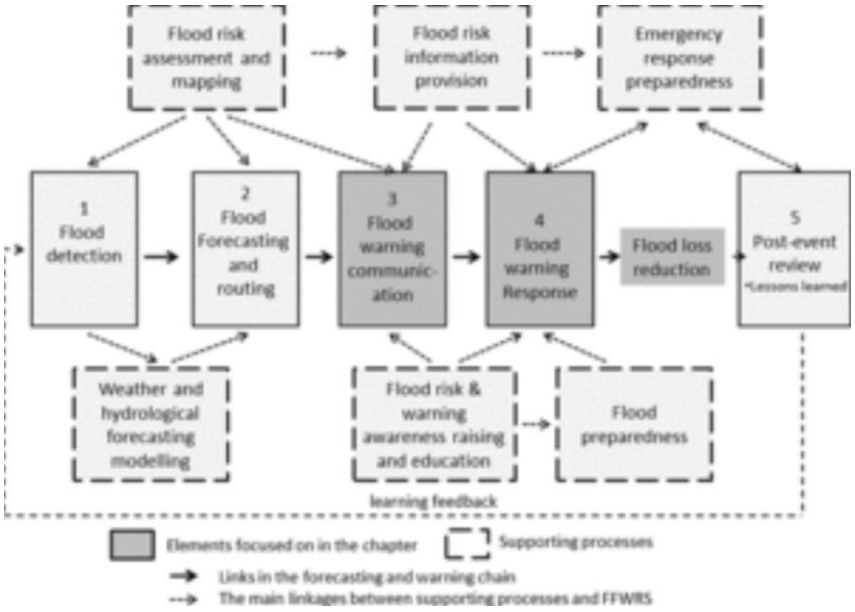

Figure 1: Flood detection, forecasting, warning, and response systems (source: Parker, 2017)

Drawing on especially the community aspects of the FFWRS (such as awareness-raising, education, preparedness and emergency response) and previous research into flood warning in Australia (e.g. Smith and Handmer, 1986), Molino et al. (2011) identified a further six components of a TFWS based on an analysis of the Manual 21 components (see Figure 2).

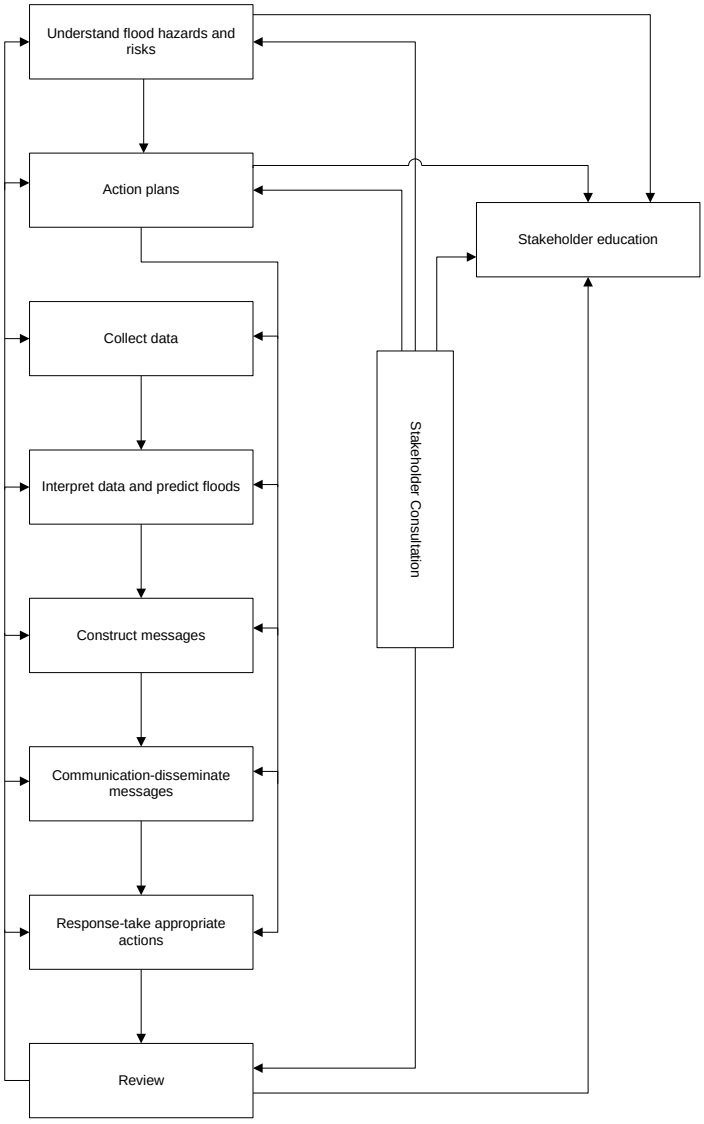

Figure 2: Expanded TFWS components (source: Molino et al., 2011)

The additional six components of the TFWS identified are:
1. Understanding the flood risk
2. Emergency management planning
3. Community flood education
4. Data collection including location and use of rain gauges and river level gauges
5. Community participation
6. Integration of the TFWS components.

A community-based approach

The community-based approach advocated in this paper couples this broader scope for TFWS assessment and design with a community study which sets the scene for community participation in the development, implementation and review of the TFWS.

The initial community study involves obtaining an understanding of the at-risk community through community profiling and community engagement.

Community profiles provide an insight into those at risk of flooding. The profiles can be developed from a range of data sources including:

- Census statistics
- Prior social research e.g. community surveys conducted by local councils and other organisations
- Social research/ community engagement for the TFWS assessment (see below)
- Insights from local council community development and engagement staff
- Insights from local emergency agency staff including volunteers
- Social network analysis – this can be done at a rudimentary level by investigating community groups and other networks listed in the local council's community directory.

Coupled with the results of flood hydrologic and hydraulic modelling, an understanding of flood risk can be obtained through the use of flood extent maps related to social vulnerabilities (e.g. older and younger age, Culturally and Linguistically Diverse people, people with disabilities) and exposure (by estimation of the number of people at risk at a certain flood level). This enables the identification of local 'hot spots' where there is greater risk and flood warning will be paramount.

Community engagement is also an important preliminary part of a community-based TFWS approach. This can be conducted in conjunction with social research (e.g. surveys, focus groups) to learn more about the effectiveness of the current warning system, warnings in previous floods and potential configurations to develop a TFWS. Community engagement activities could include workshops, focus groups, social media groups and online engagement tools such as local council 'Have Your Say' sites.

As the 12 components of the TFWS are assessed and designed it is important to obtain community input also through engagement.

Opportunities for community input to the TFWS components include:
1. Understanding the flood risk: assistance with the calibration of flood modelling, provision of details about vulnerable people including neighbours, previous flood experience, how best to inform people about flood risk e.g. property certificates.
2. Emergency management planning: community participation in flood planning (Webber et al., 2017).
3. Community flood education: what are the best ways to learn? what should be included in the guidance regarding warnings? how to encourage people and organisations to prepare emergency plans that include triggers and actions for flood warning?
4. Data collection: local flood experience to help locate possible stream and rain gauges, crowdsourcing flood information e.g. photographs of previous floods.
5. Prediction: evaluation of BoM predictions, how to use BoM products and services including for flash floods.
6. Interpretation: crowdsourcing of river levels and other flood impacts to the Incident Control Centre to provide real-time local data.
7. Message construction: advice regarding how to make warning messages "timely, relevant and tailored" (Fire Services Commissioner, 2011).
8. Message communication: what are the most effective ways to communicate warnings for the local community?
9. Response: what are the motivators and barriers to appropriate responses to flood warnings including early self-evacuation? How can people help each other including vulnerable people?
10. Community participation: what are the best ways for the community to participate in the TFWS?

11. Review: how can the community evaluate the TFWS over time? (Parker, 2017)
12. Integration of the TFWS components: participation in pre- and post-flood reviews including providing views on the integration of the TFWS, how to communicate the operations of the TFWS to others.

It is important to continue community engagement through the implementation of the TFWS. This could be achieved through a floodplain risk management committee or similar.

The approach in practice

This community-based approach has been used by the author to assess and design TFWSs in several communities across Australia. An example of a published TFWS assessment report using the approach is Molino Stewart (2015).

The use of the community-based approach, including the expanded TFWS components, enabled several observations to be made that could feed into the development of a tailored, local TFWS. These observations included:

- A relatively high percentage of people residing in floodplains were unaware of their flood risk. This is similar to findings elsewhere, as shown in Figure 3, where approximately 18% of those living in high risk flood-prone parts of a part of Sydney did not know that they were at risk of above-floor flooding (Molino Stewart, 2012).

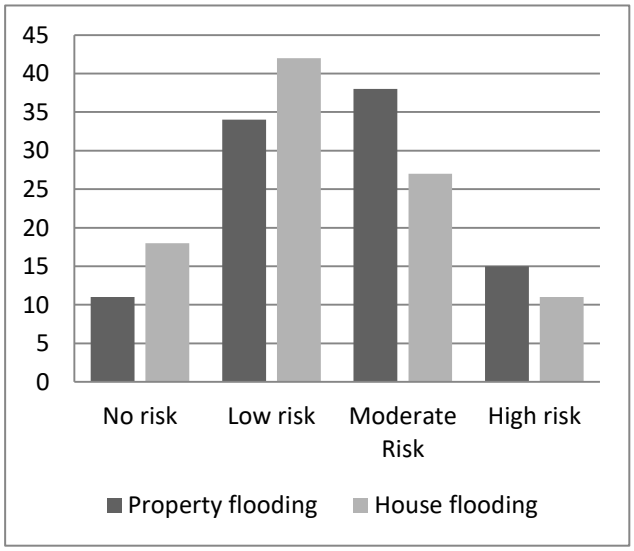

Figure 3: Awareness of flood risk from those living in a high-risk Sydney floodplain (source: Molino Stewart, 2012)

- People were interested in flood risk mainly due to the potential impact of it on property values.
- There was little evidence of community participation in local emergency planning, with most of it being carried out in a top-down fashion by local councils and emergency agencies.
- Community flood education about flood warnings tended to rely on the provision of information from emergency agencies such as Local Flood Guides; however,

in some communities there were opportunities for two-way engagement through meetings, forums, events etc.
- There had been little recognition of community participation in flood warning systems prior to this community-based approach being used.
- There were some examples of crowdsourcing data (e.g. providing real-time flood data) to assist interpretation in the ICC e.g. in the Wimmera CMA area.
- People were keen to provide advice on message construction and ways to communicate these messages to the local community.
- Response remained a problem with many people still wanting to remain in their home, regardless of the flood risk.
- Communities were able to help identify those at high risk of flooding and vulnerable people that required special assistance with warning.
- None of the communities had any formal methods to review flood warning systems.

There were some drawbacks to using the community-based approach including:
- Those people that were involved in the community engagement and social research may not have been representative of community views and had 'ulterior motives' (Dufty, 2017)
- Some members of the community tried to dominate group dialogue about flood warning.
- It is difficult to quantify the findings from community research into economic assessments (e.g. benefit-cost analysis) of potential TFWS configurations.

However, the apparent benefits outweighed these few drawbacks, with a better understanding of what the at-risk populations wanted in the TFWS and the potential for them to play a part in its ongoing implementation and improvement.

Conclusion

Flood warnings are for the people at risk, and therefore the people at risk should have a say in their flood warnings.

Community-based TFWS is not common in Australia, even though inclusion is encouraged by the Australian Government through its Manual 21 guidance. A community-based TFWS approach was developed using an expanded number of components compared with Manual 21 that covered more social aspects. The approach also involves the use of community profiling and engagement to better understand the at-risk population and its flood warning needs.

Marchezini et al. (2017, page 391) summarises the principles of a community-based approach to flood warning:

> "To make this approach effective, actions must occur at different scales, from top down and bottom up, involving multiple stakeholders in dialogue and collaboration at every stage of the process. Different forms of data, information, knowledge, and wisdom must be recognized and shared among experts, policymakers, practitioners, and local people. The system must also take into account features such as demographics, gender, age, culture, and the livelihood of the target audiences. The system planners must be aware of the different forms and degrees of vulnerability and capability of different people (minorities, refugees, gender groups, age groups, people with disabilities, and so on)."

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