

Flood Risk Management in Low Income Countries – Balancing Risk and Development

Gavin Quibell, Martin Kleynhans, and Margot Soler

Abstract— The Sendai Framework notes that disaster risk reduction is essential for sustainable development, and disaster risk reduction is included in 3 of the Sustainable Development Goals (SDGs), and 4 of the SDG targets. However, apart from promoting better governance and resourcing of disaster management agencies, little guidance is given how low-income nations can balance investments across the SDGs to achieve sustainable development in an increasingly climate vulnerable world with increasing prevalence of flood and drought disasters. As one of the world's poorest nations, Malawi must balance investments across all the SDGs. This paper explores how Malawi's National Guidelines for Community-based Flood Risk Management integrate sustainable development and flood management objectives at different administrative levels. While Malawi periodically suffers from large widespread flooding, the greatest impacts are felt through the smaller annual floods and flash floods. The Guidelines address this through principles that recognize that while the protection of human life is the most important priority for flood risk management, addressing the impacts of floods on the rural poor and the economy requires different approaches. The National Guidelines are therefore underpinned by the following; 1. In the short-term investments in flood risk management must focus on breaking the poverty – vulnerability cycle; 2. In the long-term investments in the other SDGs will have the greatest flood risk management benefits; 3. If measures are in place to prevent loss of life and protect strategic infrastructure, it is better to protect more people against small and medium size floods, than fewer people against larger floods; 4. Flood *prevention* measures should focus on small (<1:5 return period) floods; 5. Flood *protection* measures should focus on small and medium floods (up to 1:50 return period), while minimizing the risk of failure in larger floods; 6. The impacts of larger floods (> 1:50) must be addressed through improved *preparedness*; 7. The impacts of climate change on flood frequencies are best addressed by focusing on economic growth not overdesign; and 8. Manage floods and droughts conjunctively. The National Guidelines weave these principles into Malawi's approach to flood risk management through recommendations for planning and implementing flood prevention, protection and preparedness measures at District, Traditional Authority and Village levels.

Keywords— community-based flood risk management, flood risk management in low-income countries, sustainable development, investments in prevention, protection and preparedness, Malawi

I. INTRODUCTION

Malawi, a landlocked country in south-central Africa, is prone to frequent floods and droughts [1]. Floods make up 45% of the recorded disaster events in Malawi, and 50% of the natural disaster related deaths occur from flooding.

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Globally these figures are 43% and 26% respectively [2], [3]. Floods and droughts also have substantial impacts on Malawi's economy. The World Bank and the Global Facility for Disaster Risk Reduction (GFDRR) have estimated that floods affect 26,000 people and 6,000 dwellings every year [4]. Malawi loses 1.7 percent of its gross domestic product, on average, every year due to the combined effects of droughts and floods. This is equivalent to almost US\$22 million in 2005 prices [1]. Of that loss, some 0.7% is attributed to flood related crop losses and infrastructure damage [4]. Our studies over the last 3 years suggest that these figures are likely to be significantly underestimated due to under reporting of flash floods, and smaller and more frequent flooding events. Recognising the devastating impacts of floods on the country, the Government of Malawi initiated the development of National Guidelines for Community-Based Flood Risk Management, as part of its Shire River Basin Development Programme – Phase 1.

While Malawi had developed a Disaster Risk Management (DRM) Policy [5], it is not clear on how it should be reflected in the country's approach to flood risk management (FRM). In this paper we explore how Malawi's sustainable development challenges have influenced the approaches outlined in the National Guidelines. Drawing on these experiences, we present some key considerations and principles for FRM in a developing country context.

II. MALAWI'S DEVELOPMENT AND FLOOD CHALLENGES

Malawi's National Guidelines were framed both by the country's overarching development as well as its specific flood challenges. The CIA's World Fact Book ranks Malawi's GDP per capita (corrected for purchasing power parity), at 223rd out of 230 counties [6]. This limits the resources Government has available to invest in, and maintain, FRM measures. Agriculture and agro-processing generate half of gross domestic product (GDP), and most of the export earnings and employment [1]. Floods and drought losses, therefore, have a direct effect on the economy, further reducing the resources available for FRM. Perhaps more importantly, much of the population is still primarily dependent on growing their own food for survival [1], selling excess production in the good times, and heavily dependent on food aid when droughts and floods reduce crop (mostly maize) yields. Clearly, reducing the impacts of flood disasters will have knock on benefits for the country as a whole.

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However, a range of physical and socio-economic factors increase the risk of flood disasters for Malawi. Some 84% of the population is rural, compared to other low-income countries where some 69% of the population is rural. In high-income countries typically less than 20% of the population is rural (Fig. 1).

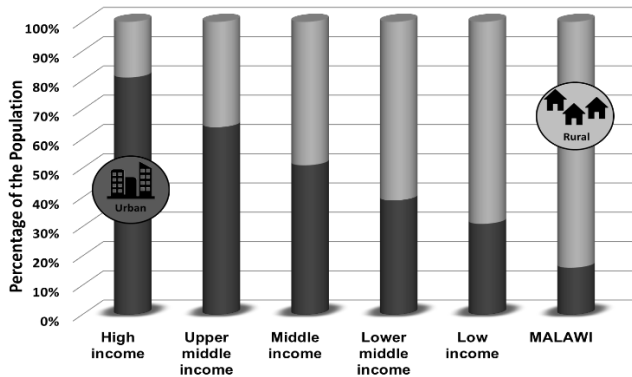


Fig. 1 The proportion of the population that is urban and rural in different countries (data from <https://data.worldbank.org/>)

High population densities add to the pressures on the environment. Sub-Saharan African countries have an average population density of 96.25 people/km². Malawi's population density is nearly twice that at 146.67 people/km² [7]. The mountainous terrain of much of the country means that much of the population is forced to live on floodplain areas. Periodic droughts have driven people to make the most of residual moisture left by the annual floods, and many people live, and grow their food, on floodplain areas that flood almost every year.

Densely populated catchments, together with low household electricity connection rates and insecure electricity supply, contribute to rapid deforestation. In the 25 years from 1990 to 2015 Malawi lost 749,000 hectares of forest, an annual loss of 0.9%. This is more than 10x the global deforestation rate of 0.08% [8]. Rural Malawi is now characterised by highly degraded catchments, with steep slopes. This contributes to flash flooding, and almost annual flood losses for the rural poor. Very little active water storage reduces the country's ability to manage these smaller floods. Malawi's vulnerability to flood disasters, consequently results from a vicious cycle of factors, which limit economic growth, opportunities for less vulnerable livelihoods, and the resources available to reduce flood risks.

However, while periodic significant flood disasters garner the global attention, the frequent smaller and unreported floods appear to be a greater problem for the rural poor, trapping them in poverty, and driving this cycle.

III. SUSTAINABLE DEVELOPMENT AND FRM

World-wide floods cause 25% of the economic damage reported due to disasters [2]. While the total economic losses due to disasters are higher in more developed nations, in developing nations economic losses can make up 5% of their GDP (Fig. 2) [2]. This underpins the notion that effective disaster risk reduction contributes to sustainable development, as is embodied in the Sendai Framework [9]. However, in

Africa, floods are reported to result in only 1% of the economic damage, potentially due to a lack of reporting and data [2]. In Malawi floods have been reported to reduce GDP by only 0.7% [1]. This is both due to the lack of reporting of losses due to smaller floods, and the low value of the infrastructure damaged and the economic activities that are impeded.

However, studies on the economic damage due to flooding largely ignore the impact of a poverty-vulnerability cycle on many of the rural poor. Smaller frequent floods, while causing less economic damage, disrupt village life and trap people in a flood vulnerability – poverty cycle. Poorer households have marginal livelihoods, and the loss of only a few assets in floods has a devastating impact. The women often attempt a second planting when crops or stored food are damaged early in the season. Children, mostly girls, may be taken out of school to provide the additional labour.

The very poorest people in the village live in mud brick houses. When these houses are inundated, even if only to a few centimetres for a brief time, they become unusable for the whole wet season, and these families often seek shelter in evacuation centres, and rely on food aid. The very poorest do not have the resources to rebuild their houses on higher ground, and must invest a significant amount of their resources to recoup flood and drought losses. When these impacts are felt on nearly an annual basis, the rural poor get trapped in a flood poverty-vulnerability cycle which is very difficult to break. This cycle has knock on effects on the economy, limiting opportunities for growth, and making the need for food aid an almost annual occurrence.

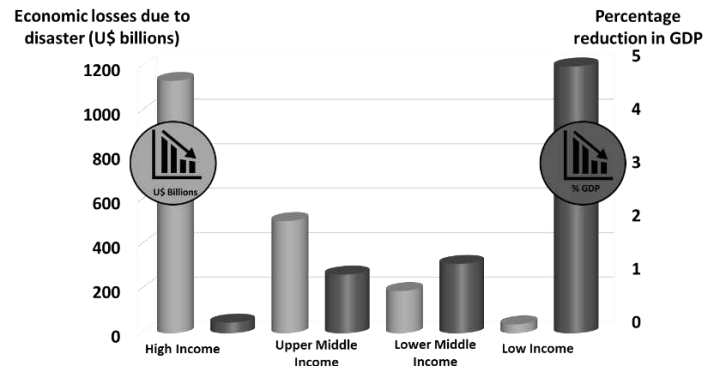


Fig. 2 Economic losses due to disaster, and those losses as a percentage of GDP for different countries (modified from [2]).

Unsurprisingly therefore, 3 of the 17 Sustainable Development Goals (SDGs) recognise the need for disaster risk reduction, and 4 of the 169 targets make specific reference to reducing the impacts of disasters [10]. A nexus approach to implementing the SDGs is gaining traction [9] - [12]. This approach recognizes the mutually supportive role of all the SDGs. Simply put, to achieve any of the SDGs, countries should invest in all the SDGs. Because low-income countries have fewer resources to invest, balancing investments across all the SDG targets is even more critical to their overall development trajectory.

IV. ACCOMMODATING CLIMATE CHANGE

The need to accommodate climate change in disaster risk reduction strategies is reflected in the Sendai Framework [7], and in Malawi's policy and strategy for disaster risk management [5]. Malawi's National Climate Change Policy also follows global trends by urging the integration of climate change in all sectors, including FRM [14]. This is largely predicated on the fact that a warming climate will increase the intensity of rainfall, and hence the frequency and size of floods over the coming decades. The Shire River Basin Plan's – Climate Change Adaptation Plan [17] notes that future rainfall predictions for Malawi vary considerably, but that the wet season is predicted to be shorter and more intense, while the dry season is anticipated to become longer.

However, the impact of climate change on flood disasters is more difficult to predict. Here it is useful to consider definition of floods and flood *disasters*. Floods are natural occurrences, and are often necessary for ecological functioning. Flood *disasters* result from the impact of the floods on infrastructure and people [18]. The impact of climate change on flood disasters, therefore, largely depends on the extent to which people will still be primarily dependent on flood vulnerable livelihoods in the coming decades.

Importantly, the climate is not the only thing that may be changing. Indeed, we hope that balanced investments across all the SDGs would make flood *disasters* less common, even in the face of increased flood frequencies and magnitudes.

V. FLOOD RISK MANAGEMENT IN MALAWI

Malawi's National Guidelines for Community-based Flood Risk Management follow the European Union approaches, as outlined in [16] and [17]. In Malawi's case, FRM interventions are separated into;

- **Prevention:** This includes measures reduce the flood peaks by getting more of the rainfall to soak into the ground where it falls, hold back some flood waters in storage, and making space for the river.
- **Protection:** This includes measures to stop the flood waters damaging or inundating infrastructure. It includes dykes, retaining walls, raised houses and buildings and roads, or designing roads to cope with flooding.
- **Preparedness:** This includes a range of measures aimed at helping the community cope with the flood. It includes improved flood warnings, evacuation plans and the provision of evacuation centres.

To simplify the technical jargon for the Guidelines, floods are classified as Small, Medium and Large. Table 1 outlines how these link to flood return periods, the focus of FRM, and the planning and administrative arrangements in Malawi. In this context, the impacts of small floods will be managed at a village level through prevention measures (mostly catchment rehabilitation), as well as protection measures on the smaller flash flooding river. Medium size floods (up to a 1:50 return period) will be managed through protection measures. Large floods (over a 1:50 return period) will be addressed through preparedness measures (flood warnings, evacuation and

recovery). This may include international assistance for the larger flood emergencies.

TABLE I
THE FOCUS FOR FRM FOR DIFFERENT FLOODS AS OUTLINED IN MALAWI'S NATIONAL GUIDELINES

	Return Period	Focus of FRM	Plan	Admin Responsibility
Small	< 1:5	Prevent Protect	Village Flood Action Area	Village CPC*
Medium	1:5 to 1:50	Protect	Intervention Plan	Area CPC
Large	> 1:50	Prepare	District Contingency	District CPC

* CPC = Civil Protection Committee

Administratively, small, medium and large flood risks are addressed in Village Flood Action Plans, Area Intervention Plans, and District Contingency Plans respectively. These are prepared by Village, Area and District Civil Protection Committees.

VI. CONSIDERATIONS FOR FRM IN A DEVELOPING CONTEXT

The need to integrate sustainable disaster risk reduction strategies into sustainable development is often quite glibly stated. Similarly, there is often a push to overdesign flood infrastructure to accommodate a probable future with increased flood frequencies and magnitudes. However, FRM in a developing context should be more nuanced. Our experience in developing Malawi's National Guidelines have highlighted the following considerations for FRM in a developing country context:

A) Recognise resource and governance constraints.

Least developed countries face significant resource constraints. Expensive protection measures may rob other sectors of investments, while state of the art preparedness measures may impose operational and maintenance costs that the country may struggle to meet.

B) Investments in other sectors realise the objectives of FRM.

Investments across all the SDGs will improve the long-term prospects for economic growth, and with it reduced vulnerability to flood disasters both by providing less flood vulnerable livelihoods and increased resources.

C) Long-term and Short-term approaches are needed.

In the short-term measures that break the poverty-vulnerability cycle are needed. This will enable the poor to start investing in reducing their own vulnerabilities at a village level. Longer-term approaches that recognise the need to move away from flood prone areas by creating an enabling environment to support the voluntary movement of people can be created through economic growth.

D) Different approaches are needed for different floods.

The most immediate need is often to reduce the impacts of the smaller frequent events. In many cases, these events can be addressed with smaller labour-intensive works at lower cost, and can be supported by NGOs. Medium size floods may require larger civil works designed by specialist engineers. The costs of structural measures to protect against infrequent large floods can reduce the number of people who can be helped with limited

resources. FRM for these floods should focus on preparedness measures.

E) The impact of climate change on flood disasters is uncertain.

Forecasting flood *disasters* is uncertain, and depends on a range of factors including changing demographics, economic growth, and catchment rehabilitation, as well as forecasts of increasing rainfall intensity and the frequency of storm events. Investing in more expensive FRM measures to protect against a potential future, where large flood events are more frequent, takes resources away from other sectors. Moreover, many FRM measures may need extensive repair and possibly upgrading within climate change timeframes. The 5th Assessment Report of the Intergovernmental Panel on Climate Change [18] proposes ‘*iterative climate risk management*’ in this regard.

F) Focus on the management of flood disasters not floods.

In many cases, flood disasters can be limited without physically obstructing the natural flow of the flood waters. All viable and reasonable measures to do this should be explored as a first option. This is consistent with environmental legislation and policies.

G) Manage floods and droughts conjunctively

In many developing countries, both floods and droughts dominate the disaster risk profile, but are interlinked phenomena. Preventing the regular flooding of fields can raise the risk of drought disaster, while food banking measures can help the rural poor cope with both drought and flood losses, and can break the poverty-vulnerability cycle.

H) It is not possible to protect against all floods

An over-reliance on large scale protection infrastructure ultimately results in the need for more expensive infrastructure. This holds substantial environmental and social costs, and may also provide a false sense of security.

The following principles have been derived from these considerations and could be considered in similar developing contexts.

1. The protection of human life is the highest priority, but this can be achieved through structural and non-structural measures.
2. Protection of key transport and community services infrastructure (major access routes; clinics and hospitals, police stations, emergency service centres), is critical. This can include less expensive infrastructure that can survive temporary inundation.
3. Protection of water supply infrastructure against very large floods (dams, barrages, wells, water supply systems), which assures ongoing water supply for irrigation, hydropower and domestic use is necessary to minimise the long-term impacts on the economy.
4. The delivery of flood protection infrastructure must aim at breaking the poverty-vulnerability cycle by preventing frequent flood losses.
5. Provided that flood infrastructure maintains its structural integrity in larger floods, it is better to protect more people with smaller infrastructure, than fewer people with larger infrastructure; and

6. The previous principle only applies if effective flood warning measures are in place to save lives when larger floods occur.

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