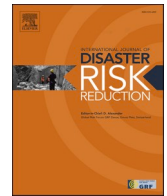




ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

## International Journal of Disaster Risk Reduction

journal homepage: [www.elsevier.com/locate/ijdrr](http://www.elsevier.com/locate/ijdrr)

# Evaluation of national disaster management strategy and planning for flood management and impact reduction in Gaborone, Botswana

Gorata Samuel<sup>a,\*</sup>, Mulalu I. Mulalu<sup>a</sup>, Ditiro B. Moalafhi<sup>c</sup>, Mark Stephens<sup>b</sup>

<sup>a</sup> Department of Environmental Science, Faculty of Science, University of Botswana, P/Bag UB00704, Gaborone, Botswana

<sup>b</sup> School of Chemistry, Environmental and Life Sciences, Faculty of Pure and Applied Sciences, University of The Bahamas, P O Box N-4912, Nassau, Bahamas

<sup>c</sup> Department of Wildlife and Aquatic Resources, Faculty of Natural Resources, Botswana University of Agriculture and Natural Resources, P/Bag 0027, Gaborone, Botswana

## ARTICLE INFO

## Keywords:

Flood disasters  
Disaster management strategy  
Disaster risk management plan  
Disaster management policy  
Risk management index (RMI)  
Gaborone

## ABSTRACT

Floods and droughts are the most common natural disasters that have and continue to result in huge economic losses and loss of life across southern Africa. Flood disasters come about due to intersection of flood waters with areas that are unprepared to deal with flooding, mostly due to poor physical planning and layout of developments and corresponding storm drainage networks especially in urban areas. With the case of Botswana, this is further exacerbated by ineffective disaster management strategies which are limited in providing comprehensive and proactive guidelines for mitigation and adaptive measures. Further, failure of the Botswana disaster management strategy is as a consequence of it being used as an all-purpose disaster management framework that does not recognize that different types of disasters have their individual unique challenges. This study, therefore, used the disaster management cycle to evaluate Botswana's generic national disaster management strategy and planning program in Gaborone. In evaluating the strategy, planning and policy, a mixed method approach was adopted at which key informant interviews were purposefully implemented with process evaluation through document review to identify and determine whether the strategies and plans meet intended goals following Risk Management Performance Index (RMI) criteria. Botswana's generic national disaster management strategy performed low when evaluated against the RMI. This low performance is mostly attributed to low technology uptake as use of technological advancements to respond to the changing dynamics of flood disasters are not assimilated into the current strategy, planning and policies which appear outdated. This, therefore, means the national management strategy, plan, and policy has reached their design life and thus should be replaced as a matter of urgency.

## 1. Introduction

The world has been witnessing a rise in the number of weather-related disasters such as droughts, floods, and heat waves resulting in several fatalities and economic losses [1]. For example, between 1980 and 2019, flooding accounted for some 40% of worldwide natural disaster losses, totaling more than US\$1092 [2]. It is likely that the intensity of extreme events such as floods will increase

\* Corresponding author.

E-mail address: [samuelg@ub.ac.bw](mailto:samuelg@ub.ac.bw) (G. Samuel).

<https://doi.org/10.1016/j.ijdrr.2022.102939>

Received 28 July 2021; Received in revised form 28 February 2022; Accepted 30 March 2022

Available online 6 April 2022

2212-4209/© 2022 Elsevier Ltd. All rights reserved.

globally, partly, due to climate change [1]. Urban sprawl and rapid urbanization without the availability of essential services is also likely to exacerbate the situation [3], with over 30 cities having already experienced major flooding in the southern and western Queensland between December 2010 and February 2011 [4]. It is, therefore, important to approach disasters such as floods through risk reduction approaches (pre-disaster activities) rather than waiting and responding to a once-off disaster event by providing relief [5]. Disaster management strategies are essential to ensure that sufficient levels of capacity and resources are made available for preparedness, response, recovery, and rehabilitation/reconstruction from disasters [6].

Countries around the world have different approaches on how they manage floods through global, regional, national, and local strategies and/or plans as well as policies. China prioritizes disaster risk reduction at national and local level with a strong institutional basis even though the implementation of disaster reduction plans runs up against complex management processes and difficulties in fund raising [7]. After several incidents of flood disasters, Government of Nepal prepared a National Action Plan on Disaster Management to illustrate priority item groups and activities but there is lack of a proper policy and legal environment for an effective disaster management system there [8]. An integrated Flood Risk Management (FRM) framework for Vietnam basically has different phases of the disaster management cycle as well as the stakeholders responsible for flood management activities [9]. The [10] confirms that a framework allows stakeholders to recognize their roles and contributions to disaster preparedness. Nonetheless [9], argue that, decision-makers on steering committees are usually government officials but they often do not possess expertise in disaster management therefore lack of involvement of experts, researchers, and scientists could affect the decision-making process.

Guiding principles and frameworks on disaster prevention, preparedness, management, and recovery are available. In this regard, there is the Hyogo Framework for Action (HFA) [11], United Nations Strategy for Disaster Reduction (UNSDR) [12], Africa Regional Strategy for Disaster Risk Reduction [13], Sendai Framework [14] as well as the sustainable development goals [15]. [16] state that the HFA was adopted in 2005 in Japan to provide a global strategic plan to disaster risk reduction aiming to lessen disaster losses. The framework offers guiding principles, priorities for action, and practical means for achieving disaster resilience for vulnerable communities. UNSDR aims to build disaster resilient communities by promoting increased awareness whereas AU established an Africa Regional Strategy for Disaster Risk Reduction to guide towards facilitating discussions and promoting political commitment to DRR [16]. The Sendai Framework for Disaster Risk Reduction (2015–2030), as the recent framework aims to “prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic ... educational, environmental, technological ... and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience” [14]; p. 12) which aligns with this study. Botswana’s strategy and plan were developed well along the above-mentioned global frameworks which have been reviewed, but Botswana’s have never been reviewed which means they are outdated and left behind. Some of the shortcomings of the Botswana’s strategy and plan are the limited correlation between disaster risk reduction and law and policy. Consequently, lessons are not learnt and documented, and there is limited focus on awareness programs hence limited evidence that vulnerability to disasters is decreasing [17]. This shows that Botswana’s disaster management strategy, plan and policy are more on provision of relief than preparedness. [18]; identified a number of challenges in the National Disaster Management Office (NDMO) of Botswana such as; a) lack of specific legislation to support the implementation of disaster risk reduction; b) inadequate resources and lack of capacity to encourage active participation of multiple sectors; c) not all the sectors participate actively; d) lack of monitoring and evaluation tools to ensure active participation of the local level partners.

With more than a third of the world’s droughts and about a fifth of the world’s floods having taken place in Africa during the past decade [19], Africa is one of the continents susceptible to flood disasters. Each country responds to floods differently depending on many factors including spatial extents, frequencies, magnitudes, and occurrences. In Nigeria [20], explained that institutional framework deals with government response procedures such as policies, regulations, guidelines and agencies involved in planning and managing flood conditions. Ghana on the contrary, has divided its strategic plan into three phases which are pre-disaster phase (measures taken to prevent man-made disasters); emergency phase (immediate actions necessary to meet the requirements of search and rescue operations); and post-disaster phase (rehabilitation and reconstruction) [21]. Mozambique has also been one of the hardest hits by floods and several management activities and institutions have been put in place to facilitate flood disaster management. According to Ref. [22]; the Master Plan for the Prevention and Mitigation of Natural Disasters (2006–2014) is the key reference for disaster risk management in Mozambique as it links disaster mitigation and recovery with poverty and vulnerability reduction in an agriculture-based economy.

In South Africa, the National Disaster Management Centre (NDMC), which monitors the implementation of multidisciplinary disaster risk management activities in different disaster institutions, is the primary functional division for disaster risk management [23]. Because river flooding has always been a major cause of death and destruction of property in Malawi, the Malawi Government saw the need to change its strategy towards the flood hazard as the number of victims and the frequency of floods had increased over time. This necessitated the formulation of the Flood Contingency Plans and District Development Plans to fight against flood risk [24]. This was a thoughtful move for Malawi to change the strategy and have an alternative backup plan but would have been much more effective if geospatial solutions were fused into the plans to provide visible feedback on flood disasters.

In Botswana, the country suffered from several drought and flood related disasters which have affected 1.5 million people and economic losses of over US\$3 million to the country between 1965 and 2006 [25]. Between the years 2009 and 2014, over US\$4 million was expended to provide relief for flood disasters alone [26]. Damages due to flooding and associated costs are mostly felt around the capital Gaborone and its surroundings due to high investment in infrastructure and high population densities over the area. The increasing intensity of destruction caused by recurring floods on a yearly basis in the capital Gaborone [27] is widely believed to be an indication that the existing plans are not adequate to manage floods. Therefore, the country needs a comprehensive disaster management strategy. The disaster management cycle is not followed systematically in Botswana since only relief is provided and the

response is reactive and not proactive [28]. Botswana rather uses the generic disaster management strategy which is inadequate because it does not accommodate different types of disasters that are likely to happen in Botswana as well as different settings e.g., the different urban and rural settings.

To give some background, Botswana's strategy is structured in a way that it shows mainly products of consultation and inputs by different stakeholders such as the police, military, health, agriculture, the red-cross and other private stakeholders. The NDMO encourages that the strategy should be read in conjunction with the plan and the policy [29]. Botswana's 1996 national policy on disaster management is currently used to reduce future disaster impact and vulnerability. This policy also ensures that disaster preparedness measures are in place to cope with disasters when they occur [30]. The policy includes the country's institutional and legal framework for disaster reduction and outline key definitions, measures and responsibilities for disaster preparedness at all levels of the hierarchy coordinating sectors [30]. It is also noted that Botswana does not have any legislation for disaster management but rather uses the emergency power act (Cap 22.04) to back the declaration of disasters [28]. The National Disaster Risk Management Plan of 2009, on the other hand lays out the national framework for disaster risk reduction and emergency management in Botswana with all stakeholders in the disaster management involved [28].

It is thus imperative that the country develops pro-active and efficient disaster management strategies that are reviewed periodically to keep up with current emerging challenges especially regarding flooding. The aim of this study is therefore to use the disaster management cycle to evaluate Botswana's generic national disaster management strategy, planning and policy for pro-activeness and its responsiveness to increasing challenges of flooding especially in urban settings using Botswana's major urban center anchored on the capital city Gaborone [31]. defines evaluation as an evidence-based, systematic, and unbiased assessment of a strategy to conclude on its relevance, satisfaction of objectives, efficiency, effectiveness, and sustainability. This systematic assessment is done in different ways depending on the preferences of the evaluators. This study will contribute towards attainment of the second objective of Botswana's 1996 National Policy on Disaster Management which intends to create a framework which facilitates the preparation of plans and legislation by developing a comprehensive and proactive flood disaster management strategy. The intended output of this paper is recommendations from a review of the national management strategy, plan, and policy for an appropriate and dynamic contingency plan for better flood risk reduction in urban centers.

To achieve this, the study adopted a mixed method approach at which key informant interviews were purposefully used with process evaluation through document review to identify and determine whether the strategies and plans meet intended goals following Risk Management Performance Index (RMI) criteria. The Risk Management Performance Index (RMI) by Ref. [32] was successfully used to improve the effectiveness of Flood Emergency Management Systems (FEMS) in Europe. RMI was used to quantify the effectiveness of organizational abilities and capacity to plan and address the consequences of disasters. These include the following six indicators; a) organization and coordination of emergency operations; b) emergency response planning and implementation of warning systems; c) endowment of equipment, tools, and infrastructure; d) simulation, updating, and test of interinstitutional response; e) community preparedness and training; and f) lastly rehabilitation and reconstruction planning. Each indicator was quantified using a 1 to 5 scale to determine the scale of achievement against the desired objective [32–34].

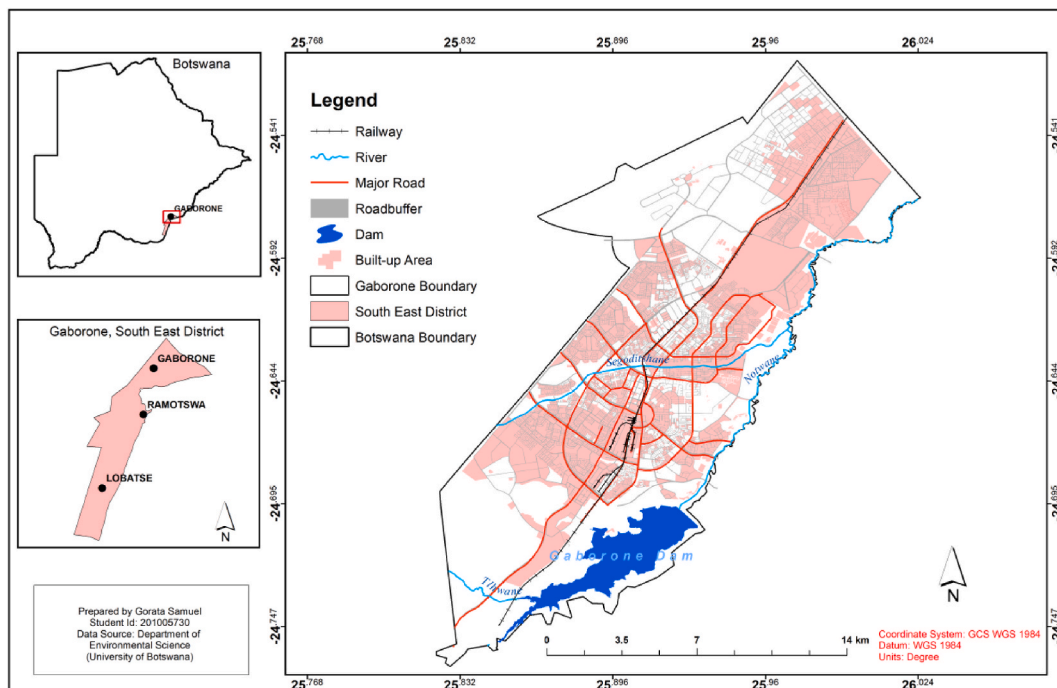


Fig. 1. Map of the study area.

The main contributions offered in this article are as follows:

1. Demonstration of an objective and well-thought evaluation of the Botswana's disaster management strategic plans using the RMI in order to facilitate motivations, preparations and adoption of comprehensive and proactive flood disaster management strategy, plan and policy.
2. Qualitative case study with key informants to evaluate potential and motivations for an appropriate and dynamic contingency plan for better flood risk reduction in urban centers.
3. Recommendations from a review of the national management strategy, plan, and policy for an appropriate and dynamic contingency plan for better flood risk reduction in urban centers.

The rest of the paper is organized as follows: Section 2 presents data and methods where the study area is briefly described, followed by the methods of data collection and analysis; Section 3 presents results presentation followed by discussion in Section 4 whereas Section 5 concludes the study and makes recommendations.

## 2. Data and methods

### 2.1. Study area

Gaborone is in the southeastern Botswana, 15 km from the South African border to the east within 24°39'16.11"S and 25°54'24.71"E (Fig. 1). The topography of Gaborone is undulating to flat [35], sited in a flat valley between Kgale and Oodi hills [36] with Notwane River flowing from south to north, with a total catchment area of 18 053km<sup>2</sup> [37] including the Gaborone dam with a capacity of 141,100,000 cubic meters. Gaborone like the rest of Botswana has a semi-arid climate with hot and dry summers from October to March. The rainfall is erratic and unpredictable [38]. noted that this rainfall pattern is influenced by the movement of the Inter-Tropical Convergence Zone (ITCZ) and tropical temperate troughs and their associated bands. Since large amounts of rainfall are recorded from November to March, the long dry seasons hardens the land surface thus promoting quick runoff and causing flash floods.

### 2.2. Methods

Document review and key informant interviews were used to collect data to determine whether the strategy policies and plans met the desired objectives. Document review was used as the main method to identify strategies and plans that already exist to find what is being practiced currently and their effectiveness. Face to face key informant interviews in which key stake holders were purposively selected provided expert opinion on previous flood events focusing mainly on the effectiveness and efficiency of their strategy, plan and policy. An interview guide was used, designed in a semi-structured format with both closed and open-ended questions to allow free flow of opinions from the key informants. The three main key players responsible for hydrological disasters for the study area are the National Disaster Management Office (2 respondents), Department of Meteorological Services (3 respondents) and Department of Water and Sanitation (2 respondents), a total of 7 key informants. These key stakeholders were recommended by the NDMO as the coordinating body for disaster management in Botswana, but they also recommended other sectors which were reluctant to help. Some of the main themes that were developed for the key informants are; a) general information on the disaster management strategies and plans; b) implementation of disaster management strategies and plans; c) stakeholder contribution towards the development of flood disaster management strategy as key stakeholders; d) successfulness and unsuccessfulness of the strategy, plan and policy; e) key elements (inputs & activities) of the strategy, plan and policy; f) proactiveness of the strategy, plan and policy; g) their evaluation/review criteria of the strategy, plan and policy.

Risk Management Index (RMI) developed by Ref. [33] was used to quantify the effectiveness of organizational abilities and capacity

**Table 1**

Risk management performance index (RMI).

Evaluation terms	Evaluation Assumptions	Criterion score
<b>Relevance</b> (Prevention/mitigation Preparedness Response recovery) (RMI <sub>R</sub> )	R1. Strategy components relevant to national needs and priorities and fit for Botswana. R2. Community involvement and activities are appreciated by the community and stakeholders. R3. Emergency and evacuation plan activation	
<b>Effectiveness</b> (RMI <sub>EF</sub> )	EF1. Vulnerable communities are reached quickly and efficiently when disaster strikes. EF2. Mobilizing resources, equipment, tools, and infrastructure. EF3. Organization and coordination of emergency operations (stakeholders are selected effectively).	
<b>Efficiency</b> (RMI <sub>EC</sub> )	EC1. Quality of technical assistance up to the expected level EC2. Damage assessments and Relief management EC3. Efficient use of resources and implementation of warning systems	
<b>Degree of change</b> (RMI <sub>DC</sub> )	DC1. Data collection and dissemination DC2. Data collected and disseminated. DC2. Simulation, updating, and test of inter-institutional response DC3. Community preparedness and training (Individual development in intellectual, moral, and social terms): response	
<b>Sustainability</b> (RMI <sub>S</sub> )	S1. Local level capacities are upgraded and resources available to cope with flood disasters S2. The road map identified the national priorities and implemented without interruption. S3. Budgetary allocation for DRR	

to plan and address the consequences of disasters based on the existing strategy, plans and policy. Attempts were made to determine if the strategy, plans, and policy meet intended goals and objectives; stakeholders were also consulted on how the strategy is being implemented; and then conclusions were derived. The RMI was constructed by using three disaster management documents (National Disaster Risk Reduction Strategy 2013–2018, National Disaster Risk Management Plan of 2009, and Botswana Disaster Management Policy 1996), and one of the RMI major indicators, the disaster management (DM) by Refs. [33,34]. The DM was used because the study is only interested in evaluating the performance of the disaster management strategy, plan and policy. Within the DM indicator, the study adopted evaluation indicators from Ref. [39] which are shown in Table 1 in the first column (relevance (R), effectiveness (EF), efficiency (EC), degree of change (DC) and sustainability (S)). The OECD original six criteria evaluation was altered to fit the intentions of the study and to reduce many terms for the interview thereby consolidating the “impact” and “coherence” into one simple term “degree of change” to simplify evaluation scoring for the study and respondents. Degree of change in this case study involves the strategy, plan, and policy’s flexibility to move away from its present state towards a desired future state to enhance its relevance, effectiveness, efficiency, and sustainability. This ability to change important characteristics in response to the changing climate (threats and opportunities) provide its capacity to add value, complement and harmonize with the international frameworks such as the Sendai and the Hyogo Frameworks, regional and local frameworks. Degree of change and its flexibility and inclusive nature assesses if the plan, strategy and policy factors are customizable looking at the speed at which variables in the flood management change over time. Some of these variables are, simulation, updating and test of inter-institutional response; and community preparedness and training for intellectual development, to cover for both impact and coherence. These indicators were chosen because they have also been used to evaluate other policies and strategies in Botswana such as; OECD Investment Policy Reviews: Botswana 2014; Revenue Statistics Africa: Key findings for Botswana, to name a few. The assumptions were developed subjectively but following the [39] key questions, the [34]; and [33] indicator descriptions and the reports themselves (disaster management strategy, plan and policy). Some of the key inputs and activities of key informant interviews were used to produce sound and realistic assumptions. The study recognizes Botswana’s disaster management strategy, plan, and policy as interventions because they were implemented as mediators between disaster governance and the local community. The [39] also indicate that the criteria are widely recognized as playing a central role in improving the quality of global evaluation practice and supporting collaborations. Even though the criteria were originally developed for use in international development co-operation, it can be applied to evaluate thematic topics or strategic issues, policies and projects [39].

The levels of performance (1–3) were established as in Table 2, for indicators ( $RMI_R$ ,  $RMI_{EF}$ ,  $RMI_{EC}$ ,  $RMI_{DC}$ ,  $RMI_S$ ) with assistance from authorities responsible for disaster management and strategy development and implementation. Criterion scores for each sub-indicator were also established using the performance levels shown in Table 2 in correspondence to the criteria. The criterion scores were subjectively coded in the following manner;

Criterion Score (1): The subjected strategy is given a score of 1 for the lowest compliance if;

- a) Relevance (R) – the objectives are not relevant and do not fully acknowledge the disaster management cycle.
- b) Effectiveness (EF) – the strategy, plans and policy does not deliver to the satisfaction of intended objectives
- c) Efficiency (EC) – the strategy, plans and policy does not provide useful and enough content for disaster management.
- d) Degree of change (DC) - strategy, plans and policy does not employ or incorporate innovative technology.
- e) Sustainability (S) – It is not possible to establish if strategy, plans and policy will continue

A score closest to 3 for an evaluation term means more compliance or effectiveness. The following equation was used to calculate RMI.

$$RMI = (RMI_R + RMI_{EF} + RMI_{EC} + RMI_{DC} + RMI_S) / 5 \quad (1)$$

There are several methods that can be used to evaluate strategies such as IADB/IDEA Indicators Program which describes comparative levels of disaster risk and factors considered to reduce risk but the method is of control and not the precise evaluation of risk, procedure and objective that are realistic in the real world [33]. The other criteria found in literature is the evaluation criteria developed by Ref. [39], which the study adapted but the problem is, it cannot be used alone to evaluate disaster management strategies because it does not quantify performance of these documents hence infused into the RMI to provide solid outcomes. RMI was regarded as the best method for this study because it qualifies a group of indicators that measure risk management performance and their effectiveness which is definitely what the study was aiming to achieve. This gives objective and unbiased views on the performance of the strategy, plan and policy. RMI also provide measures for disaster management based on well-established targets that risk management efforts should aim to achieve [41]. Even though RMI (Disaster Management) indicators were limited, the study adopted sub-indicators from the OECD to expand them.

**Table 2**  
RMI values (degree of achievements).

Scale	Performance Level
1	Low to Non-existent
2	Incipient
3	Outstanding

Adopted and modified from [40].

### 3. Results

#### 3.1. National Disaster Risk Reduction Strategy of 2013 to 2018

The study identified National Disaster Risk Reduction Strategy (2013–2018) which was evaluated based on key components of the RMI evaluation framework where weights were assigned the strategies based on stakeholder preferences and the researcher's expert

**Table 3**  
Evaluation of the national disaster risk reduction strategy of 2013–2018.

Evaluation terms	Evaluation	Criterion score
<b>Relevance</b> (Prevention, Mitigation, Preparedness, Response, Recovery) (RMI <sub>R</sub> )	R1. <i>Strategy components relevant to national needs and priorities and fit for Botswana.</i> This study found the National Disaster Risk Reduction Strategy as relevant to enhancing national needs for managing disasters. The strategy identifies the increasing frequency and magnitude of disasters and the ultimate need for finances for upliftment and development for disaster response. The strategy underscores that hundreds of households and thousands of people locally are affected by disasters annually where livelihoods, environment, private and public property are destroyed. The strategy highlights the negative impacts of disasters on the economy and underscores that disaster risk reduction should be prioritized.	3
	R2. <i>Community involvement and activities are appreciated by the community and stakeholders.</i> This strategy does not show any point of contact with communities in reducing disaster risk. Even though the document acknowledges the importance and needs for community involvement in reducing mass risk to disasters it does not create avenues for public participation in such. RP1 added that "the strategy might be proactive on paper but on the ground, it is a different case as community involvement is lacking in the strategy even on the ground."	1
	R3. <i>Emergency and evacuation plan activation.</i> The National Disaster Risk Reduction Strategy does not provide guidelines for emergencies and evacuations thereafter. The document rather emphasizes the need for well-planned emergency response and evacuation without objective guidance on such.	1
<b>Effectiveness</b> (RMI <sub>EF</sub> )	EF1. <i>Vulnerable communities are reached quickly and efficiently when disaster strikes.</i> Whereas the national strategy highlights reduced vulnerability in the last five years, there is limited evidence that vulnerability to disasters is decreasing. The strategy does not outline pathways for reaching out to affected communities as well as to defining evacuation procedures in terms of disasters.	1
	EF2. <i>Mobilizing resources, equipment, tools, and infrastructure.</i> RP1 argued that "single-hazard strategies that follow the disaster management cycle are old-fashioned but rather the most effective strategy is one that has adopted the multi-hazard approach because hazards are believed to be intertwined." At the same time, the strategy notes that there is no dedicated disaster risk management staff and there are also inadequate resources at all levels. RP 1 indicated that disaster response depends more on outsourcing resources from other sectors such as BPS, BDF, and CTO. All Key-informants indicated limited to no adoption of geospatial technologies for planning and response.	1
	EF3. <i>Organization and coordination of emergency operations (stakeholders are selected effectively).</i> All key informants indicated that priority is given to sister sectors in crafting the risk reduction strategy as opposed to the public. Informants also indicated a previous instance where the former strategy was formulated solely through an external consultant. This strategy also showed a preference for technocratic expertise as opposed the community ideas.	2
<b>Efficiency</b> (RMI <sub>EC</sub> )	EC1. <i>Quality of technical assistance up to the expected level.</i> RP3, RP4, RP5, RP6, RP7, RP8, RP9, and RP10 indicated limited contributions to the national risk reduction strategy except making specific contributions to smaller components of the strategy. The strategy also does not show technical suggestions such as the use of geospatial technologies for mapping and assessments of floods.	1
	EC2. <i>Damage assessments and Relief management.</i> The local strategy does not inform damage assessment in cases of disaster incidence as well as articulating relief procedures to be followed. Rather the document articulates those resources should primarily focus on reducing disaster risk and less on disaster relief. On the other hand, RP1 and 2 stressed the department's key emphasis on response.	1
	EC3. <i>Efficient use of resources and implementation of warning systems;</i> The strategy indicated that early warning shall be carried out on the incidence of a disaster. The strategy indicated partial achievement in the implementation of early warning strategies. On the other hand, all key-informants indicated that they are efficient in early warning except the fact that they face resistance from the public when issuing warnings.	2
<b>Degree of change</b> (RMI <sub>DC</sub> )	DDC1. <i>Data collection and dissemination:</i> Disaster risk reduction strategy states that continuous engagement with communities via meetings, providing risk reduction-focused information material in the form of flyers/brochures and posters and posters and capacity building sessions. However, key-informants showed that initial information on forecasting, estimation remains much circulating between affected government departments as opposed to the communities.	2
	DDC2. <i>Simulation, updating, and test of inter-institutional response:</i> This strategy articulates that there should be planning and execution of simulation exercises. RP1 and 2 also confirmed that their department executes simulation exercises in preparation for disasters. However, the respondents indicated that simulations are executed utilizing print media (flyers, pamphlets) as opposed to animations and real-life simulations.	2
	DDC3. <i>Community preparedness and training (Individual development in intellectual, moral, and social terms):</i> The strategy points that training, capacity building, and research on disaster risk management will continually be executed by all institutions, stakeholders, and role players. On the other hand, all key informants iterated that their community preparedness is only limited to simulations.	2
<b>Sustainability</b> (RMI <sub>S</sub> )	S1. <i>Local level capacities are upgraded and resources available to cope with flood disasters:</i> This strategy identifies that there is still a continued lack for appropriate training, resources and equipment and financial resources at local level to enhance resilience.	1
	S2. <i>The road map identified the national priorities and implemented without interruption:</i> The strategy is focused to support enhancement of national policies and legal and institutional basis for efficient disaster risk reduction planning and implementation. However, it remains disadvantaged by limited capacity building at community level and well as limited skilled personnel for disaster management.	2
	S3. <i>Budgetary allocation for DRR:</i> The National Disaster Management Office is obligated to recommend funding for the costs related to disaster preparedness and relief. The strategy advises that individual ministries, sectors, and councils should also include disaster risk reduction in their budgets.	1

Source; Authors' fieldwork (2019).

R = Relevance; EF = Effectiveness; EC = Efficiency; DC = Degree of Change; S= Sustainability.

knowledge as shown in Table 3.

### 3.2. National Disaster Risk Management Plan of 2009

The second document identified was the National Disaster Risk Management Plan of 2009 which was also evaluated using the key components of the RMI evaluation framework as shown in Table 4.

### 3.3. National policy on disaster management of 1996

Lastly the National Policy on Disaster Management of 1996 was also evaluated by means of the RMI evaluation framework components as shown in Table 5.

**Table 4**  
Evaluation of the national risk management plan of 2009.

Evaluation terms	Evaluation	Criterion score
<b>Relevance</b> (Prevention, Mitigation, Preparedness, Response, Recovery) (RMI <sub>R</sub> )	R1. <u>Strategy components relevant to national needs and priorities and fit for Botswana.</u> National disaster risk management plan of 2009 identifies that there are existing and potential risks in Botswana which calls for a comprehensive NDRMP. The plan appears relevant to local context as it addresses basic principles which are building the resilience; Safe and secure development planning; Multi Hazard Approach; and decentralized approach. Mostly the plan is among others informed by the constitution of the country.	3
	R2. <u>Community involvement and activities are appreciated by the community and stakeholders.</u> The plan presents a top-down approach where disaster response in its contents is particularly emphasized on sectoral preparedness as opposed to community response. Similarly, RP1 indicated that the plan is basically formulated to guide sectoral response to disaster.	2
	R3. <u>Emergency and evacuation plan activation.</u> That plan articulates a four phased approach for emergency activation which bestows much responsibility of the national emergency operations center. The emergency center is activated partial or fully based on the level of emergency of a disaster. This study rather identifies that the plan does not outline evacuation plans and responsibilities at all levels of emergency.	1
<b>Effectiveness</b> (RMI <sub>EF</sub> )	EF1. <u>Vulnerable communities are reached quickly and efficiently when disaster strikes.</u> In addressing vulnerability and vulnerable communities, the plan presents a general appreciation of varying vulnerability in Botswana as per different disaster occurrences. This study identifies a limited scaling of vulnerability and seasonality of disasters. As such the plan does not detail effective and efficient methods of reversing or reaching out to vulnerable groups.	2
	EF2. <u>Mobilizing resources, equipment, tools, and infrastructure.</u> The local plan stresses out an Emergency Support Function which emphasizes a requirement for support effort in disaster response. The support outlines locating, procuring, and issuing supplies such as food, equipment, and transport to the affected. To this regard KP1 stressed that the local generic strategic provides relief-based funds as opposed to proactive funding.	1
	EF3. <u>Organization and coordination of emergency operations (stakeholders are selected effectively).</u> The plan indicates that when emergency occurs, the chairperson of the National Committee on Disaster Management shall act as the National Emergency Coordinator. However, where a disaster occurs at a district level the District Commissioner shall take charge of operational command at district level which shows an all-encompassing approach in terms of leadership involvement.	3
<b>Efficiency</b> (RMI <sub>EC</sub> )	EC1. <u>Quality of technical assistance up to the expected level.</u> Technical assistance in the disaster response is only limited to ensuring the establishment of communications systems within affected areas. There is no articulation on utilizing technical expertise not only of response but general management of disasters locally.	1
	EC2. <u>Damage assessments and Relief management.</u> The plan indicates that provision of relief shall follow full assessment of the impact of a disaster. The government or NGOs shall provide relief which can be materials and equipment, immediate relief assistance and on-going assistance.	3
	EC3. <u>Efficient use of resources and implementation of warning systems.</u> According to the plan early warnings will be coordinated from a single centralized authority to ensure flow of accurate between government sectors. This study finds that warnings systems as articulated in this report remain owing much to adopting of technology for baseline setting and enhancing preparedness.	2
<b>Degree of change</b> (RMI <sub>DC</sub> )	DDC1. <u>Data collection and dissemination:</u> The Emergency Support Function collects, processes, analyze and disseminates information about potential or actual disaster to facilitate government agencies in aiding and managing the disaster.	2
	DC2. <u>Simulation, updating, and test of inter-institutional response:</u> The plan suggests that simulations for specific hazard preparedness should be carried by various sectors. However, it does not provide specific or generic guidelines which should be followed on simulations.	2
	DC3. <u>Community preparedness and training (Individual development in intellectual, moral, and social terms):</u> The current plan does not offer any opportunity for community engagement on preparedness as well as capacity building. As RP1 stated it, "We haven't reached out to people and the private sector because the strategy is more of a government document."	1
<b>Sustainability</b> (RMI <sub>S</sub> )	S1. <u>Local level capacities are upgraded and resources available to cope with flood disasters:</u> The plan does not promote local level capacities to be resilient; rather it is relief based emphasizing rehabilitation and reconstruction post a disastrous event.	1
	S2. <u>The road map identified the national priorities and implemented without interruption.</u> The plan's road map remains relevant to national priorities by choosing to address the national constitution, national policy on disaster management and various laws and policies of Botswana. However, its implementation remains not a clear path as it pays little empowerment on communities.	2
	S3. <u>Budgetary allocation for DRR:</u> National Disaster Management Office remains identified as the key custodian to the management of disasters in Botswana according to the National Disaster Risk Management Plan of 2009. As such the plan does not outline any fund allocation strategy for aiding sector which suggests that the NDMO assumes responsibility of coordinating response as well as its budgetary issues.	2

Source; Authors' fieldwork (2019).

R = Relevance; EF = Effectiveness; EC = Efficiency; DC = Degree of Change; S= Sustainability.

### 3.4. Overall performances of the disaster management strategies and planning

Overall performances of the national management strategy, plan, and policy are presented below. As can be seen from Fig. 2, the 2013–2018 National Disaster Risk Reduction's relevance; effectiveness; efficiency degree of change and sustainability to the disaster management of the country is low ( $RMI_R = 1.7$ ;  $RMI_{EF} = 1.3$ ;  $RMI_{EC} = 1.3$ ;  $RMI_{DC} = 1.7$ ;  $RMI_S = 1.8$ ) which shows that the strategy is underperforming ( $RMI = 1.56$  (min: 1 and max: 3)) This indicates the underperformance by the strategy which is also shown in the overall performance of the three documents in Fig. 3.

As shown in Fig. 3 the NDRMP has a satisfactory level of performance ( $RMI_R = 2$ ) in relation to its relevance in flood disaster management. The graph shows that the plan is still effective as is scaled at an average performance level of 2 ( $RMI_{EF} = 2$ ) which means the plan's effectiveness is still substantial and this is probably the reason why the National Disaster Management Office is still using the plan. Based on Fig. 3, the plan's efficiency is satisfactory as it is still used by the coordinating disaster office ( $RMI_{EC2} = 2$ ) and the graph also illustrates a low degree of change ( $RMI_{DC} = 1.7$ ). Sustainability of the plan is unsatisfactory as it records a low performance level ( $RMI_S = 1.7$ ) and the overall performance of the plan is also low ( $RMI = 1.88$ ), but the plan is performing better than the strategy.

Fig. 3 shows evaluation of the Botswana Disaster Policy of 1996 which indicates that the performance level of the policy's relevance to its mandate is very low ( $RMI_R = 1.3$ ). This is because the policy is too old to be used for the current disaster trends and environment

**Table 5**  
Evaluation of the national policy on disaster management.

Evaluation terms	Evaluation	Criterion score
<b>Relevance</b> (Prevention, Mitigation, Preparedness, Response, Recovery) ( $RMI_R$ )	R1. <i>Strategy components relevant to national needs and priorities and fit for Botswana.</i> This policy identifies Botswana as prone to a variety of disastrous events hence a need to ensure that disaster management programme is consistent with development objectives of the country. However, the policy does not outline any justifiable systematic approach to addressing the disasters. The policy is as well outdated considering the changing of disasters particularly those propelled by agro meteorological parameters.	2
	R2. <i>Community involvement and activities are appreciated by the community and stakeholders.</i> This policy identifies communities as critical victims of disasters. As such it suggests importance of their engagement in building self-reliance and sustainability. The policy does articulate methods of to be utilized to engage communities. It does not also address communities will be engaged considering their different structures.	1
	R3. <i>Emergency and evacuation plan activation.</i> The policy does not address key components of disaster management such as Response which informs emergency and evacuation activation. This policy is rather shy from technical aspects of disaster management.	1
<b>Effectiveness</b> ( $RMI_{EF}$ )	EF1. <i>Vulnerable communities are reached quickly and efficiently when disaster strikes.</i> The National Policy on Disaster Management is limited to address specific components of disaster management. The policy does not speak to responding to differing vulnerabilities.	1
	EF2. <i>Mobilizing resources, equipment, tools, and infrastructure.</i> This document assumes an advisory stance in terms of dispensation of resources for management of floods. It advises that disaster management should be implemented in a cost-effective way using existing resources and capacities. It asserts that the establishment of a national disaster contingency fund makes resources only available at short notice to deal with specific disaster requirements. This study views this as a potential limitation to management of floods.	1
	EF3. <i>Organization and coordination of emergency operations (stakeholders are selected effectively).</i> Coordination of emergency operations in this policy is addressed at all levels of governance where the Deputy Permanent Secretary within the office of the president shall be responsible for overseeing the implementation of disaster activities. Council secretaries and traditional leaders are empowered to coordinate operations at district and village levels, respectively.	3
<b>Efficiency</b> ( $RMI_{EC}$ )	EC1. <i>Quality of technical assistance up to the expected level.</i> Technical assistance is not emphasized in this plan as well as any aspirations to adopt current technologies to enhance response.	1
	EC2. <i>Damage assessments and Relief management.</i> Even though the plan encompasses cost effective relief approach it does not address procedures to focus administration of relief. The document as well does not address damage assessment of affected communities.	1
	EC3. <i>Efficient use of resources and implementation of warning systems;</i> Despite having identifies the coordination of disaster response, this policy did not provide guidance on dispensation of resources to execute their mandate. Early warning as a critical component of disaster management has not been addressed in the document.	1
<b>Degree of change</b> ( $RMI_{DC}$ )	DDC1. <i>Data collection and dissemination:</i> The policy advises that systematic collection of data to build an effective information base should be prioritized. The policy does not bestow responsibility of this action on any government entity as well as stating how the dissemination of information should be carried out to reach all affected.	1
	DDC2. <i>Simulation, updating, and test of inter-institutional response:</i> The local policy is rather limited to address preparedness in terms of simulations. The policy only advises that training of disaster management should explore local educational institutions.	1
	DDC3. <i>Community preparedness and training (Individual development in intellectual, moral, and social terms):</i> At the same no avenue is created in this policy to expand and improve community preparedness and response to disasters. This study identifies the relief-based approach as the only available opportunity of contact with communities.	1
<b>Sustainability</b> ( $RMI_S$ )	S1. <i>Local level capacities are upgraded and resources available to cope with flood disasters;</i> This policy promotes only a relief-based approach to avail resources to affected communities. Therefore, the policy does not offer any other means to improve local level capacities except provision of relief.	1
	S2. <i>The road map identified the national priorities and implemented without interruption.</i> The policy is however excellent to identify national level priorities to manage disasters however it does relate its purpose to the promotion of other national development policies.	2
	S3. <i>Budgetary allocation for DRR;</i> The document does not offer budgetary guidance in relation to management of disasters as well as advising on the source of funding for response.	1

Source; Author's fieldwork (2019).

R = Relevance; EF = Effectiveness; EC = Efficiency; DC = Degree of Change; S= Sustainability.



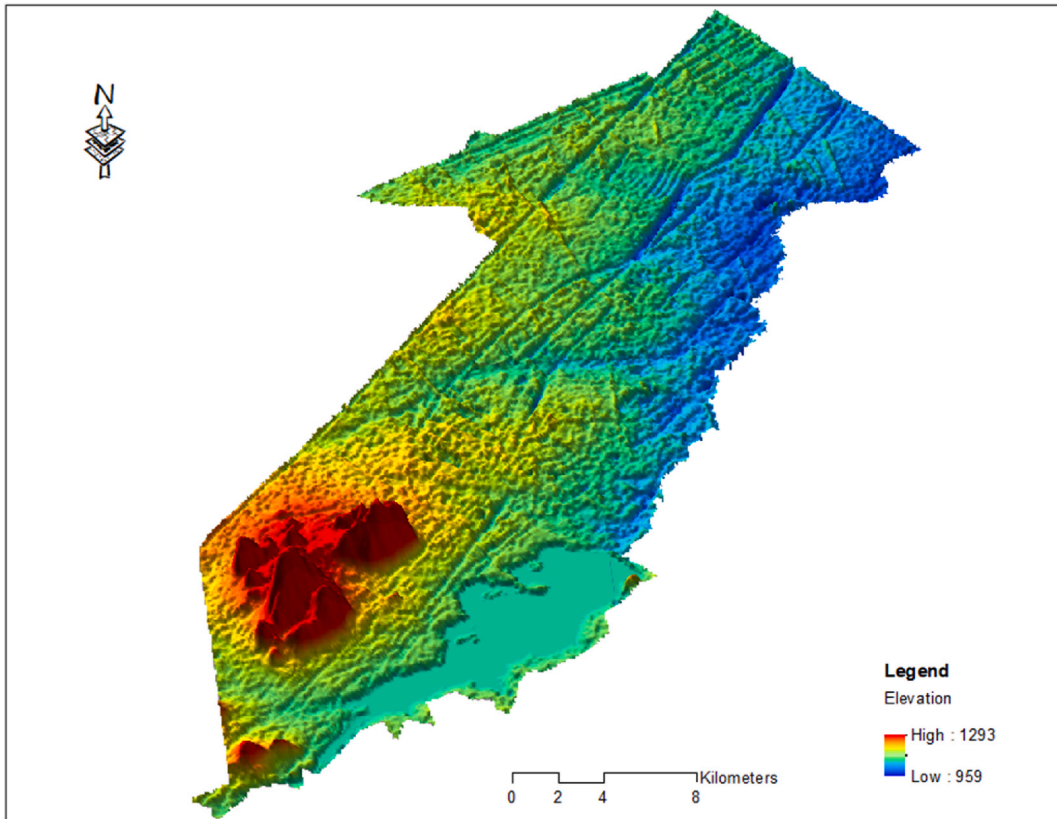


Fig. 2. Elevation (masl) map of the Study Area.

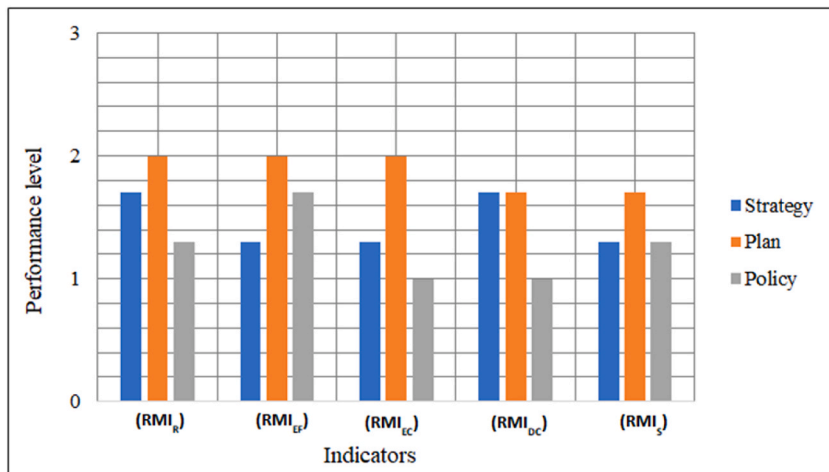


Fig. 3. RMI performance indicators for disaster management strategic plans.

although some of its components can still be used because some of the activities are relevant to the disaster management cycle. The effectiveness of the policy is also not adequate as it shows a low  $RMI_{EF}$  of 1.7. Furthermore, the efficiency of the policy is also very low ( $RMI_{EC} = 1$ ) because the policy does not clearly state how resource utilization, implementation of early warning and relief management were reached or managed. Fig. 3 reveals that the policy fails to address community preparedness and training; data collection and dissemination hence leading to low degree of change ( $RMI_{DC} = 1$ ). The policy’s sustainability is very low at 1.3 performance level, which basically means the policy is not sustainable, therefore needs to be reviewed as a matter of urgency. The policy’s overall performance according to the RMI is low at 1.26.

Key-informants generally perceive the current generic national disaster management strategy as not proactive. NDMO respondent

added that, “the strategy can be proactive on paper but a different case on the ground. District levels are not active as they only meet after a disaster strikes hence reactive.” On the other hand DMS respondent asserted that, “the strategy is not proactive as we experience challenges in executing models for and predictions as well as operational system.” Respondents highlighted that the current disaster management strategy lacks key components which are otherwise critical for managing disasters. As Fig. 4 shows, all respondents (100%) indicated that the current strategy is only relief based as opposed to prioritizing prevention. “The government budget only provides relief based funds even though we believe that it’s cheaper to be proactive than responsive”, said one NDMO respondent.

At the same time the respondents indicated that the disaster management committee is particularly reactive. About 70% of the informants indicated that the strategy does not integrate geospatial intelligence in flood management plans and related prevention and rehabilitation initiatives. This same portion (70%) of the respondents further highlighted that land allocation is not fully informed by flood disaster patterns. Sixty percent (60%) noted that the local strategy has no implementation plan and that there is no monitoring and evaluation framework for the performance of the strategy. Only 20% of the subjects indicated that the strategy does not integrate gender dynamics. “The strategy does not cover crosscutting issues. The development of the strategy does not involve the community. We haven’t reached out to people and the private sector because the strategy is more of a government document”, said one NDMO respondent.

#### 4. Discussion

The overall intention of the strategy, plan and policy is to reduce disaster risk in Botswana. The major evaluation finding of Botswana’s strategic planning is that the strategy goals are not really achieved on the ground because there are no identified development policies and programmes that disaster risk reduction was incorporated into at national, district, community, and household levels.

First and foremost, all the three disaster management documents; the NDRSS (2013–2018); the NDRP (2009); and the NDP (1996) have all reached their design life spans. Flood hazard patterns have changed with respect to climate change and this on its own makes the strategy, plan, and policy inconsistent as indicated by low RMIR (RMIR = 1.46; 1.88 & 1.26) shown in Figs. 2 and 3 respectively and need to be revised to fit the status of hazards and environment. From majority of the key informants, both the policy and the strategy do not cover cross cutting issues such as gender and issues of climate change as there is a parallel between climate change and disaster risk. However, with the trends and status of hazards in the country especially the flood hazard as the point of focus, the NDRMP partly accommodates the current trends of flood disaster in Botswana which clearly state what is done exactly in each phase of the disaster management cycle. The plan recorded RMIEF of 2 which means the plan is effective as compared to the policy and strategy which are low (RMIEF = 1.7 and 1.3). The informants added that the strategy, plan, and policy formulations are usually a top-down approach that is developed through consultation with sectors with very little involvement of the public and this makes the office to question if they represent the community well or not.

According to the strategy, planning for the disasters involves reducing hazard level, severity, and probability of the hazard [29], but it is not explained exactly how this will be done and the relevant stakeholders for each of these activities are not specifically indicated. Moreover, the planning is only done at national and district levels which in turn marginalizes the community who are the key victims of disasters. This explains the low sustainability of all the three disaster management documents, that is the NDRRS, NDRMP & NPDM (RMIS = 1.3; 1.7 & 1.3). The low sustainability of these documents shown in Figs. 2 and 3 is also influenced by lack of legislation on disaster risk reduction which weakens the strategy, plan, and policy as it is hard to determine the rights and responsibilities of individuals (community) and authorities (stakeholders) affected by the legislation. Informants added that the NDMO does not have enough human resources to carry this load of work alone as the coordinating institution.

Most, if not all, key informants added that it is very difficult to implement the strategy, plan, and policy because there is limited political buy-in and financial support. Nonetheless, the goals for the strategy, plan and policy are outlined very clearly as they are mainly focused on disaster risk reduction which is the best and most present priority action in disaster management worldwide. The overall RMI of the strategy indicates that the strategy is weak (RMI = 1.46) as noted in the [17,29] document which states that some projects are still ongoing and considered good indicator of the positivity the strategy is bringing in terms of preparing for response.

The key informants indicated that they have knowledge about the formulation of disaster management strategy (DMS), plan and policy and the coordinating body emphasized that they engage all the relevant stakeholders when these are formulated. These stakeholders are Botswana Geoscience Institute, Water Utilities Corporation, Department of Meteorological Services, Police, Central Transport Organization, Gaborone City Council, and Department of Water and Sanitation. Nonetheless, besides the three key players of flood disaster management, all these other sectors only provide information to the NDMO during formulation of DMS, plan and policy and never follow up on it. So, all of these sectors were not keen to give information on the effectiveness of the DMS, plan and policy. The key players being NDMO, DMS and DWS indicated that the DMS, plan and policy were effective back then but they are now outdated and overdue for review.

#### 5. Conclusion & recommendations

In conclusion, Botswana’s generic national disaster management strategy performed low when evaluated against the RMI at (RMI = 1.46). This is largely due to limited use of technological advancements to respond to the changing dynamics of flood disasters as they are not assimilated into the current strategy, plan and policy. Despite the Botswana’s NDRSS (2013–2018); NDRP (2009); and NDP (1996) having served the country over the past, these are deemed outdated as per the findings of this study as they also do not follow the Sendai framework and the Hyogo Framework for disaster, which are the recent global frameworks for disaster risk reduction. The strategy and the plan, therefore, need to be reviewed. Additionally, the policy performance is low, and for that reason, relevance, effectiveness, efficiency, degree of change and sustainability are compromised or inadequate. Moreover, according to RP1, the strategy

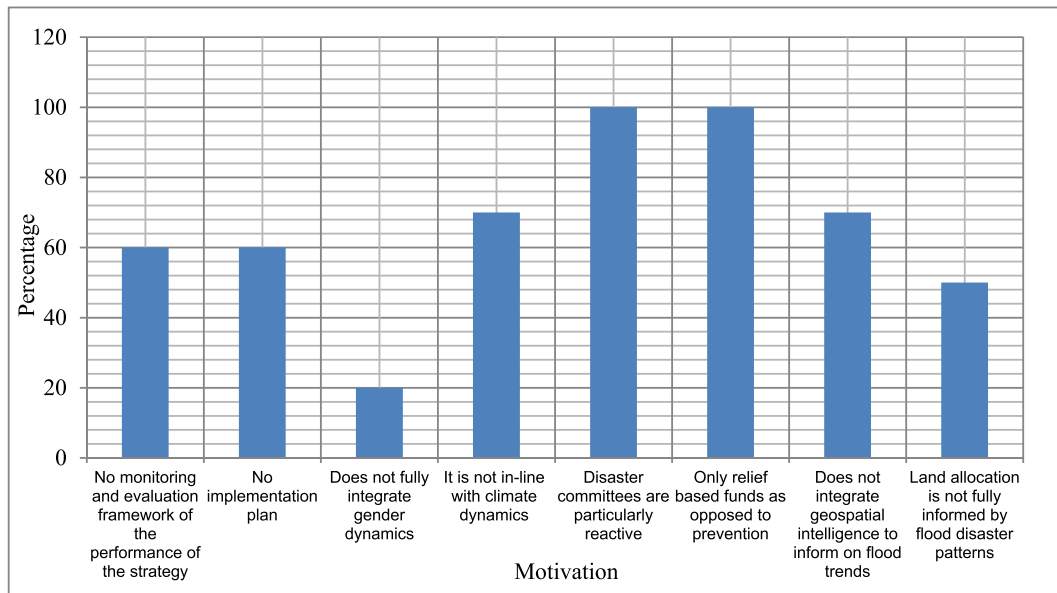


Fig. 4. Motivations for alternative flood disaster management strategy content. Source: Authors' fieldwork (2019).

evaluation has never been undertaken before, making it difficult to tell how the strategy has been performing.

It is based on the above that the study recommends the following;

1. The national management strategy, plan, and policy have reached their design life and thus should be replaced as a matter of urgency.
2. The stakeholders in disaster management that includes the local people should be involved when formulating strategies, plans and policies because they are the first victims of flood disasters.
3. Stakeholders should collectively undertake to have periodical review evaluations of the strategy, plan, and policy as appropriate whether there is a hazard threat or not.
4. There is need to encourage more scientific investigations on flooding and other disasters to strengthen existing institutional strategies and stimulate increased responsibility towards flood risk reduction in the country.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Acknowledgments

The authors would like to thank the Department of Disaster Management at the Office of The President of The Republic of Botswana for assistance with the required strategy, policies and plans that were very critical to this study. Key Informant Interviewees also played a very important part in offering their expertise on flood information, knowledge, and associated challenges in Botswana. This is highly appreciated. The University of Botswana under which the first author successfully completed her master's degree from which this research output emanated is also acknowledged. The authors would also like to thank the editor and the anonymous reviewers for their comments and suggestions which helped improve the manuscript.

#### References

- [1] B. Parida, D.B. Moalafhi, Regional rainfall frequency analysis for Botswana using L-Moments and radial basis function network, *Phys. Chem. Earth, Parts A/B/C* 33 (8–13) (2008) 614–620.
- [2] R.E. Munich, Risks from Floods, Storm Surges and Flash Floods, 2019. Retrieved October 31, 2021, from, <https://www.munichre.com/en/risks/natural-disasters-losses-are-trending-upwards/floods-and-flash-floods-underestimated-natural-hazards.html>.
- [3] V. Krysanova, H. Buiteveld, D. Haase, F.F. Hattermann, K. Van Niekerk, K. Roest, M. Schlüter, Practices and lessons learned in coping with climatic hazards at the river-basin scale: floods and droughts, *Ecol. Soc.* 13 (2) (2008).
- [4] K. McDougall, Using Volunteered Information to Map the Queensland Floods, in: Paper Presented at the Proceedings of the 2011 Surveying and Spatial Sciences Conference: Innovation in Action: Working Smarter (SSSC 2011), 2011.
- [5] UNISDR, Disaster Risk and Resilience. Thematic Think Piece, UN System Task Force on the Post-2015 UN Development Agenda: United Nations International Strategy for Disaster ReductionS, 2012.
- [6] UNDP, Issue Brief: Disaster Risk Governance, Crisis Prevention And Recovery, New York, 2012.
- [7] UNISDR, Progress and Challenges in Disaster Risk Reduction: A Contribution towards the Development of Policy Indicators for the Post 2015: United Nations International Strategy for Disaster Reduction, 2014.

- [8] G. Tuladhar, Disaster management system in Nepal-policy issues and solutions, *J. Risk Anal. Crisis Response* 2 (3) (2012) 166–172.
- [9] C. Luu, J. Von Meding, S. Kanjanabootra, Flood risk management activities in Vietnam: a study of local practice in Quang Nam province, *Int. J. Disaster Risk Reduc.* 28 (2018) 776–787.
- [10] World Health Organization, A Strategic Framework for Emergency Preparedness, World Health Organization, 2017.
- [11] UNDRR, Hyogo framework for action 2005-2015: building the resilience of Nations and communities to disasters, in: Extract from the Final Report of the World Conference on Disaster Reduction (A/CONF.206/6), United Nation for Disaster Risk Reduction, 2007, p. 25.
- [12] UNISDR, UNISDR Strategic Framework 2016-2021, in: United Nations International Strategy for Disaster Reduction, 2017, p. 13.
- [13] African Union, in: New Partnership for Africa's Development Planning and Coordinating Agency, African Development Bank, United Nations Office for Disaster Risk Reduction - Regional Office for Africa (Eds.), Africa Regional Strategy for Disaster Risk Reduction, vol. 16, African Union, 2004.
- [14] United Nations, in: United Nations Office for Disaster Risk Reduction (Ed.), Sendai Framework for Disaster Risk Reduction 2015 - 2030, vol. 32, United Nations, 2015.
- [15] UNDP, The SDGs in Action, 2015. Retrieved 11/17/2021, 2021.
- [16] C.C. Dingel, A. Tiwari, Report on the Status of Disaster Risk Reduction in Sub-saharan Africa, World Bank, 2010.
- [17] NDMO, National Disaster Risk Reduction Strategy 2013-2018, UNDP, Gaborone, 2012.
- [18] N. Moyo, Botswana: Compilation of National Progress Reports on the Implementation of the Hyogo Framework for Action (2009-2011), National Disaster Management Office, 2010.
- [19] World Bank, Climate Change Adaptation and Economic Transformation in Sub-saharan Africa, vol. 24, 2021.
- [20] U. Nkwunonwo, W. Malcolm, B. Brian, Flooding and flood risk reduction in Nigeria: cardinal gaps, *J. Geogr. Nat. Disasters* 5 (1) (2015) 136–148.
- [21] Strategic Partnership for Preparedness, Strategic Partnership for Preparedness (SPP): National Response Capacity Assessment for Ghana, 2010. Ghana.
- [22] GFDRR, GFDRR, in: Recovery from Recurrent Floods 2000-2013: Mozambique, Recovery Framework Case Study, 2014.
- [23] National Disaster Management Centre, Inaugural Annual Report Financial Year 2006/2007, South Africa: Provincial and Local Government, 2008.
- [24] P.L. Mijoni, Y.O. Izadkhah, Management of floods in Malawi: case study of the lower Shire river valley, *Disaster Prev. Manag.: Int. J.* 18 (5) (2009) 490–503.
- [25] EM-DAT, International Disaster Database, from Universite Catholique de Louvain, 2007.
- [26] Statistics Botswana, Botswana Environmental Statistics: Natural Disasters Digest 2015, 2015.
- [27] B. Parida, D. Moalafhi, P. Kenabatho, Effect of urbanization on runoff coefficient—a case study of Notwane catchment in Botswana, in: Paper Presented at the Proceedings of the Intl. Conf. On Water and Environment (WE-2003), 2003.
- [28] NDMO, National Disaster Risk Management Plan, National Disaster Management Office, Gaborone, 2009.
- [29] NDMO, National Disaster Risk Reduction Strategy 2013-2018, UNDP, Gaborone, 2012.
- [30] NDMO, National Policy on Disaster Management Gaborone, Office of the President, 1996.
- [31] World Meteorological Organization, Integrated Flood Management Tools Series Effectiveness of Flood Management *Measures Integrated Flood Management Tools Series*, 2015.
- [32] H.K. Gilissen, M. Alexander, P. Matczak, M. Pettersson, S. Bruzzone, A framework for evaluating the effectiveness of flood emergency management systems in Europe, *Ecol. Soc.* 21 (4) (2016).
- [33] O.D. Cardona, Information and Indicators Program for Disaster Risk Management *Indicators for Risk Management: Methodological Fundamentals*, Instituto de Estudios Ambientales, Manizales-Colombia, 2003, p. 26.
- [34] IADB, Indicators for Disaster Risk and Risk Management, Programme for Latin-America and The Caribbean Bahamas Inter-American Development Bank, 2011.
- [35] A. Kent, H. Ikgopoleng, Gaborone, *Cities* 28 (2011) 478–494, <https://doi.org/10.1016/j.cities.2010.11.004>.
- [36] R. Sebege, T. Gwebu, Patterns, determinants, impacts and policy implications of the spatial expansion of an African capital city: the greater Gaborone example, *Int. J. Sustain. Built Environ.* 2 (2013), <https://doi.org/10.1016/j.ijsbe.2013.12.002002>.
- [37] N. Mladenov, K. Strzepek, O.M. Serumola, Water quality assessment and modeling of an effluent-dominated stream, the Notwane River, Botswana, *Environ. Monit. Assess.* 109 (1) (2005) 97–121, <https://doi.org/10.1007/s10661-005-5842-8>.
- [38] V.K. Boken, A.P. Cracknell, R.L. Heathcote, Monitoring and Predicting Agricultural Drought: a Global Study, Oxford University Press, 2005.
- [39] OECD, Applying Evaluation Criteria Thoughtfully, OECD Publishing, Paris, 2021.
- [40] D. Novelo-Casanova, G. Suárez, Estimation of the risk management Index (RMI) using statistical analysis, *Nat. Hazards* 77 (2015), <https://doi.org/10.1007/s11069-015-1663-4>.
- [41] M.L. Carreno, O.D. Cardona, A.H. Barbat, Evaluation of the risk management performance, *Intersectii/Intersections* 2 (2) (2005).