Hacettepe University Inistitute Of Health Sciences
Public Health Program

A STUDY OF SCALE DEVELOPMENT TO EVALUATE INDIVIDUAL PREPAREDNESS TO FLOODS (KASSALA, SUDAN)

MSc. MBBS. Marwa OSMAN

Program of Public Health
DOCTOR OF PHILOSOPHY THESIS

ANKARA
2023

Hacettepe University Institute Of Health Sciences
Public Health Program

A STUDY OF SCALE DEVELOPMENT TO EVALUATE INDIVIDUAL PREPAREDNESS TO FLOODS (KASSALA, SUDAN)

Marwa OSMAN (MBBS, MSc)

Program of Public Health
PHILOSOPHY OF DOCTORAL (PhD) THESIS

ADVISOR OF THE THESIS
Prof. Kerim Hakan ALTINTAŞ, MD, EMDM

SECOND ADVISOR OF THE THESIS
Assoc. Prof. Gülşen TAŞDELEN TEKER, PhD

ANKARA
2023

ACCEPTANCE AND APPROVAL

A STUDY OF SCALE DEVELOPMENT TO EVALUATE INDIVIDUAL PREPAREDNESS TO FLOODS (KASSALA, SUDAN)

Student: Marwa OSMAN

Supervisor: Prof. Kerim Hakan ALTINTAŞ, MD

Co-supervisor: Assoc. Prof. Gülşen Taşdelen TEKER, PhD

This thesis study has been approved and accepted as a PhD dissertation in "Public Health Program " by the assesment committee, whose members are listed below, on 21/12/2023.

Chairman of the Committee : Prof,Metin, HASDE, MD

Sağlık Bilimleri University, Gülhane Faculty of Medicine

Member: Prof. Banu Çakir, MD, PhD

Hacettepe University, Faculty of Medicine

Member : Prof. Deniz ODABAŞ, MD

Ankara University, Faculty of Medicine

Member : Assoc. Prof.Cavit Işık YAVUZ, MD

Hacettepe University, Faculty of Medicine

Member : Assoc. Prof. Mahmut Saadi YARDIM , MD

Hacettepe University, Faculty of Medicine

This dissertation has been approved by the above committee in conformity to the related issues of Hacettepe University Graduate Education and Examination Regulation.

Prof. Müge YEMİŞCİ ÖZKAN, MD, PhD

Director

YAYIMLAMA VE FİKRİ MÜLKİYET HAKLARI BEYANI

Enstitü tarafından onaylanan lisansüstü tezimin/raporumun tamamını veya herhangi bir kısmını, basılı (kağıt) ve elektronik formatta arşivleme ve aşağıda verilen koşullarla kullanıma açma iznini Hacettepe Üniversitesine verdiğimi bildiririm. Bu izinle Üniversiteye verilen kullanım hakları dışındaki tüm fikri mülkiyet haklarım bende kalacak, tezimin tamamının ya da bir bölümünün gelecekteki çalışmalarda (makale, kitap, lisans ve patent vb.) kullanım hakları bana ait olacaktır. Tezin kendi orijinal çalışmam olduğunu, başkalarının haklarını ihlal etmediğimi ve tezimin tek yetkili sahibi olduğumu beyan ve taahhüt ederim. Tezimde yer alan telif hakkı bulunan ve sahiplerinden yazılı izin alınarak kullanılması zorunlu metinlerin yazılı izin alınarak kullandığımı ve istenildiğinde suretlerini Üniversiteye teslim etmeyi taahhüt ederim.

Yükseköğretim Kurulu tarafından yayınlanan ***"Lisansüstü Tezlerin Elektronik Ortamda Toplanması, Düzenlenmesi ve Erişime Açılmasına İlişkin Yönerge"*** kapsamında tezim aşağıda belirtilen koşullar haricince YÖK Ulusal Tez Merkezi / H.Ü. Kütüphaneleri Açık Erişim Sisteminde erişime açılır.

- Enstitü / Fakülte yönetim kurulu kararı ile tezimin erişime açılması mezuniyet tarihimden itibaren 2 yıl ertelenmiştir. (1)
- Enstitü / Fakülte yönetim kurulunun gerekçeli kararı ile tezimin erişime açılması mezuniyet tarihimden itibaren 6 ay ertelenmiştir. (2)
- Tezimle ilgili gizlilik kararı verilmiştir. (3)

22/01/2024

Marwa Osman

[1] *"Lisansüstü Tezlerin Elektronik Ortamda Toplanması, Düzenlenmesi ve Erişime Açılmasına İlişkin Yönerge"*

(1) Madde 6. 1. Lisansüstü tezle ilgili patent başvurusu yapılması veya patent alma sürecinin devam etmesi durumunda, tez ***danışmanının*** *önerisi ve* ***enstitü anabilim dalının*** *uygun görüşü üzerine* ***enstitü*** *veya* ***fakülte yönetim kurulu*** *iki yıl süre ile tezin erişime açılmasının ertelenmesine karar verebilir.*

(2) Madde 6. 2. Yeni teknik, materyal ve metotların kullanıldığı, henüz makaleye dönüşmemiş veya patent gibi yöntemlerle korunmamış ve internetten paylaşılması durumunda 3. şahıslara veya kurumlara haksız kazanç imkanı oluşturabilecek bilgi ve bulguları içeren tezler hakkında tez ***danışmanının*** *önerisi ve* ***enstitü anabilim dalının*** *uygun görüşü üzerine* ***enstitü*** *veya* ***fakülte yönetim kurulunun*** *gerekçeli kararı ile altı ayı aşmamak üzere tezin erişime açılması engellenebilir.*

(3) Madde 7. 1. Ulusal çıkarları veya güvenliği ilgilendiren, emniyet, istihbarat, savunma ve güvenlik, sağlık vb. konulara ilişkin lisansüstü tezlerle ilgili gizlilik kararı, ***tezin yapıldığı kurum*** *tarafından verilir *. Kurum ve kuruluşlarla yapılan işbirliği protokolü çerçevesinde hazırlanan lisansüstü tezlere ilişkin gizlilik kararı ise,* ***ilgili kurum ve kuruluşun önerisi*** *ile* ***enstitü*** *veya* ***fakültenin*** *uygun görüşü üzerine* ***üniversite yönetim kurulu*** *tarafından verilir. Gizlilik kararı verilen tezler Yükseköğretim Kuruluna bildirilir.*

Madde 7.2. Gizlilik kararı verilen tezler gizlilik süresince enstitü veya fakülte tarafından gizlilik kuralları çerçevesinde muhafaza edilir, gizlilik kararının kaldırılması halinde Tez Otomasyon Sistemine yüklenir

****** Tez* ***danışmanının*** *önerisi ve* ***enstitü anabilim dalının*** *uygun görüşü üzerine* ***enstitü*** *veya* ***fakülte yönetim kurulu tarafından karar verilir.***

ETHICAL DECLARATION

In this thesis study, I declare that all the information and documents have been obtained based on the academic rules and all audio-visual and written information, and the results have been presented according to the rules of scientific ethics. I did not do any distortion in the dataset. In the case of using other works, related studies have been fully cited in accordance with scientific standards. I also declare that my thesis study is original, except for the cited references. It was produced by myself in consultation with my supervisors (Prof. Kerim Hakan ALTINTAŞ, MD, EMDM and Assoc. Prof. Gülşen TAŞDELEN TEKER, PhD) and written according to the rules of thesis writing of Hacettepe University Institute of Health Sciences.

Marwa Osman

ACKNOWLEDGEMENT

I would like to thank my supervisor Prof. Kerim Hakan Altıntaş, MD, EMDM for his valuable advices and support through out my educational journey to gain the PhD degree. I would like to thank my thesis co-supervisor Assoc. Prof. Gülşen Taşdelen Teker, PhD for teaching me the analyses related to this thesis and her worthy advices in relation to the development and analysis of the scale up to the final form of it. I am very thankful to my thesis monitoring commitee members Prof. Banu Çakır, MD, PhD and Prof. Deniz Odabaş, MD for their precious recommendations and advices through out the steps of this study. My gratitude to Professor Nuri Doğan for his time and advices regarding the scale. Deep thanks to the professors of public health who provided us with their valuable opinions and advices at the stage of development of the scale to ensure its content validity. My deep thanks as well to all my professors at Department of Public Health, Institute of Health Sciences, at Hacettepe University for the very informative courses that I took with them.

I would like to thank my family, my husband and my son, parents, sisters and brother for their patience and support through out this long journey. My thanks as well to members of Department of Community Medicine at Faculty of Medicine University of Khartoum. I would like to specify Prof. Taha El Mukashfi, Prof. Fatih Malik for their advices and continuous support.

Finally, I would like to thank those who helped me in the data collection of this study, from Ministry of Health in Kassala State in Sudan Dr. Wael and Dr. Abdelrahman and from the locality Ms. Jameela and the data collectors. Many thanks to all my friends and colleagues who were asking eagerly about the progress of this study.

ABSTRACT

Osman, M. A Study Of Scale Development To Evaluate Indıvıdual Preparedness To Floods (Kassala, Sudan) Hacettepe University, Institute of Health Science, Public Health Program Doctor of Philosophy Thesis, Ankara, 2023. The study aimed to provide scale tools for measuring individual preparedness for measuring individual's knowledge and behavior regarding flood preparedness in Kassala, Sudan. Item development was conducted by reviewing the literature and considering the opinions of the target population. Six experts agreed on the item pool and confirmed its content validity with a content validity index ≥0.75 for all the items. This process resulted in dividing of the item pool into two draft scales: knowledge and behavior. Study participants were 413 household key persons from seven neighborhoods affected by the 2018 floods in Kassala city in Sudan. Analysis of the collected data was carried out using the Statistical Package for Social Sciences (SPSS) software for Exploratory Factor Analysis (EFA) construct validity, Cronbach's alpha internal consistency, test retest reliability analysis, and item analysis. In addition LISREL 7.8 program was used for Confirmatory Factor analysis construct validity and Monte Carlo application for Pararel to analyze factor number in construct validity. Experts confirmed the content validity of the scales. EFA revealed a construct of two factors in Knowlege scale and construct of three factors for the behavior scale. Parallel analysis confirmed the number of factors. Items loaded on their factors by > 0.3. CFA also revealed acceptable significant loadings of the items of the two scales and acceptable measures of goodness of fit. Cronbach's alpha, composite reliability indices for all factors were ≥ 0.7. The test–retest reliability coefficients were 0.75 and 0.63 for the knowledge and behaviour scales respectively. Item analysis showed acceptable corrected total item correlations and Cronbach's alpha if the item was deleted for all the items. Differences between means scores of the highest and lowest score groups for all the factors were significant which indicate good power of discrimation of the items.The findings support the hypothesis that the two scales are instruments that produce valid and reliable measures that can be used for measuring individual's knowledge and behavior regarding flood preparedness in Kassala, Sudan.

Keywords: Sudan, Flood, Knowledge, Behaviour, Validitiy, Reliability, Scale

ÖZET

Osman, M., Sele Bireysel Hazırlığı Değerlendirme Ölçeği Geliştirme Çalışması (Kassala, Sudan). Hacettepe University, Institute of Health Science, Public Health Program Doctor of Philosophy Thesis, Ankara, 2023. Bu çalışma, Sudan'ın Kassala kentinde bireylerin sele hazırlık konusundaki bilgi ve davranışlarını ölçmek için bireysel hazırlığı ölçen ölçek araçları sağlamayı amaçlamıştır.

Madde geliştirme esas olarak literatürün taranması ve hedef kitlenin görüşleri dikkate alınarak gerçekleştirilmiştir. Altı uzman madde havuzu üzerinde anlaşmış ve tüm maddeler için kapsam geçerlilik indeksi ≥0,75 olacak şekilde içerik geçerliliğini doğrulamıştır. Bu süreç madde havuzunun iki taslak ölçeğe bölünmesiyle sonuçlanmıştır: Bilgi ve davranış ölçekleri. Bu ölçeklerin doğrulama çalışmasının katılımcıları, Kassala şehrinde 2018 yılındaki selden etkilenen yedi mahallenin 413 hanedeki kişileridir. Veri analizi, Açımlayıcı Faktör Analizi (EFA) yapı geçerliliği, Cronbach alfa iç tutarlılığı ve test tekrar test güvenirlik analizi ve madde analizi için SPSS programı kullanılarak gerçekleştirilmiştir. Ayrıca Doğrulayıcı Faktör Analizinin yapı geçerliliğinde LISREL 7.8 programı ve yapı geçerliliğinde faktör sayısı analizinde Pararel için MonteCarlo uygulaması kullanılmıştır. Uzmanlar ölçeklerin içerik geçerliliğini onaylamışlardır. EFA, Bilgi ölçeğinde iki faktörlü bir yapı ve davranış ölçeği için üç faktörlü bir yapı ortaya çıkarmıştır. Paralel analiz faktör sayısını doğrulamıştır. Tüm maddeler kendi faktörlerine > 0,3 oranında yüklenmektedir. CFA aynı zamanda iki ölçeğin maddelerinin kabul edilebilir anlamlı yüklerini ve kabul edilebilir uyum iyiliği ölçümlerini ortaya çıkarmıştır. Tüm faktörler için Cronbach alfa bileşik güvenirlik indeksleri ≥ 0,7 çıkmıştır. Test tekrar test güvenirlik katsayısı bilgi ve davranış ölçekleri için sırasıyla 0,75 ve 0,63 olarak bulunmuştur. Madde analizi, kabul edilebilir düzeltilmiş toplam madde korelasyonlarını ve maddenin tüm maddeler için silinmesi durumunda Cronbach alfa değerini göstermiştir. Tüm faktörler için en yüksek ve en düşük puan gruplarının ortalama puanları arasındaki farklar anlamlı bulunmuştur, bu da maddelerin ayırt ediciliğinin iyi olduğunu göstermektedir. Bulgular, iki ölçeğin bireysel bilgi ve sele hazırlık davranışını ölçmek için geçerli ve güvenilir araçlar olduğu hipotezini desteklemektedir.

Anahtar sözcükler: Sudan, Sel, Bilgi, Davranış, Geçerlik, Güvenirlik, Ölçek

Contents

ABREVIATIONS AND SYMBOLS

BPPS: bushfire psychological preparedness scale

CAR: capability assessment for readiness

CEGS: code enforcement grading system

CFA: confirmatory factor analysis

CFI: comparative fit index

COSMIN: consensus based standards for selecting health measurement instrument

COVID 19: coronavirus disease of 2019

CRS: community rating system

CVI: content validity index

DF : degrees of freedom

DM: disaster management

DMIS: disaster management information system

DPET: disaster preparedness evaluation tool

DPI: disaster preparedness index

DRM: disaster risk management

DRR: disaster risk reduction

EFA: exploratory factor analysis

EPS:earthquake preparedness scale

ERI: earthquake readiness index

ERS:earthquake readiness scale

FEMA: federal emergency management system

GDP: gross domestic product

GDPB: general disaster preparedness beleif scale

GFDRR: global facility for disaster risk reduction

GPS: global positioning system

HDPI: household disaster preparedness index

HEPPT: household earthquake persian preparedness tool

IDNDR: international decade for natural disaster reduction

IGDPB: improved general disaster preparedness beleif scale

ISO: international standardisation organization

IFI: incremental fit index

ISDR: International strategy for disaster reduction

KMO: Kaiser-Meyer-Olkin

LDPT: livelihood disaster preparedness tool

MoH: Ministry of health (in Sudan)

NCDD: national council of civil defense

PGFI: parsimony goodness of fit index

PNFI: parsimony normed fit index

PPDTS: psychological preparedness for disaster threat scale

RMSEA: root mean square error of approximation

SD: standard deviation

SMA: Sudan meterology authority

SRMR: standardized root mean square residual

SUDS: sustainable urban drainage system

UNDRR: united nation office for disaster risk reduction

VIFPS: vested interest flood preparedness scale

χ^2: Chi square

FIGURES

TABLES

INTRODUCTION

Background Information

Flooding is the most frequent natural disaster world wide and it is increasing in frequency and intensity due to the climate change phenomenon. It affected more than two billion people between 1998 - 2017 worldwide. Flooding is defined as the overflow of excess water to cover ordinary dry land. (1, 2). A flooding event is registered in the emergency events data base (EM-DAT) if it fulfills one or more of these criteria: results in the death of 10 or more, affects 100 or more, leads to a state of declaration of emergency or it requires call for international aid or support (3).

The types of floods include: firstly flash floods, which occur after high intensity rainfall with a quick increase in water levels and limited time available for prediction. Secondly river floods which occur when the river floods outside its normal boundaries due to increased levels of rainfall in the flooding area or upstream areas, in addition to other causes. This type of flooding can generally be predicted in advance in some periods. Thirdly Coastal floods, which take place along the coast of seas and large lakes, occur when windstorm together with low atmospheric pressure cause setup of the water levels on the coast (2, 4, 5).

The negative impacts and the main causes of morbidity and mortality in floods are: loss of lives mainly due to drowning, injuries that can range from fatal injuries to small lacerations due to the presence of debris and nails, electrical shocks, loss of properties, damages to the infrastructure -which can be massive enough to interrupt the provision of the basic needs of shelters, food, safe drinking water, and health services and lead to displacement of people. Moreover, it can lead to increased transmission of communicable diseases especially vector and water borne diseases which may lead to outbreaks in the flood areas. In addition there are psychological and mental health effects (2, 6).

Sudan is a country in northeastern Africa that has boundaries with Egypt, the Red Sea, Eritrea, Ethiopia, South Sudan, Central African Republic, Chad, and Libya. The Nile River and its tributaries flowing on Sudan’s territories, representing the main water source for the country. Kassala City is the capital of Kassala state and it is located in the eastren part of Sudan, close to the Eritrean borders. Sudan is liable to

flash and/or river floods that affect different parts of the country almost every year. Flooding is the principal natural disaster in Sudan followed by drought which occured last time time in 1988 (7).

In 2020, the country was badly hit by floods, which affected all the 18 states of the country to varying degrees, coinciding with the COVID 19 pandemic. The unprecedented flash and riverine floods resulted in 150 deaths, critically affected 875 thousands people, destroyed or severely damaged more than 111 thousands houses and collapsed thousands of latrines. This forced the government of Sudan to announce a state of emergency and call for international aid (8, 9).

Kassala state was of the most affected state in Sudan by 2018 floods at the time of planning for this study. Kassala city is known for the flooding of the Gash seasonal river, which washed out almost two-thirds of the city by the most damaging flood of 2003, resulting in 200,000 affected people and 12 deaths. Key buildings, schools, the sole hospital, and the main water plant were damaged. Many homesteads were partially or fully destroyed, leaving 17,000 families (105,000 people) without shelters. With the collapse of major infrastructure, the health situation became precarious, leaving Kassala's 350,000 inhabitants with no access to safe drinking water, limited food, and poor sanitation facilities (10, 11). However, in 2018, there was flooding of the seasonal Emiray valley in addition to the flash floods. Sudan was affected in many parts including mostly Kassala state by both flash and river floods which affected more than 222 thousand people (47500 of them were in Kassala state), resulted in at least 23 deaths (3 of them were in Kassala state), in addition to severe damage to houses, laterines, crops and livestock as the farms were submerged by the flood (12, 13). Moreover, these floods resulted in an epidemic of the mosquito-borne disease Chikungunya, with suspicion of the occurrence of hemorrhagic fevers in addition. Chikungunya resulted in 13978 cases and 95% of them were in Kassala state, and other six states were affected in Sudan. News spoke about occurrence of deaths mostly among elderly and children, however, no official death was attributed to the disease (14). The outbreak put pressure on the already weak health system. This made the activists launch Hashtag 'Kassala is dying', which occupied the social media in Sudan for a period of time. Kassala state was also affected by 2019's floods, after which a confirmed outbreak of Dengue fever occurred in Sudan, with total number of cases

reached 4225 and 13 deaths (15). Most of the cases and deaths especially at the start of the outbreak were in Kassala state. There were coinciding reported cases of Chikungunya, Rift Valley Fever, Malaria, Cholera and Diphtheria (16).

Like all types of natural hazards, preparedness at both the individual and governmental levels plays an important role in decreasing the disaster's negative impacts. Individual preparedness in broad lines includes: Firstly, procedures to be done "before" the floods, which include: knowing about the risk of flooding, its time, places, how to be informed about it, developing a plan, practicing and communicating with family and others about it. Secondly, procedures to be done "during" the floods include: evacuation and application of the prepared plan. Thirdly, procedures to be done "after" the flood including all the measures that keep people safe after the end of the state of emergency and returning to the flooded area (17).

Assessing complicated, multiple items containing behaviors such as disaster preparedness attaches special importance to the use of valid reliable tested scales rather than simple questionnaires, which may not be efficient enough to give conclusive evaluations for these behaviors. Many studies and some scales have assessed the individual preparedness to disasters interms of its underline beliefs and attitudes linking them to the social cognitive models (18-22). In contrast, this study focused directly on the evaluation of what individuals should know and do regarding floods, especially in the settings of poor infrastructure, as in Sudan.

Aim and General Objective of the Study:

To develop a valid and reliable scale to measure individual flood preparedness in Kassala Sudan and similar settings.

Specific Short Term Objectives:

a) To design a scale that assesses individual flood preparedness in Kassala, Sudan
b) To assess the validity and reliability of this scale in measuring individual flood preparedness among a group of citizens of Kassala population.

Long Term Objectives

There is absence of national individual flood preparedness guidelines in Sudan, in addition to lack of awareness about ways and importance of individual preparedness in decreasing the negative impacts of floods, and absence of a valid reliable scale that suits the settings similar to that of Sudan for measuring the individual preparedness to flood. For theses reasons, this research aims to design or develop and bring into the literature such a scale that can be used in other researches and in evaluation of the outcomes of the campaigns and training programs. The ultimate goal of the study is to increase the actions towards floods from just emergency actions of provision of temporary shelters, food, safe water, hygiene and sanitation after the occurrence of floods, to add long term disaster risk reduction activities like improving the preparedness and resilience of the community and the early warning systems.

GENERAL INFORMATION

Epidemiology of Floods Worldwide:

Flooding is the most frequent natural disaster in the world. It accounted for 47.0% of all the extreme weather event disasters in the world between the years 1969-2018 (23) and for 51.7%, 49.0% and 40.0% of all the natural disasters occured in the years 2020, 2019 and 2018 with frequencies of 201, 194, 127 flooding events worldwide respectively (24-26).

Floods caused 41.0% of all deaths due to natural disasters in 2020, which were 15080. Six flooding events occurred in India, Nepal, Pakistan, Kenya, China, and Bangladesh, and were among the 10 most deadly natural events in the world in 2020. Flooding accounted for three of the 10 events in which the highest number of affected people, occurred in China (10 million affected), Bangladesh (5.4 million), and again China (4.5 million people affected). The natural event that caused the highest economic losses in 2020 was flooding in China, which resulted in a loss of 17 billion dollars. Two other flooding events were among the top 10 events with the highest economic losses. They occurred in India (7.5 billion $) and Japan (5.8 billion $) (26).

Almost all parts of the world are affected by floods, with only a few unaffected areas. Figure 2.1 shows the places affected by flooding disasters in the world between the years 1985-2010.

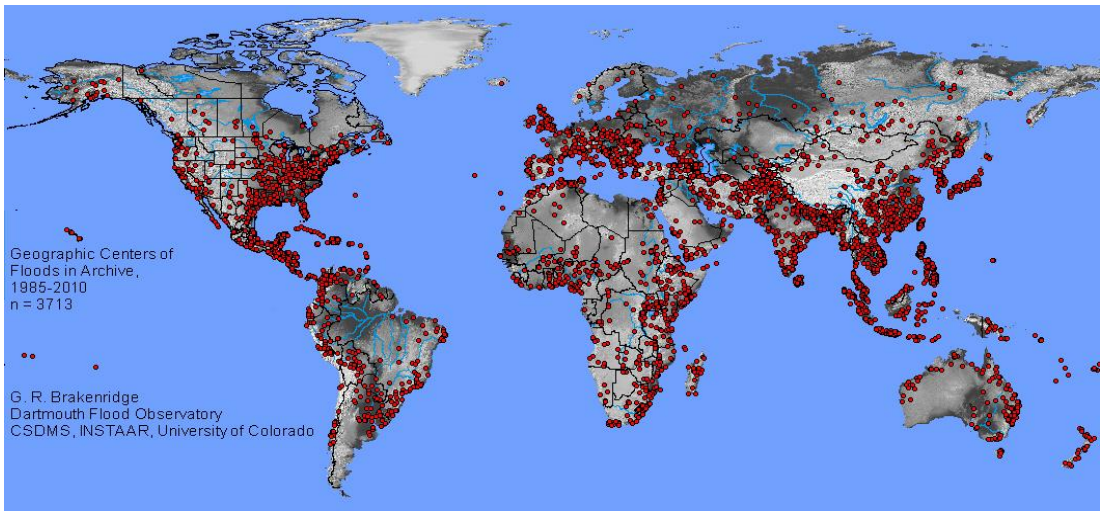


Figure 2. 1. Distribution of floods disasters between 1985 -2010 worldwide (27)

A disaster -includig natural disasters such as floods- is defined as a serious disruption of a community's or a society's functioning due to hazardous events in the presence of the exposure, vulnerability conditions leading to human, economic, environmental impacts and losses. To understand the determinants of flooding disasters, we first need to outline the components of disaster risk, namely: hazard, exposure, and vulnerability. They are expressed by the equation: disaster risk = hazard × exposure × vulnerability.

Hazards such as floods, storms, and earthquakes are defined as phenomena, processes, or human activities that can lead to loss of lives, injuries, environmental degradation, or economic losses. The presence of a natural hazard does not indicate the occurrence of a disaster. Other components that must be available are: exposure and vulnerability. Exposure is defined as what is liable to damage (individuals, assets, infrastructure, etc.) being present in a hazard prone area. Exposure is a component of a disaster because a cyclone in the ocean will not directly result in a disaster as there is no exposure to it. It is affected by the population density and number of the assets exposed (28). Nineteen percent of the world's population are exposed to one in a 100 year flood events hazard, of which 89.0% are in low- and middle-income countries. Most flood exposed people are located in Southeast Asia. Figure 2.2. shows the exposure to floods inundation risk of 15 cm or more at the country level. The top 10 countries with the highest number of people exposed to significant flood risk are: China, India, Indonesia, Pakistan, Bangladesh, Vietnam, Nigeria, the Philippines, Egypt, and Japan (29).

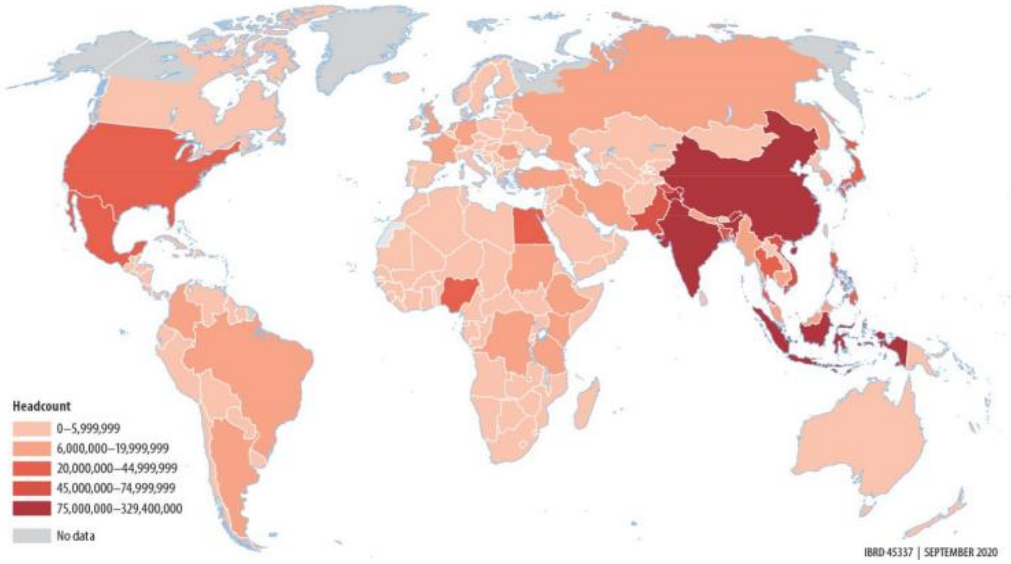


Figure 2. 2. Absolute population exposure to 15 cm or more floods indundation risk at the country level (millions) (29).

Vulnerability is the susceptibility of what is liable to damage (such as individuals, assets, and systems) to the impacts of disasters. It is determined by physical factors like poor infrastructure and construction, social factors like poverty, inequality, age, disability, economic factors like depending on single industry and un-insured informal sector, environmental factors like climate change and overconsumption of the natural resources (28).

Reducing vulnerability is one of the most effective ways to reduce disaster risk. To achieve this it is important to understand the disaster risk drivers which are: climate change, environmental degradation, poverty and inequality, poorly planned urban development, and weak governance (28). In the following paragraphs, each of these drivers will be discussed separately.

Climate change is a long-lasting shift in weather patterns caused mainly by the burning of fossil fuels and the emission of greenhouse gases, in addition to other natural causes. One of the important features of climate change is the current increase in the average temperature of the earth by 1.1 degree celsius compared to that in the 1800s. Climate change directly increases the frequency and intensity of floods and other natural disasters, in addition to increasing vulnerability and changing the peoples'exposure patterns. The mechanisms of these effects are rising sea levels,

increasing the severity and frequency of extreme precipitation events, decreasing agricultural yields, which can lead to migrations, changing the geographical distribution of weather related hazards such as insects, and as a result, increasing and changing the distribution of communicable diseases, in addition to decreasing resilience by increasing poverty. Climate change effects tend to concentrate more in the developing countries, poorer communities and rural livelihood (28, 30-32)
Environmental degradation is a decrease in the ability of the environment to respond to ecological and social needs through the depletion of its resources. It is a wide term that includes pollution, deforestation, desertification, loss of biodiversity, and others (33). Environmental degradation can be both a driver and a result of natural disasters. It can also increase the mechanisms by which climate change acts and occurs.

Poverty does not simply increase vulnerability and decrease resilience to natural disasters (34, 35). It has complex interactions with other disaster risk drivers as shown in Figure 2.3. The figure starts from the global processes of uneven economic and territorial development, climate change, rising social and economic inequality, and collapsing planetary systems. These global processes lead to an increase in the underlying risk drivers, namely, increasing hazard exposure of the populations and economic assets, lack of accountability, and limited social cohesion, in addition to vulnerable rural livelihoods, poorly planned and managed urban deveplopment, declining ecosystems, and weak social protection. These risk drivers aggravate the poverty nexus, which starts by exposing vulnerable people to frequent low severity and infrequent severe hazards. This leads to disaster losses in the form of mortalities, damage to housing and local infrastructure, morbidities, and loss of crops and livestock. These losses result in more poverty outcomes, which have short- and long-run impacts on income, consumption, welfare, and equality. These outcomes lead to multidimensional poverty which means economic poverty, powerlessness, exclusion, illiteracy, discrimination, and limited opportunities to access and mobilize assets. Multidimensional poverty aggravates the everyday risks of food insecurity, crime, disease, pollution, accidents, and lack of sanitation and clean water. These everyday risks increase vulnerability, and the cycle recreates itself by exposing these vulnerable people to extensive and intensive hazards.

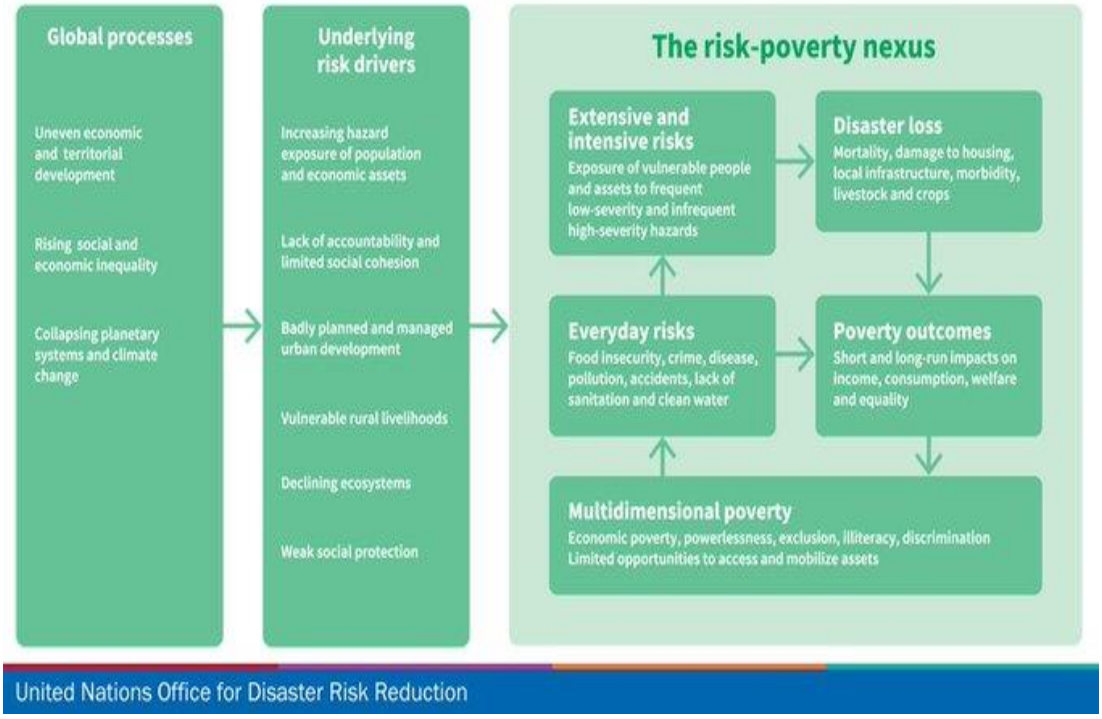


Figure 2. 3. Interaction between poverty and disasters (28)

Inequality is one of the important determinants of disaster risk (28, 36). It redistributes disaster risk through uneven economic development, as it facilitates the transfer of risk from those who benefit from the risk taking of the overconsumption and unaccountable use of resources to those who bear the cost. Inequality decreases access to basic services such as secure housing, health, education, communication, transportation, infrastructure, sanitation and drainage, and social protection, in addition to political voices, social, and economic status which has a direct effect on disaster risk, resilience, response, and recovery.

Poorly planned urban development is one of the disaster risk determinants that usually occurs in the contexts of poverty and weak governance (37). It increases population density and exposure mostly in hazardous areas with poor infrastructure settings and increases vulnerability. Moreover, it aggravates hazards by changing the ecosystem, for example by decreasing the absorption of rainwater through the expansion of impermeable paved areas which create floods, that can also be created or further contaminated by indiscriminate waste disposal.

Weak governance is one of the main social determinants of natural disasters (37). It is defined as the situations when governments or public sector actors are

unwilling or unable to carry out their responsibilities in protecting rights, providing basic services and ensuring that public sector management is efficient and effective (38). These government failures lead to broader failures in political, economic and civic institutions (28). Starting from establishment of well-functioning institutions responsible for prevention, preparedness, response, and recovery from natural disasters to the formulation and adherence to the policies, rules and regulations (such as building codes), to the building of public infrastructure and ensuring social protection and equity, all of which require good governance and directly affect disaster risk.

There are factors that can make some populations more vulnerable to flooding risks, morbidities, and mortalities than others, especially when evacuation is needed. These factors are: limited physical capacity like in elderly, children, people with chronic conditions or people with physical, sensory or cognitive impairment or disability, weak social networks like in homeless, those living alone, substance misusers, ethnic minorities, those with low income, and rural inhabitants. Another factor that increases vulnerability is poor flood awareness if associated with living in high flood risk area and in structurally vulnerable houses in deprived areas. Little access to public warning because of linguistic, social or cultural factors like in migrants, visitors and tourists also increases vulnerability to flooding risks (39).

Epidemiology of floods in Sudan

Regarding Sudan's climate, Sudan is one of the hottest and driest African countries. The mean annual temperature ranges between 26-32 degrees Celsius, However in summer it exceeds 43 degrees Celsius with a seasonal summer rainfall concentrated in four months (June, July, August and September) (40). The climate varies within the country, ranging from a dry desert climate in the north to a semi desert and tropical climate in the south. Figure 2.4. shows the monthly minimum, mean and maximum temperatures and precipitation for 1991 - 2020.

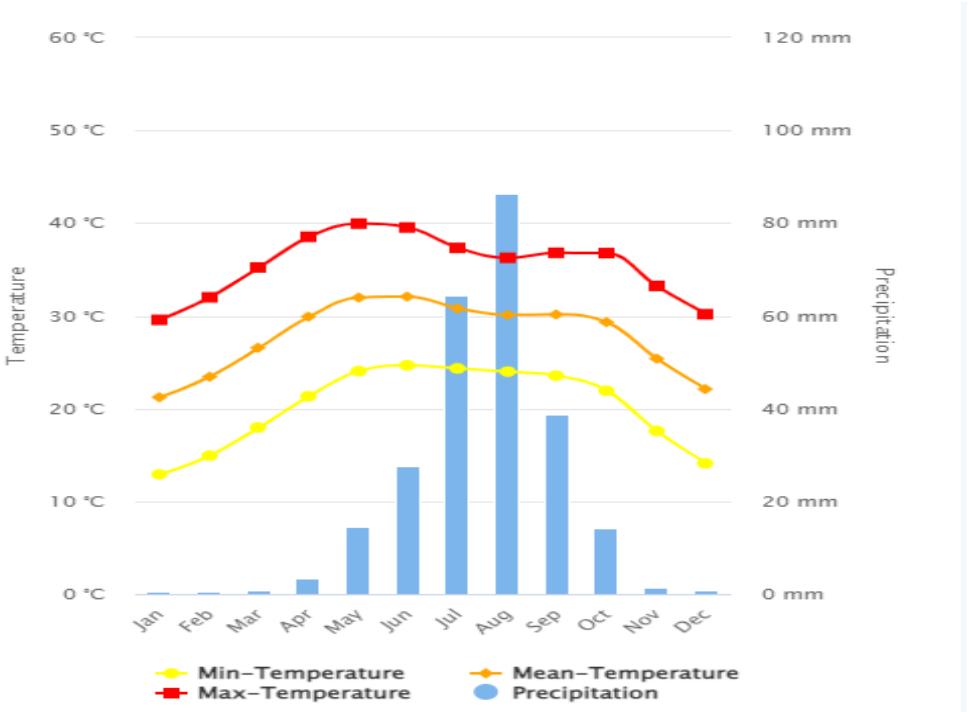


Figure 2. 4. Sudan's monthly minimum, mean and maximum temperature and precepitations from 1991 - 2020 (40).

Sudan is liable to flooding almost every year. Flooding is the main natural disaster in Sudan, followed by drought (7). Almost all the states of Sudan are at risk of pluvial floods due to rainfall or fluvial floods due to overflow of the Nile River or one of its tributaries (See Figure 2.5 and Table 2.1). Rain is the main source of water in the country for agriculture and livestock, and any fluctuation in precipitation directly affects food security in the country (41).

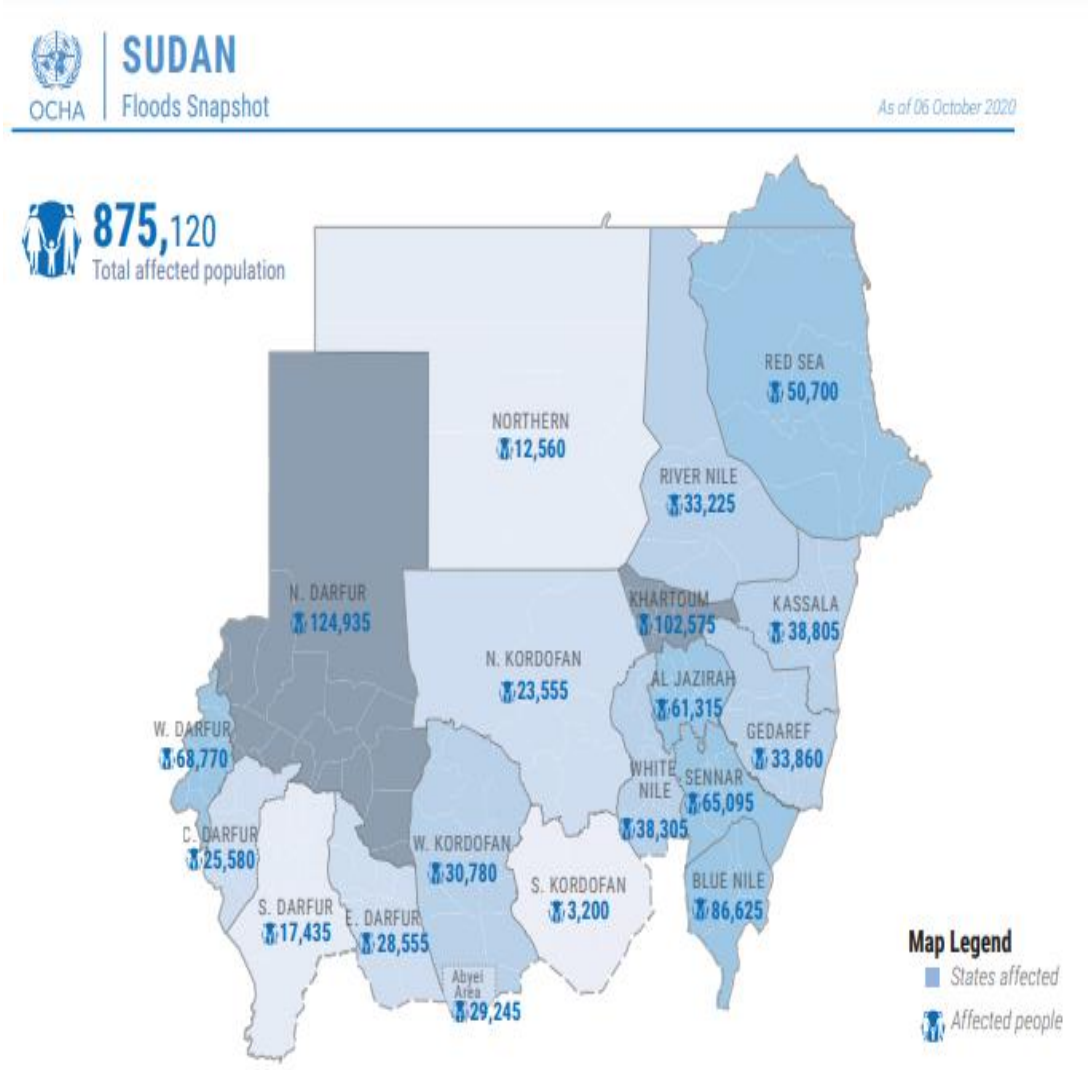


Figure 2. 5 Number of people affected by floods in every state in Sudan in 2020 floods (9).

Table 2. 1. Number of affected people, mortalities and the most affected states in Sudan in 2018, 2019, 2020, 2021 floods (7)

Floods of the year (affected states/18)	Number of affected people	Number of deaths	Number of destroyed and damaged houses	The most affected 4 states
2021 (14/18)	314,547	No reported deaths	15,541 destroyed 46,546 damaged	White Nile, Gadaref, Al Jazira, River Nile
2020 (18/18)	880,000	150	82,500 destroyed 92,500 damaged	North Darfur, Khartoum, Blue Nile, Sennar
2019 (17/18)	426,300	78	45,104 destroyed 27,742 damaged	White Nile, Kassala, Khartoum, Al Jazira
2018 (15/18)	222,257	23	19,640 destroyed	Kassala, Sennar, West Kordofan, Gadaref

Regarding determinants of flooding in Sudan, Sudan is liable to almost all risk drivers of flooding disasters. Firstly, concerning climate change, the temperature in Sudan increased between the years 2000-2009 by 0.8 to 1.6 compared to the temperature between the years 1960-1969, by a rate of 0.2- 0.4 increase per decade. Rain fall also became very variable and unforeseeable (40, 42). Sudan's National Adaptation Program of Action states that droughts and extreme flooding events are major hazards associated with climate change in Sudan. Some states are at higher risk of environmental hazards namely North Kordofan, Kassala, Red Sea and Khartoum (43). The country is also facing desertification and deforestation as aspects of environmental degradation which has its effect on the climate as well (44, 45).

Most of the population in Sudan is poor, with per capita GDP of 595 $ in 2022 and a wide range of inequalities in economic and social development. Some states are falling below the national rural poverty average such as Kordofan, Darfur, Red Sea and Kassala states (43, 46).In general the country faces problems regarding infrastructure (roads, railways, drainage and sewage system, water and sanitation,

irrigation facilities, etc). It is either nonexistent, inadequate or underdeveloped. Many villages in Sudan in the rainy season become isolated and inaccessible unless a tractor is used. This is because of the absence of paved roads, which have its health effects regarding the inability to reach hospitals, and the absence of ambulance systems contribute to this situation. The sewage system covers only a 6.8 km^2 area in Khartoum state. The rest of the country depends on on-site sewerage facilities and natural drainage courses or channels (khor) for the streets. This simple drainage system is not yet available in many places, is ineffective because of sediment and sand encroachment, or it gets blocked by urban waste.

It is apparent that there are problems regarding urban development in the country. Some people build houses in the natural pathways of ephemeral water, which puts their houses at risk of being washed by floods. Most of the houses which are destroyed by floods are already weak to withstand heavy rains, being built by traditional local materials (dried mud and bricks) (47). Collapsed buildings constitute together with electrocution the main causes of flood mortalities in Sudan (48). No building codes were adhered to in many areas, in addition to the problem of slum. Driving a car even on average rains in the cities of Sudan is hazardous and inconvenient because of the poorly constructed roads that lack periodic maintenance and the presence of holes that become unseen and full of water in already poorly drained roads. This puts cars and pedestrians at risk of falling into these holes and suffering injuries or economic losses in the event of car breakdowns. This leads to some sort of disruption in life and slowness in the flow of transportation, which is run mainly by the private sector. Davis and Walshin in the nineties argued that, there is a special type of flooding which occurs in Khartoum and similar cities even with light to moderate rainfalls that they call it “diffuse urban runoff” that results from the bad urban drainage and low soil infiltration due to compaction effects of people, vehicle, animals and houses building wastes (49). The water lacks drainage so it remains in hollows formed by uneven land, stagnates, and becomes breeding areas for the mosquitoes and only dries by the effect of the sun, leaving a bad smell of mud and refuse. Another problem is the construction of roads without adequate drainage, and on many occasions, roads are built higher than the surrounding land with inadequate

culverts. These roads in floods lock up the water that gets trapped in the residential areas, and many times the road has to be broken to let the water drain.

Concerning governance, Sudan had one of the longest civil wars in the world, ended with the separation of South Sudan, which had negative economic impacts on the country. In addition there were armed conflicts in Darfur, South Kordofan, and Blue Nile areas that suffered marginalization. The inflation rates and prices continued to increase, leading to demonstrations in December 2018, which ousted Omar al-Bashir from the presidency after 30 years of rule and led to a transitional government formulation in a power-sharing regime between the military and civilian forces. This partnership ended in October 2021 with the military partner of the regime, who overthrew the civilian partner and monopolized the power. This put Sudan in political instability as the military failed to formulate a new government for more than three months. Nevertheless weak governance in Sudan is not a new phenomenon, Paual Savage in his book published in 2003 and entitled as "The crisis of governance and challenges to peace in Sudan" stated the deep causes of weak governance in Sudan which include long history of military dictatorships, lack of democratic traditions and institutions, security interventions into public institutions, use of legal and constitutional frameworks to maintain control, legal and administrative restrictions to civil society, obstruction of liberties, an elite monopoly on use of natural resources, corruption, economic activities and employment opportunities and credits only to those who are affiliated with the regime, low quality and inequalities in education, food security being undermined by the government policy, in addition to social marginalization (50). In relation to floods in Sudan, the consecutive governments failed to establish and develop adequate infrastructure, technology, policies, and institutions that aid in decreasing vulnerability, increasing resilience of the population, and insuring the provision of the basic needs of education, health, social protection, environmental sanitation, and in some areas security and potable water.

Haitham et al conducted a study to measure vulnerability to floods and flood induced health risks in a rural area and a semi-urban area in Kassala state in Sudan. The vulnerability composite index was calculated in 250 randomly selected households and validated by comparing the index for every household with the level of flood impact in the 2009 floods that occurred in the area. The study found that only

2.0% of all the surveyed households had low vulnerability to floods and 68.0% were moderately vulnerable. Percentage of highly vulnerable households was significantly different between rural and semi- urban households. While semi-urban households were more vulnerable to flooding disasters, the rural households were more vulnerable to flood induced health risks. The factors found to affect the vulnerability of the households were: the number of earning family members in addition to the education and economic activity of the head of the household. The study concluded that factors of poorly managed urbanization, poverty and education affect vulnerability to floods in the study area (51).

Impacts of floods in the context of floods in Sudan

Health impacts

In the following paragraphs, we will discuss the following health impacts of floods: mortality, injuries, exposure to toxins and chemical hazards, communicable diseases, effects on health care services, psychological impacts, impacts on chronic and non-communicable diseases, malnutrition, and other reported health impacts.

Mortality is the most severe health impact of a flood. The number of deaths of floods worldwide in 2020 was 6182 and in Sudan was 150. Flood-related deaths tend to concentrate in low-income countries at a ratio of 23:1 compared to the high-income countries from 2002 to 2011. This is most probably due to the high vulnerability of the population and the poor disaster management systems in the low income countries (6). Regarding the causes of deaths, the commonest cause of flood mortality worldwide is drowning (2, 52, 53), while the commonest causes of flood related deaths in Sudan are collapsed roofs and electrocutions (48). Giuliano et al in an attempt to diagnose the causes of flood fatalities in Africa have found that the main cause is the high vulnerability of the population, as the magnitude of African floods did not increase compared to the increase in floods' fatalities during the Twentieth century (54). Intense urbanization and unplanned human settlements in flood susceptible areas, especially by the poor people, play major roles in increasing flood mortality.

Floods related injuries can occur during or after flooding events among the affected individuals or the rescue teams. There is a lack of reporting of these injuries and the reported injuries are not linked to floods. Injuries include those occuring as a

result of collapse of the buildings or falls due to slippery lands or ladders, or stairs during clean up. This can result in fractures, strains, and sprains. Injuries in addition include lacerations due to presence of debris, electrical injuries, animal bites (snakes or pets), hypothermia (6, 39, 55). Flood related injuries reported from the routine surveillance in 1993 after Midwest flood in Missouri included 250 cases which accounted for 47.0% of all flood-related conditions presented to the emergency departments between the 16th of July and the 3rd of September (56). Of the 250 patients; 34.0% had sprains or strains, 24.0% had lacerations, 11.0% had abrasions and contusions, and 11.0% had other injuries.

Another known health impact of floods is the exposure to toxins and chemical hazards. This can occur by release of stored chemicals in agricultural and industrial areas or from hazardous landfill areas or abandoned mines by the flooding damage (39). The pollutants can come into direct contact with people, especially skin, or contaminate rivers or crops. The released chemicals include lead, arsenic, polycyclic aromatic hydrocarbons, pesticides, fertilizers, acid mine and others. Another well-documented common exposure is carbon monoxide poisoning, which occurs mainly from emissions from diesel generators used indoors or near open windows due to blackouts. Other sources of carbon monoxide are gas-powered pressure washers, unventilated cooking tanks, and house fires (6, 39, 52). In the United States six deaths and 167 cases of carbon monoxide poisoning were reported after four hurricanes in Florida in 2004. Ninety six percent of the incidents were related to the use of the portable gasoline generators and the inappropriate placing of them (57).

Communicable diseases, mainly water-borne, vector-borne, and rodent-borne diseases are known to occur after floods especially in countries with poor sanitation and drainage systems or in displaced populations where there is no access to safe water and sanitation. The reported communicable diseases occurred in relation to floods are: cholera, cryptosporidiosis, poliomyelitis, rotavirus, typhoid, paratyphoid, hepatitis A and E. Mosquito-borne diseases were reported in Africa, Asia and Latin America include malaria, Dengue fever, lymphatic flariasis and rodent-borne diseases. Most importantly outbreaks of leptospirosis associated with floods and were reported in different countries including Brazil, India Mexico and Portugal. Skin, eye and respiratory infections were also reported to increase with floods (53, 57). A systematic

review of the incidence for the incidence of mosquito-borne diseases after floods revealed an increase in incidence of Dengue fever in a period of 1-4 months after an initial decrease for less than 1 months. Malaria showed increase of incidences after flooding; however, temporality was less clear. Outbreaks of Rift Valley Fever and Japanese encephalitis may occur after flooding events. The study also presents a conceptual framework of the mechanisms by which floods can increase mosquito-borne diseases (58).

In Sudan, there were confirmed outbreaks of Chikungunia following the 2018 floods (13978 cases), outbreaks of Dengue fever (4225 cases and 13 deaths), cholera (344 cases and 11 deaths), and Rift Valley Fever outbreaks (572 cases and 11 deaths) following the 2019 floods (7, 14, 16, 59). Most of these outbreaks occurred in August, September, and October within or immediately after the rainy seasons in flooded areas, however proving the association between these events and flooding is not that simple. Diseases such as cholera and malaria, show obvious seasonality. Heitham et al by revising secondary data in Kassala state's ministry of health have found that the incidences of cholera in the months from July to September, which is the rainy season in Sudan, were three times more the incidence in the other three quarters of the year collectively between the years 2006-2011. On the other hand, those of malaria in the same period were 1.5 times more (51). In another study a health assessment was carried out based on sentinel surveillance in 24 health facilities and three hospitals in Khartoum state after 1988 floods, which displaced nearly one-third of the residents. This assessment was carried out in the period between August 21 and 31, 1988 and revealed no outbreaks. Diarrhea accounted for 31.0% of the total 29529 cases. *Shigella boydii* was isolated from cultures of 38 patients. The case fatality rates were 11.0% for the examined year and 9.0% in the same period in the previous year. Malaria accounted for 20.0% of the cases and increased to 30.0% of the cases by the first week of September, respiratory tract infections were 17.0%, measles 1.0%, Jaundice 1.0% and others were 30.0% (60). A significant increase in malaria cases was observed following the 2013 floods in Managil locality in Jezira state in Sudan in 13 sentinel surveillance sites in 12 weeks' period compared to the same period in the 2 previous years (6.09, 6.48 and 8.24 per 100,000 person-days respectively). The increase in the

incidences was the highest among under 5 year age groups especially among those under 1 year of age (61).

Floods can directly damage the healthcare facilities and render them out of service or disrupt the access to them. An example of badly affected health care system is what was reported in September 2014 floods in Kashmir which washed most of the Srinagar city. The flood inundated the healthcare facilities and made them dysfunctional at all the primary, secondary and tertiary levels for more than two weeks. Everything was damaged in the inundated hospitals, from the needle to the high technology magnetic resonance imaging machines. Six children died while they were in the ventilator because of the inundation of the oxygen plants. Submerging pharmacies led to damage to all stored drugs and resulted in a shortage of lifesaving drugs, intravenous fluids, and sanitary products. Health services were temporarily provided in camps, unaffected mosques, and schools. The economic loss was estimated to be 200 crores of Indian rupees (62). In 2003 in Kassala state in Sudan, the floods washed two third of Kassala city including the sole hospital, as a result the health situation in the city became precarious (10). In Sudan floods of 2020, the damaged health facilities were six rural hospitals, 22 primary health centers, and 16 primary health units, with a cost of damage of 5.2 million USD. This led to disruption of essential lifesaving health services in 16 states in Sudan (63).

One of the most important long-term health impacts of floods is their psychological impact. The mental health problems reported after floods include: post-traumatic stress disorder, depression, anxiety, suicide, insomnia, and psychosis (6, 52, 64). A meta-analysis to determine the incidence of post-traumatic stress disorder -the commonest psychological impact of floods- within 6 months of flood disasters were found to be 16.01% and after 6 months 11.45% (65). The range of its occurrence in literature is so wide that it can range from 8.0 – 80.0% (6, 65). The factors which were found to be affecting the occurrence of psychological disorders are; the degree of exposure, previous flood experience, disaster preparedness, female gender, older age, family structure, religion, social support, self-reported physical illness, personality factors and rural residency (6). In a primary survey in the affected areas following 2020 floods in Sudan, 17.0% (422.6 thousands) of households in Khartoum, River

Nile, Sinnar, West Darfur and Al Jezira states reported experiencing mental trauma and stress by one or more of the family members (63).

Deterioration of chronic disease related conditions and non-communicable diseases during flooding disasters may occur as a result of skipping medications or disruption of routine medical care or follow-up, such as missing doses or improper storage of insulin during lack of electrical supply or missing dialysis sessions. Worsening of hypertension and diabetes were reported after floods (66, 67). Reports from the United States revealed that one of the largest proportions of the health care visits after Hurricane Katrina in 2005 were due to chronic diseases and related conditions (68). There is little data regarding non-communicable diseases after floods in low-income countries although these countries carry the heaviest burden of these diseases.

As floods can result in food insecurity because of inundation of crops and livestock, this directly reflects itself in the low income countries as malnutrition especially among children (6, 64). A comparative cross sectional survey included 18 flooded and 14 non flooded villages in India within 1 month after 2008 floods, concluded that stunting and underweight among children whose age were between 6-59 months were significantly higher in the flooded periods with adjusted prevalence ratio of 1.6 for stunting and 1.8 for underweight (69) Evidence from the demographic and health survey in Kerala in India also linked flooding with wasting and under nutrition (70). In a sentinel surveillance in areas affected by 1988 floods in Khartoum state, the nutritional assessment using mid-upper arm circumference for 17639 children between 1-5 years, revealed that 10.0% of the examined children were severely undernourished and 14.0% were moderately undernourished. For follow-up, a subsequent survey in 19 high-risk areas using a cluster random sampling technique between the 17th of September and the 8th of October was carried out. Weight for height was measured for 5517 children under 5 years of age, out of which 4.9% were found severely undernourished and 13.9 were moderately undernourished (60). The 2020 floods in Sudan also had negative impacts on food security in an already exhausted economy (see Figure 2.7). More than two million households in the flooded areas in Khartoum, Sinnar, River Nile, and West Darfur were at risk of facing acute food insecurity due to economic vulnerabilities and food inflation (63).

Other reported health impacts include: adverse birth effects in form of preterm labors and low birth weight (71, 72), and living in damp moldy buildings which is aggravated by floods and which were linked to some respiratory symptoms like cough, wheeze, rhinitis, and irritation of the eyes insusceptible people and in some studies were linked to asthma and atopy (73-75). This impact is thought to be lower in the hot-dry countries such as Sudan.

Other Impacts of floods

Other impacts of flooding include the economic impacts. In 2020 floods cost China 17 billion dollars, India 7.5 billion and Japan 5.8 billion (26, 76). In Sudan the total economic value of the impacts of 2020 floods were estimated as 4.4 billion dollars (calculated before application of flexible managed float of the foreign currencies). Figure 2.6 shows the share of each sector in the loss. The highest losses were in the housing sector. Most of the lost houses were highly vulnerable and informal and especially in the rural areas, where they were built of mud mixed with compacted earth and wooden elements. Damage to houses is most probably associated with damaged or lost furniture and electrical devices, such as refrigerators and televisions. According to what was reported by Ministry of Social Affairs in Sudan after the 1988 floods, 24.0% of the furniture, 36.0% of the beddings, 34.0% of the refrigerators and cookers lost were owned by households whose monthly income was less than 66 $ (49). These losses further impoverish the already vulnerable and poor populations and deepen inequality in society. In the same direction, many studies on the impacts of natural disasters have concluded that floods and other natural disasters increase poverty and inequality, which are themselves risk drivers for natural disasters (77-79).

Floods can damage croplands and cause livestock losses. In China the damaged farmland due to 2020 floods was 5 million hectares (76). In Sudan, the agricultural sector was the second most affected sector in 2020 floods, as demonstrated in Figure 2.6, as floods resulted in damage of 2,216,362 hectares of croplands and loss of 107 thousand heads of livestock, including sheep, goats, poultry, and cattle, belonging to 20,521 households. Agricultural losses put the country at a risk of food insecurity. Agricultural losses in floods of 2020, together with the food insecurity situation of the country during floods, are shown for every state in the map in Figure 2.7. The most

affected states in terms of the damaged crops were Gadaref, Sinnar and Kassala while the most affected in terms of the food insecurity were red sea, North Darfur, Northern, Kassala, Gadaref, and Blue Nile states.

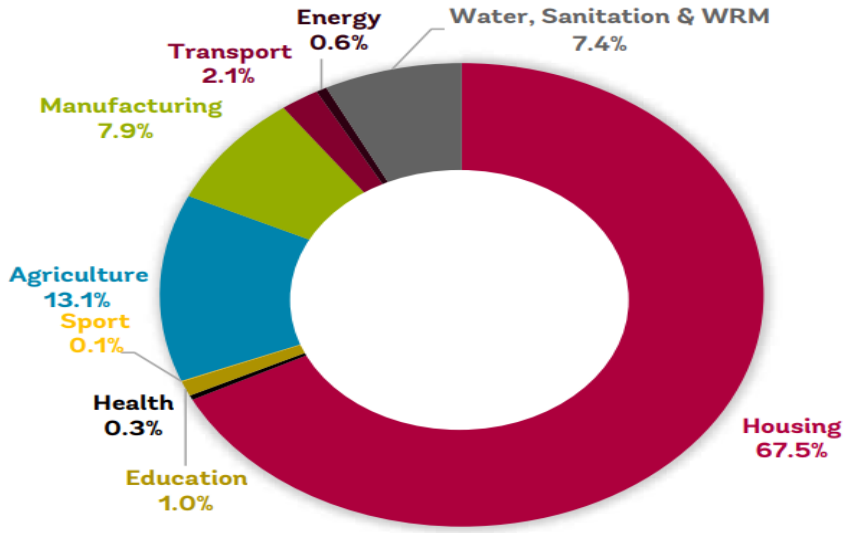


Figure 2. 6. Share of different sectors in the total economic losses of 2020 floods in Sudan (63)

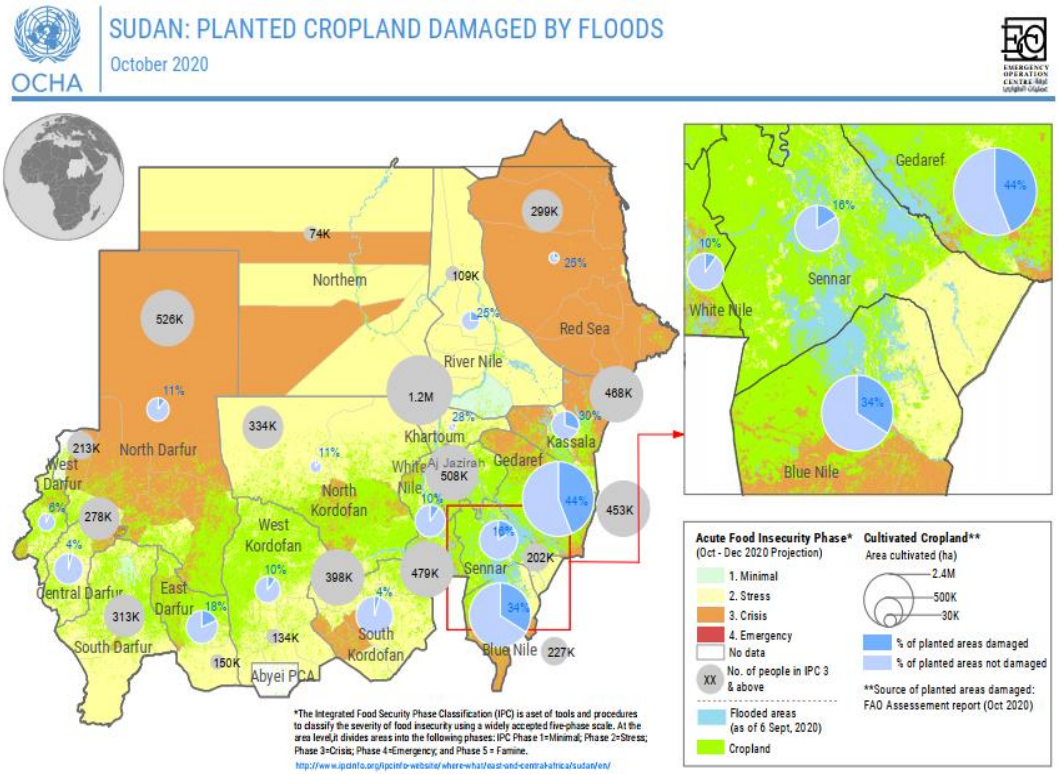


Figure 2. 7. Sudan's planted cropland damaged by 2020 floods and situation of food insecurity in the country (9)

Natural disasters including floods especially those occurred in conjunction with the COVID 19 pandemic had very negative impacts on education. The lack of the required infrastructure in Sudan and similar countries, did not enable the continuation of education in the form of distance education, which led to delay and instability in the school year.

Other impacts of flooding which were apparent in 2020 floods in Sudan include impacts on the manufacturing sector by affecting mainly small and medium enterprises in trade and service sectors, impacts on the infrastructure sector by affecting the electrical supply by damaging the power stations, impacts on water and sanitation sector by damaging the water supply infrastructure, septic tanks and latrines, impacts on transportation sector by affecting roads and vehicles, impacts on the environmental sector by damaging riverine forests, croplands, biodiversity, resulting in riverbanks and soil erosions and leading to fertility loss, impacts on the cultural sector by damaging the archeological heritage sites, in addition to the indirect social impacts of all the health impacts (mortalities, disabilities and others) and the economic impacts,

especially if it occurred to the head of the household which can directly affect the family wellbeing and welfare (63).

Historical Evolution of Disaster Risk Management DRM Concept

Disaster management approaches and practices have changed over history. The concept of civil defense prevailed as part of the military and paramilitary forces in the middle of the 20th century during the cold war, with the need to plan to relocate civilians during possible bombing or nuclear attacks. The units of civil defense were spread throughout the countries and have been developed over time to take the responsibility for responding to natural disasters and carrying out rescue and other related activities (80, 81). Later, in the 1970s and 80s there was an evolution of emergency management systems in many countries at the national level, with more integrated and holistic approaches to reduce the negative impacts of disasters.

In 1987, the UN General Assembly announced that 1990-2000 was the International Decade for Natural Disaster Reduction (IDNDR) to strengthen internationally organized efforts, increase awareness, and build capacities to reduce social and economic disaster-related losses, especially in developing countries. A special office to coordinate the (IDNDR) related activity was set up by the UN General Assembly in 1989. Furthermore, in 1999, an international agency was set up for the purpose of disaster risk reduction and was called the International Strategy for Disaster Reduction (ISDR) which was changed later to be the United Nations Office for Disaster Risk Reduction (UNDRR) (81).

Modern disaster risk management concepts resulted from three important events that took place in Japan, associated with other related events in between. First, the Yokohama International Conference was held in 1994, where the Yokohama strategy and its plan of action were formulated. In this conference, the prevention of natural disasters was identified as the most important long-term solution, along with the challenge of creating a global culture for natural disaster prevention (81).

The second event was the gathering of 168 countries at the International Conference on Disaster Reduction in 2005 in Kobe, Japan. The Hyogo Framework of Action, a 10 years plan (HFA 2005-2015), was formulated with the aim of adopting nations with a more holistic approach for increasing community resilience and

mitigating natural disasters (81). The third event was Sendai World Summit on disaster reduction and Post HFA Sendai Framework for Disaster Risk Reduction 2015-2030 was agreed upon, including a global aim of decreasing the disaster losses, economic damages and damages to housing, education and health services by 50.0% by 2025 (81). This framework of action sets out four priorities for preventing new and managing the current disaster risks: 1) understanding the disaster risk, 2) strengthening disaster risk governance to manage disaster risks, 3) Investing in disaster reduction for resilience, 4) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction (82).

In overall, the modern disaster risk management approach prioritizes pre-event disaster risk reduction activities, which include prevention, mitigation and preparedness, over post-event disaster management activities, which include response, recovery, and rehabilitation. For emphasizing the importance of risk reduction concept, the Disaster Risk Management (DRM) components can be expressed by the following equation:

DRM (Disaster Risk Management) = DRR (Disaster Risk Reduction) + DM (Disaster Management) (81, 83). The 13th of October was chosen as the international day for disaster risk reduction. The slogan of it in 2020 was “It’s all about governance” and that of 2021 was “International cooperation for the developing countries to reduce their disaster losses”.

Models of Disaster Risk Management

Several models for the phases of the disaster risk management were proposed by the researchers (84, 85). The oldest and the most widely used is the disaster management cycle which is shown in Fig. 2.8. (86-88).

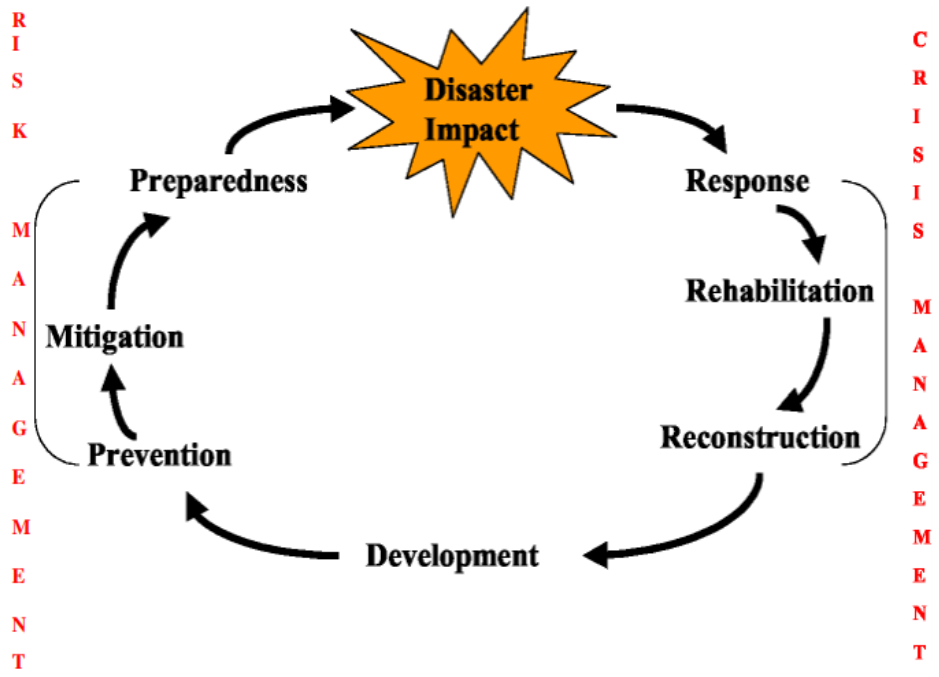


Figure 2. 8. The conventional disaster risk management cycle (87).

There are several forms of this cycle. Most of these forms mainly contain: mitigation, preparedness, event, response, and recovery. This cycle model recently has been facing criticism regarding its view of disaster as nature's fault and responsibility, ignoring the factors that influence vulnerability and the transfer of risk to disaster. Another criticism of the model is its cyclical nature, which means that the process continues and all mitigation and preparedness efforts must end in a disaster that needs a response without change or improvement. The third criticism is that it does not indicate the number of resources allocated to each stage. A fourth criticism is that the cycle portrays the disaster event as a key component. And the fifth criticism is that it does not cover some disaster risk management aspects such as hazard assessment. However, the cycle remains highly reliable (85, 89-91).

Examples of alternative models to the classic cycle are: the expand contract model, the disaster management helix, and integrated models. In the expand contract model (Figure 2.9.) the phases of disaster management include: prevention and mitigation, preparedness, relief and response, and rehabilitation. These phases are

depicted in parallel strands which means these phases can be run simultaneously rather than sequentially and each phase is expanded and contracted as needed (84, 90)

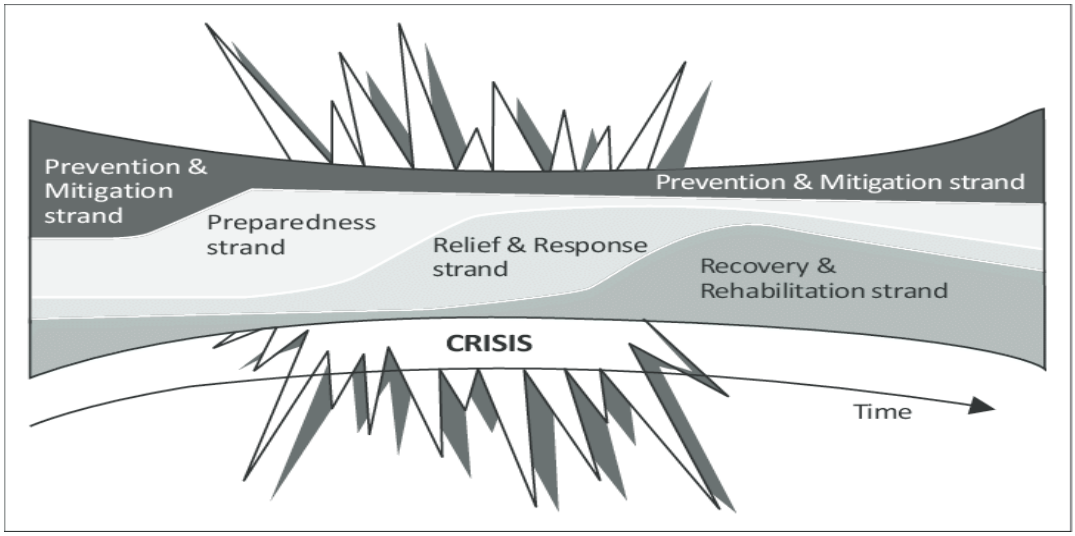


Figure 2. 9. The expand contract model (90).

In the disaster management helix, disaster management phases are depicted in a helical strand along the x-axis which is time, while the y-axis represents the efforts or resources allocated (Figure 2.10.).

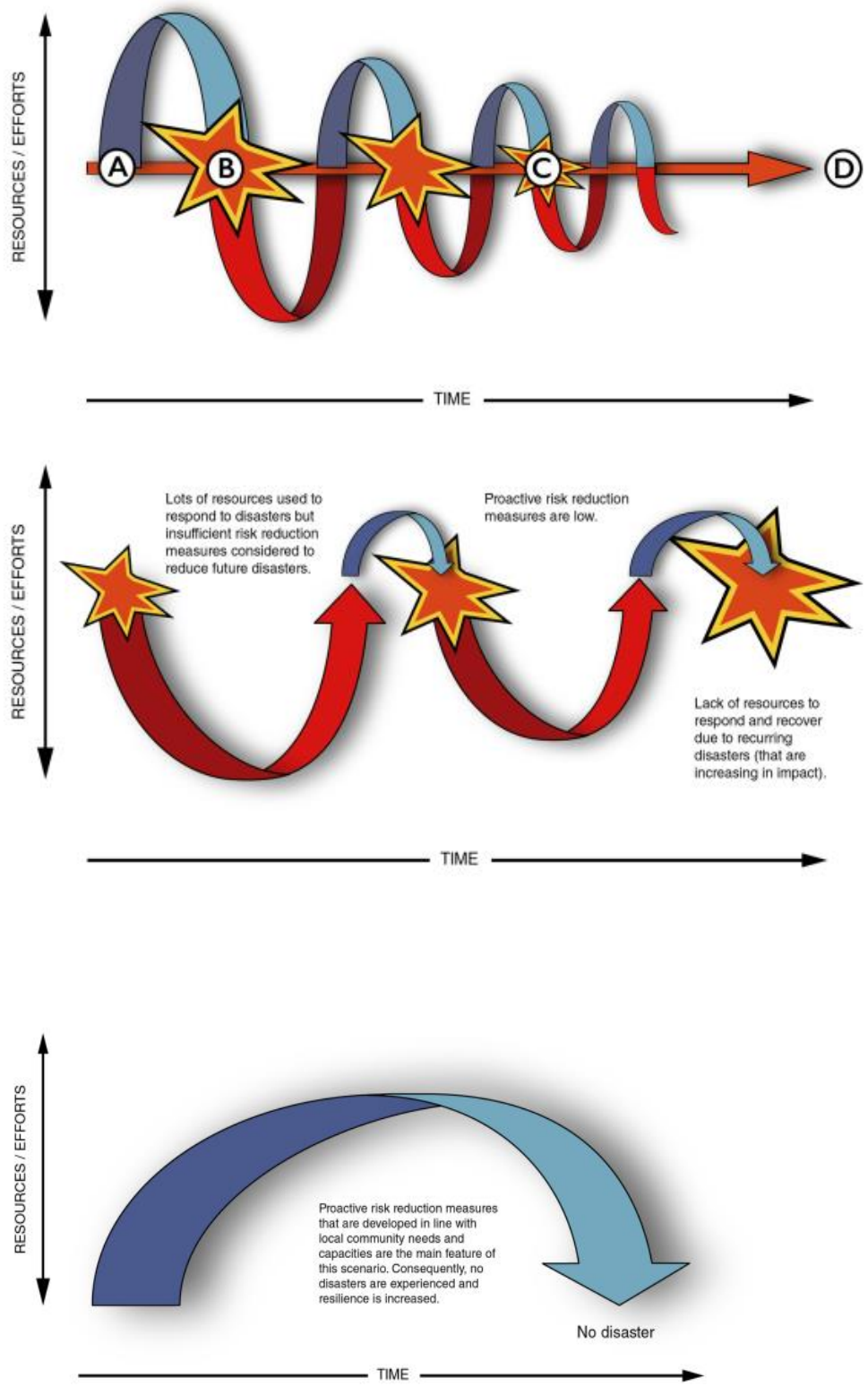


Figure 2. 10. The disaster management helix [Blue arrows are pre-disaster, Red arrows are post-disaster activities] (90).

The blue arrows above the A-D line parallel to the x-axis represent the pre-disaster phases, namely mitigation, preventive adaptation, and preparedness. The red arrows below the A-D line represent the post-disaster phases, that is response, relief, and recovery. The impact of the disasters at points A, B, and C decreases and can be eliminated, if the blue arrow (the risk reduction phases) is effective. When the risk reduction efforts are weak the impact remains constant or increases (90).

Integrated models aim at better organization for the effective and efficient implementation of activities. These models generally include four factors: hazard assessment, risk management, mitigation, and preparedness. Examples for these models are Manitoba health disaster model and Weichsel Gartner's integrated model (84, 85).

Mehdi et al carried out a thematic analysis for 38 different disaster models and proposed a comprehensive model that is illustrated in Figure 2.11. (85). In thematic analysis conducted in this study, the themes of each model were extracted and categorized into descriptive codes. Interpretive coding was then carried out by classifying the primary codes into three organizing themes. The first theme is hazard assessment which includes exposure analysis, hazard identification, hazard forecasting, hazard analysis, vulnerability assessment, and resource assessment. The second theme is risk management, with the following components: risk context, risk identification, risk analysis, risk evaluation, risk treatment, monitoring, and revising the risk control plan. The third theme is management actions and it includes prevention /warning, mitigation, preparedness, response, recovery (reconstruction and rehabilitation), learning and development (85)

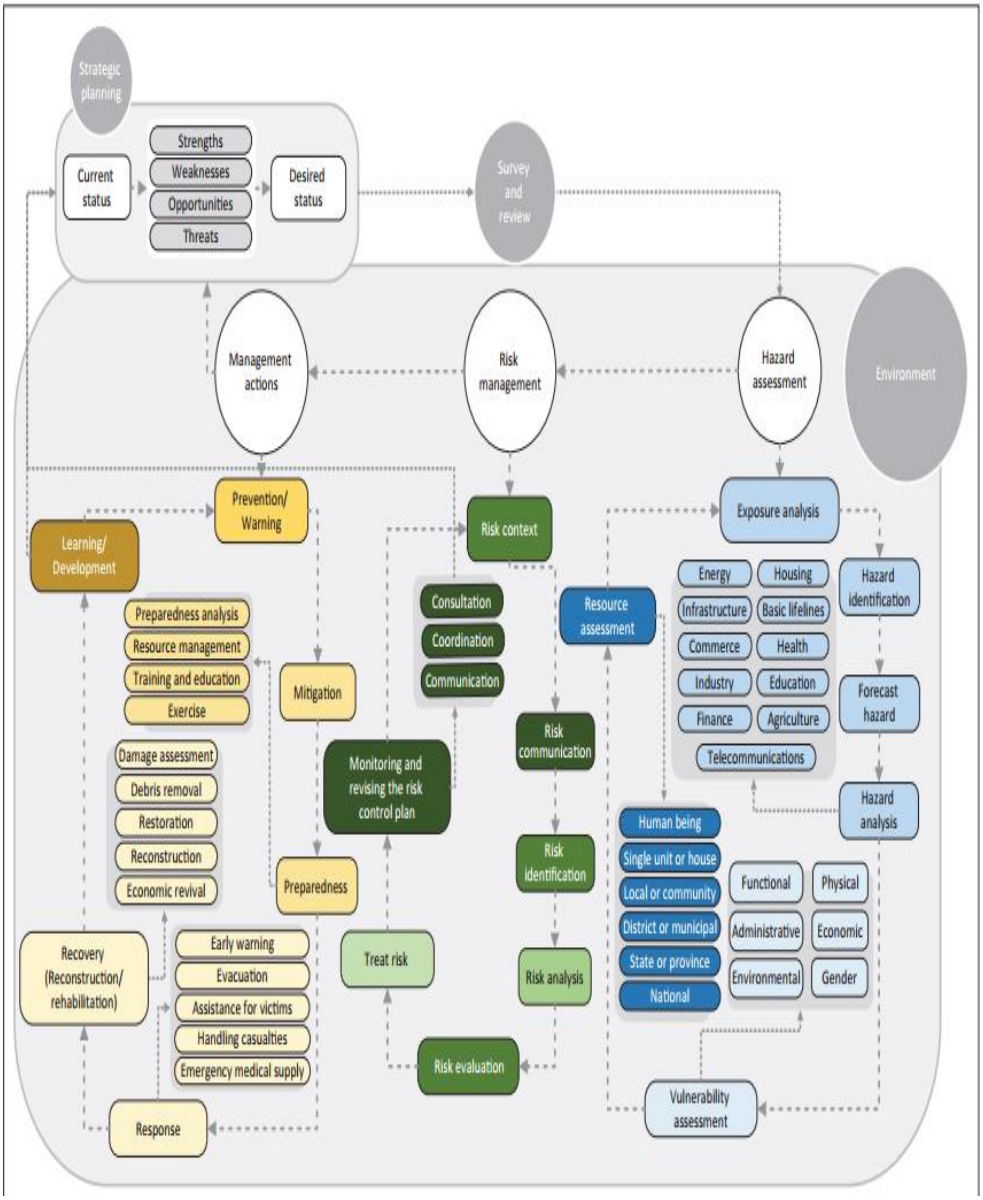


Figure 2. 11. A comprehensive conceptual model (85)

Flooding Disaster Risk Management Phases:

Relying on the comprehensive model of disaster risk management, this section will include the following phases: flooding hazard assessment and mapping, exposure and vulnerability assessments, flooding risk assessment, prevention, flooding hazard detection and early warning, flooding hazard control, mitigation, preparedness, response, recovery, and rehabilitation.

Flooding Hazard Assessment and Mapping

Flooding hazard assessment determines the probability of flood occurrence of a certain intensity (flood depth and horizontal extent) in an area over a period of time. Calculation of this probability depends on the concept of “return period” (T) which is the time interval in years for a flood with the same intensity to reoccur. Probability of occurrence of a flood exceeding this intensity for a given year is expressed as 1/T and is called the “exceedance probability. Flooding hazard assessment involves the determination of the rate of water flow through a floodplain or river, and is carried out by two main approaches. The first approach is called “Discharge frequency analysis” that relies on records of river discharge measures. These records must be sufficiently accurate and long (for at least 10 years) with no major change in upstream land use (such as deforestation or agricultural development) to allow statistical discharge frequency analysis. The second approach is called “rainfall runoff modeling” or “hydrologic modeling”. It depends on the presence of high-quality rainfall records locally or for the region, in addition to soil and land cover information, location and properties of the channels or water bodies, and records of past floods. These items are used to convert rainfall records to design discharge estimates using hydrological models. The maximum design discharges are plotted against their years of occurrence; years are then converted to return periods and then to exceedance probabilities. Finally a curve plotting design discharges for different exceedance probabilities is obtained (92). See Figure 9.2. The right upper curve.

Appropriate hydraulic models are used in flood hazard mapping. The hydraulic models used are either one-dimensional which computes the flow depth and velocity perpendicular to the cross-section. Two-dimensional models are used in areas with complex topography and can calculate the flows that are not parallel to the main flow. The three-dimensional models are particularly useful for storm surges and coastal floods. Flood hazard maps can also be produced from past floods information using satellite-based imagery. Maps are usually produced by the governments and insurance companies, and are used to define, illustrate, communicate, and regulate flood risks as well as to recognize the limitations of the mitigation measures (92, 93).

Flooding hazard is identifiable to the public through flooding risk maps which are simple overlays of the hazard maps and exposure (94). They express different risks

in different colors. Flooding hazard is identifiable as well as by revision of previous floods records, presence of coastal erosions, in addition to the presence of built flood defenses and through surveying and speaking to the local residents (93).

An example of a flooding hazard map is what was carried out by Esamaldeen et al for eastern Khartoum city, the area which was badly flooded in 2013 (95). They used remote sensing techniques and Landsat 8 images with shuttle radar topography. They produced a hazard map with three hazard categories: High, Medium and Low hazard shown in Figure 2.12.

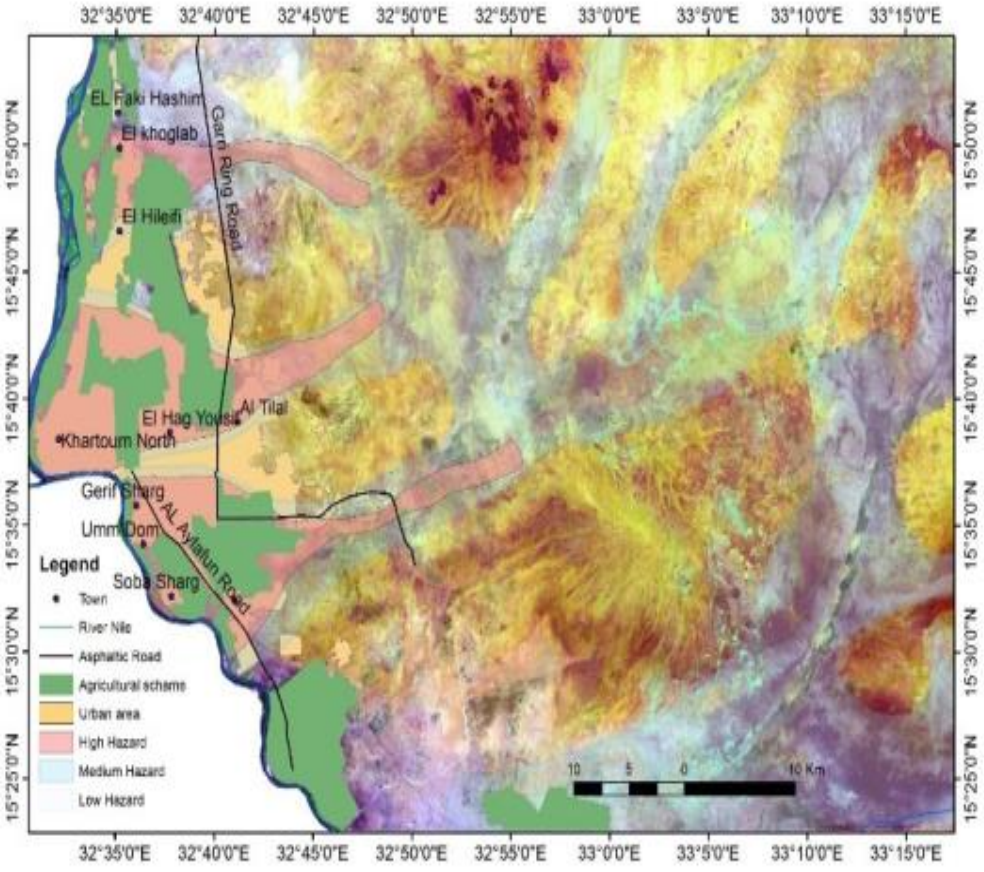


Figure 2. 12.A Flood hazard map for an area in eastern Khartoum Sudan (95)

Exposure and Vulnerability Assessments

Flooding exposure analysis is an examination of economic activities and assets that can be covered by floods. This can be illustrated by flood exposure mapping,

which can be carried out using GPS, aerial or satellite photography, or existing land-use maps. (Figure 2.13) shows an example of land-use map for flood exposure in Germany (92).

Vulnerability assessment is closely related to the proper characterization of the elements exposed to floods. It aims to understand how these elements will be affected by floods. There are different aspects of vulnerability. Physical vulnerability involves the vulnerability of buildings and infrastructure, etc. Examples of parameters to be collected for assessing physical vulnerability are type of construction, building height, use of the ground floor, location of critical infrastructure, and critical facilities. Social vulnerability addresses social groups with higher vulnerability such as children, elderly, women, people with chronic illnesses or disabilities, and others. Assessing it involves collecting data such as the population's age and sex distribution. Economic vulnerability such as vulnerability of economic assets and activities, involves collecting data on the economic status of individuals, income distribution, and workplaces. Environmental vulnerability includes the possible depletion of natural resources and environmental degradation such as deforestation and loss of wild life. Governance vulnerability involves the efficiency of the complex roles of the authorities in flooding risk reduction (93).

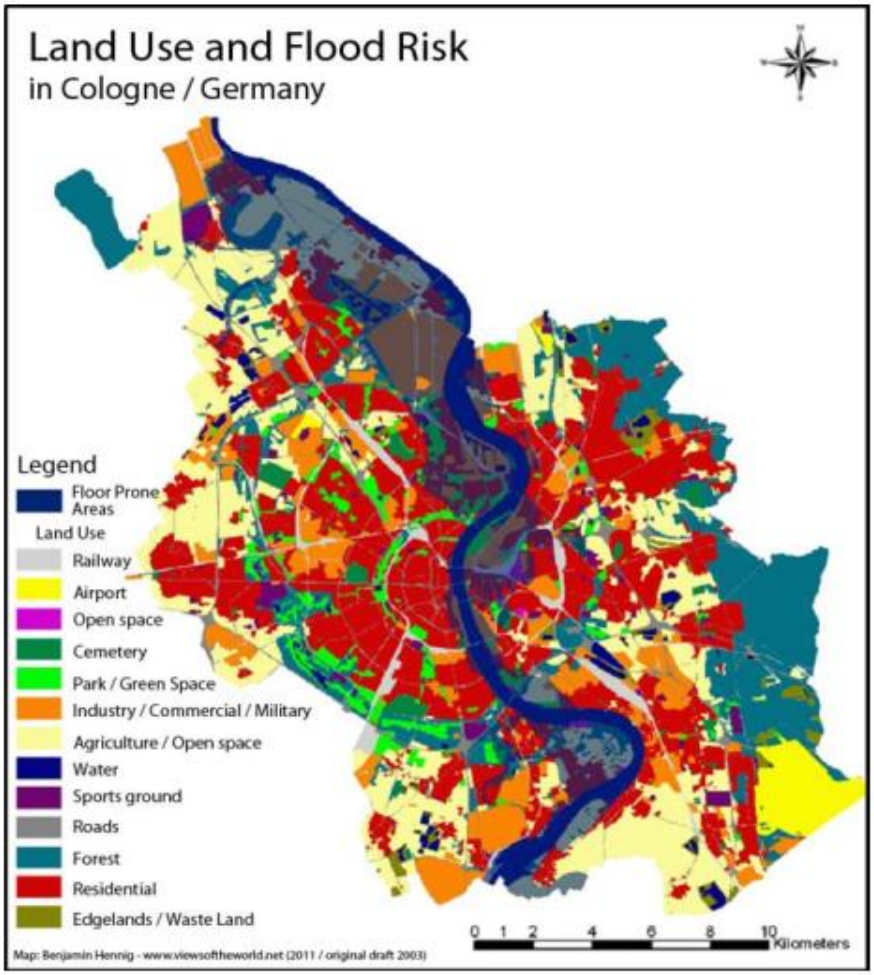


Figure 2. 13. Land use flood exposure map for Cologne Germany (92).

The impacts of floods on physical structures are described by "damage curves", which are also known as damage or vulnerability functions where damage is the money needed to restore an area to its original condition. The damage in the curve ranges from 0.0 to 100.0% (no damage – totally destroyed) and is plotted against one of the flooding characteristics such as water depth or velocity. The effectiveness of the mitigation measures is illustrated in "fragility curves" also known as fragility functions which plot the failure probability of a mitigation measure against a flooding characteristic such as water depth or velocity. The fragility curves are designed for each construction type. The damage to the mitigation measures is also explained by the damage curves (92).

Vulnerability assessments and curves can be carried out through a mix of expert judgments and field data surveying. Special metrics and estimation techniques are available for assessing social and economic vulnerabilities (92).

Flooding risk assessment

Flooding risk assessment is carried out after assessing the hazard, exposure, and vulnerability. This involves answering the following questions: What can happen? What is the probability of its occurrence? What are the consequences and costs of tham? A valuable tool for this assessment is a risk curve. The steps for creating it include calculating the design discharge for different exceedance probabilities, and then converting them to flood elevations or flood stages using hydraulic modeling together with flood plain mapping. This is followed by plotting the damage for different flood stages and then for different exceedance probabilities. The final curve represents the exceedance probability or risk curves. These curves plot the damage associated with different exceedance probabilities. (Figure 2.14) illustrates the steps involved in creating risk curves or exceedance probability curves. Putting in mind uncertainties, those curves are of the important tools for guiding the decision making in flooding risk reduction (92). The aim is to avoid too much protection that leads to unnecessary money spent on unneeded protection, as well as avoiding little protection in which people and economic assets continue to face the negative impacts of floods. Risk curves can also be carried out for different aspects of vulnerability, for example, for social vulnerability plotting mortality or number of displaced people for different exceedance probabilities. Considering all aspects of vulnerability provides a better quantification of the risk.

Both a preliminary and a full flooding risk assessment can be carried out using a combination of information on past floods, predictive analyses using modeling or other calculations, as well as the damages that can occur, in addition to the experts' opinions to identify the areas prone to floods and their consequences, both for validation and as complementary information in prediction (92).

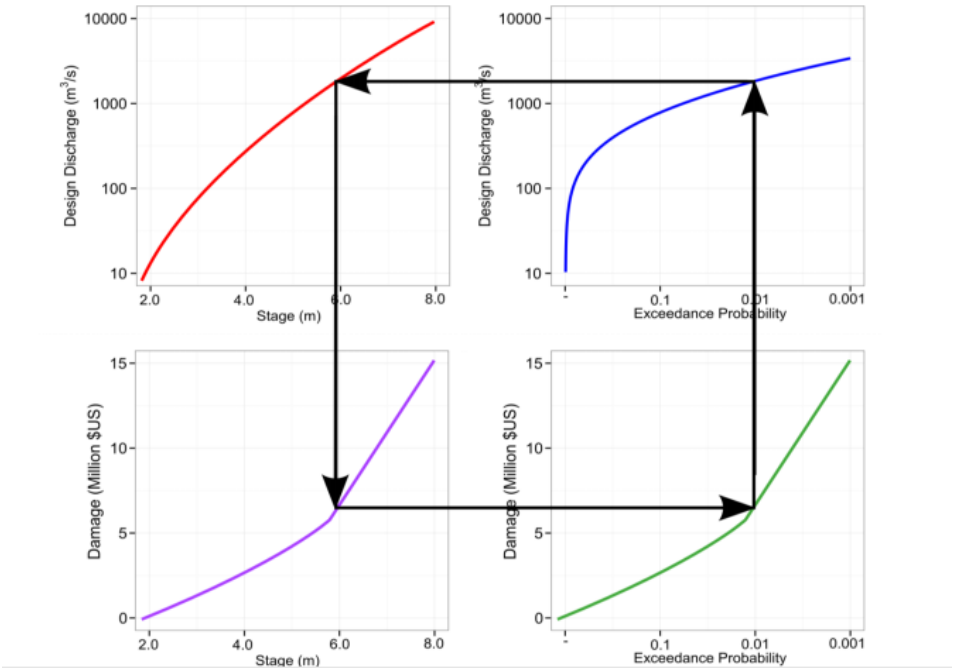


Figure 2. 14. A diagram showing the steps of creating exceedance probability curves or risk curves from hazard and vulnerability assessment curves (92)

Identification and Prioritization of Measures of Flooding Risk Reduction

There are different measures available for reducing flooding and other natural and man-made hazard risks. Prioritizing these measures depends on: 1) the effectiveness of the measure, 2) its cost compared to the benefit, 3) its technical feasibility, 4) its social acceptability, and 5) its legal requirements. Table 2.2 provides the measures of risk reduction for floods compared to other natural and manmade hazards with their effectiveness. Note that almost all risk reduction measures available for floods, with the most effective options being mitigation and preparedness. In addition, note that preparedness is an available option for almost all of the mentioned hazards.

Table 2. 2. Measures of risk reduction for floods and other hazards with their effectiveness (93)

	Prevention of hazard	Hazard detection and early warning	Hazard control	Mitigation of hazard	Preparedness and emergency response
Floods	L	L	L	Y	Y
Cyclones	N	Y	L	Y	Y
Tsunamis	N	Y	N	L	L
Tornado	N	N	N	Y	L
Land slides	L	Y	L	Y	L
Earthquakes	N	N	N	Y	Y
Volcanoes	N	L	N	L	L
Terrorism	L	L	L	L	L
Fire	L	Y	Y	Y	Y

[Y: A range of available useful options / L: There are options but of Limited effectiveness / N: Nothing or little can be done]

Prevention of flooding

Bosher et al defined prevention as decreasing the likelihood of the occurrence of a hazard. The available methods for the prevention of flooding are as follows: 1) avoidance of building within a plain, 2) redirecting the natural watercourses, 3) building dams that regulate the water flow of rivers (Dam safety should be considered as dams if failed can result in massive floods), 4) building reservoirs that can store excess water for later use, 5) encouraging the growth of natural barriers such as mangrove forests, 5) Using an appropriate urban drainage system, and 6) help the soil to be more permeable to water by planting, permeable pavements and watershed management (93, 96-98).

Flooding Hazard detection and early warning

Floods can be detected using methods such as weather forecasting and river-level gauges. Weather forecasting provides information about weather conditions,

rainfall forecasts, catchment conditions, coastal flood forecasts models for surges and large waves, seasonal factors such as leaf fall and snow cover, and the coincidence between river floods and high tides. River gauges if associated with automated alarms can notify the emergency management personnel and produce warning (93).

An early warning is the task of benefitting from hazard detection. Early warning system is defined by the UNDRR as an integrated system for monitoring, forecasting and prediction of hazards, assessment of risk, communication and preparedness activities which enable community, business, government and others to act timely to reduce the risk of disaster in advance of the occurrence of the hazardous event (99). Early warning systems have been developed for floods, droughts, typhoons, hurricanes, tornadoes, cyclones, earthquakes, volcanic activity, tsunamis, landslides, forest fires, biological and health hazards, crops and livestock diseases. The system can be single or multi-hazard, people-centered, municipally, nationally or internationally operated.

Good hazard detection, analysis and risk assessment, in addition to making decisions about communicating warnings to the general public, providing accurate, timely actionable warnings with information about the likelihood and impacts, are the basis of efficient early warning systems. Integrating modern ways of communication like social media in risk monitoring and communication is recommended (99-101)

Flooding Hazard Control

Hazard control is defined by Bosher et al as the activities that limit the size of the hazard. This can be carried out in the case of floods by protecting the natural levees of the rivers and floodplains. Wetlands (pieces of land flooded or inundated by water) can store large amount of water and slowly release them after the flood passes. Coastal wetlands are effective at reducing the storm surges and their velocities. Controlling the flow of a river is called training of the river and can be carried out by erosion resistant structures like stone, concrete, gabions logs and others (93, 96).

Flooding hazards are also controlled via construction of large-scale artificial defenses, walls, or ditches, as well as via a sustainable urban drainage system (SUDS) that manages rain close to where it falls. Although the drainage system is the best solution for flooding in new developments, it is expensive and problematic when the

water level is high or the area has a riverine flood risk. The options for Sustainable Urban Drainage Systems (SUDS) include: 1) green roofing (planted soil layer on the roofs of the buildings to store water that is later absorbed by the plants), 2) Rain harvesting (collecting rainwater from the roofs of buildings and other structures and store in tanks for local use), 3) Infiltration trench (a shallow hole with gravel inside that directs water away from the foundation of the buildings), 4) Soakaway (a pit with gravel to allow water to drain into permeable layers of soil), 5) Filter strip (a grassed area, run off is allowed to run through it to clean contaminants before reaching a water body), 6) Permeable paving (allows water to permeate through its blocks and can be stored), 7) Bioretention areas (planted areas that filter water vertically to pipes or to the ground below), 8) Swales (shallow planted depressions to filter and convey water), 9) Hardscape storage (used to store the run off in constructed containers above the ground), 10) Bonds or basins (used to store and treat water), 11) Wetlands (shallow planted water bodies used to store and filter water), 12) Underground storage (in tanks or plastic crates beneath the ground) (93).

Mitigation of flooding

Mitigation is defined by Bosher et al and the UNDRR as the protection from the hazards' effects or limitation of the negative impacts of hazards and disasters (93, 102). It gains its importance when a hazard or its negative impacts cannot be fully prevented, so their severity is reduced by mitigation strategies and actions. Mitigation measures are usually divided into structural and non-structural measures.

Structural mitigation measures are physical constructions which reduce the impacts of floods like flood defenses, gates, walls, embankments, demountable temporary flood barriers, tidal barriers, bypass channels, use of water resistant materials in buildings and infrastructure either by water exclusion or water entry strategies, access points water flood defenses such as in the access points of the metro stations, roads on stilts and amphibious buildings which are designed in a way that allow them to float on water (93, 103, 104). Some important physical mitigation measures can be carried out at the household level like: Elevated ground floor, strengthened foundation, water resistant walls, raised electricity meter, raised power sockets, anti- backflow valves and adapted furniture (105).

Non-structural mitigation measures are measures other than physical construction that decrease the negative impacts of floods or other hazards. Non-structural measures include proper use of the available knowledge, legislation, agreements, policies, laws like building codes and land use planning and zoning, raising public awareness, training and education, researches and assessments (93, 96, 104, 106).

Preparedness to Floods and its importance

Preparedness is defined as the knowledge and capacities or skills developed by governments, organizations, communities and individuals to carry out effective anticipation, response to and recovery from the impacts of likely imminent or current disasters (102). Preparedness includes everything that must be prepared to ensure the best response and least adverse effects on the hazard.

As per the definition, preparedness is based primarily on knowledge, it is an educational act, an ongoing process, and it triggers appropriate actions (107). Activities of preparedness include emergency planning and organization of the necessary arrangements and coordination required for good response and evacuation, stockpiling of supplies, informing public, providing training and field exercises, paying special attention to the vulnerable groups and the places where they congregate, such as schools, elderly dormitories, and hospitals, learning from previously experienced disasters, and putting the recommendations in practice for better outcomes.

Effective preparedness has the following requirements: a good assessment and analysis of risks; an effective early warning system; plans with clear responsibilities to be put in place when the hazard occurs; and citizens who are informed, obedient and confident in the authorities. All the preparedness actions should be supported by the official, institutional, legal and budgetary capacities and implemented at the national, regional and local levels (89, 93, 108). This highlights institutional preparedness for floods. Preparedness at the community, household, or individual level is adressed in detail in the next section of this chapter.

The importance of preparedness was well perceived during the Second World War, when preparing for an expected attack from the enemy, which required

identifying resources and planning how to use them during the crisis. Preparedness since then continued to be a cornerstone in emergency and disaster risk management, a phase that is present in almost all the models (93).

Regarding floods, preparedness was found to decrease mortality of floods by at least 50.0% (109). It was also associated with better subjective wellbeing in flood prone areas (110).

Preparedness to Floods at the Individual level

Preparedness at the individual level is the knowledge and capacities of individuals and communities to protect themselves and their properties and properly respond to hazards to minimize all their negative impacts. High levels of individual and social preparedness have a large impact on decreasing flood related losses even if the forecasting technical capacities are limited, like in low income countries (111). This preparedness is sometimes expressed as “dos and don’ts”, measures to be done before, during and after the disaster occurrence. This was apparent in the guidelines of flood preparedness directed to the general population prepared by governments of countries like the United States, the United Kingdom, and Australia (112-114)

Guidelines of flood preparedness for the population generally include measures to be taken before the flood occurrence, including first to know and quantify the risk of floods in the area where individual lives or works. This can be carried out through a risk map, revising records of previous floods, or by asking local residents. Second, to know the time of the year in which floods generally occur. For example in Sudan floods occur between June and September, and in the Midwest regions of the United States they occur in Spring and early Summer seasons (112). In Malaysia there are two types of floods: one of them occurs between May and August and the other between November and February (115). Therefore, knowing the time in general or the months in which floods occur is important for individual preparedness. Knowing the risks, consequences, and negative impacts of floods is also essential for applying measures that decrease these impacts. Fourth, to be individually prepared, it is essential for the individual to know how to be informed about the occurrence of floods, and how to receive warning messages and notifications. That is to determine the source of information about floods that can either be a radio or television station or an Internet

application, etc. It is also important to consider the source of information in power outage situations, which can be a battery operated radio with extra batteries available for use.

Other remarkable aspects of knowledge related to individual preparedness include knowledge of the communities' local evacuation plans. Where do they go, and how do they get there? For example, in Mukram neighbourhood in Kassala city in Sudan, people escape to Mukram Mountain, which is the highest place in the area. It is also important to know the escape routes if roads are blocked. It is essential for surviving massive floods to know what to do if get trapped in different situations, as most of the deaths occur as a result of being trapped in floodwaters. For example, if trapped in a building, the best practice is to go to the highest place in the building without entering a closed attic. If trapped in a car or a vehicle in rapidly moving water, the individual is instructed to stay in the vehicle and seek refuge on its roof if the water level is rising in the vehicle. It is also emphasized that a person has to call only an emergency number or helpline to get help if trapped in flood water. This number varies from country to country. For example, it is 999 in Sudan, 112 in Turkiye, and 911 in the United States.

An evacuation plan is a simple determination of what a person will do if he or she decides to evacuate voluntarily or compulsorily. Where will the person stay? How to get there, or the means of transportation that will be used, keeping in mind that at least half of the tank is always full if evacuation will be carried out using a private car. In addition, the plan include determining the evacuation routes and what will be taken during evacuation, considering the 5 Ps of evacuation recommended by the United States Federal Emergency Management Agency (FEMA) which include evacuating People (pets and livestock if safely possible), prescriptions, papers and important documents, personal needs and priceless items like irreplaceable pictures and mementos (112).

It is recommended to prepare an emergency kit to be quickly grabbed when evacuation is required. The detailed contents of the emergency kit differ from a guide to another (112-114, 116). Most of them recommend placing basic items that the household may need in an easy-to-carry container or bag. The recommended items of the emergency kit are: water, food, battery powered radio, torch, extra batteries, first

aid kit, prescriptions, whistle to call for help, masks, towels and personal sanitation needs, cash money, change clothing for every household member, blankets, and plastic utensils (117).

Learning how to provide first aid is important for saving lives and improving the outcomes if someone is hurt during an emergency. Red Cross and Red Crescents provide training classes on first aid both in presence and online. individuals can learn how to provide first aid as part of their individual preparedness for emergencies.

It is also important to detect the signs of post-traumatic stress disorder, depression, anxiety, or other mental health problems related to flood experiences in self and others and seek help from mental health providers. These signs include sleeping difficulties, loss of appetite, feeling physically or mentally drained, frustrated, lonely, worried, having difficulties in concentrating or taking decisions (64).

Protecting crops from floodwaters is necessary for food security in agricultural areas. Learning or knowing the right ways to protect crops can be part of individual preparedness in these areas. A study was carried out by Fadul et al in Kassala Sudan to evaluate the measures to cope with uncertain high and low water supply including floods (118). They found that preparedness is one of the most effective measures. There are measures that should be taken by farmers before floods such as land preparation and making small earth bunds. Measures to be done during floods, such as digging small ditches to distribute water flow. Measures to be taken after floods like increasing the seeding rate for fodder production and double tillage. Adopting effective measures requires institutional arrangements and support to the farmers with adequate resources (96, 118).

In addition to knowledge, individual preparedness includes capacities, skills and practices that must be performed before, during, and after floods. First, individuals can prevent or decrease the risk of flooding by choosing to live in low-risk areas. They can also mitigate risk by choosing water-resistant building constituents and applying the other individual mitigation measures mentioned in mitigation section of this thesis, in addition to measures that ensure that water will drain from the individual's house. Before floods, individuals should follow up the means that can inform them about the possible occurrence of floods to receive warning messages. In the absence of early

warning systems individuals can get clues about possible occurrences of floods by following up the expected rains in the individual's area and the upstream area (11).

Individuals are encouraged to speak about and discuss preparedness for emergencies with their families and communities. One of the recommended activities for families before the occurrence of floods is to practice the evacuation plan to test its effectiveness and determine how the family members will communicate with each other during emergencies, considering that sending text messages is preferred as it is faster than making calls, and reaching someone outside the emergency area can be easier. Individuals are encouraged to keep important phone numbers written in wallets and not only saved on their phones (112).

Community involvement and participation at the level of planning, decision making and implementation is recommended in preparedness and other developmental activities as people have good knowledge about their lives and places (119). Individuals are encouraged to participate with their communities for mitigation, preparedness, and evacuation activities. Special plans are recommended to be prepared by communities to evacuate vulnerable community members such as the elderly, children, and people with disabilities.

Insurance is one of the recommended methods for disaster risk sharing and transfer (112, 120, 121). Individuals are encouraged to purchase or activate their property insurance to compensate for flood damages.

Evacuation is important to save lives in cases of massive or fast-moving flood situations. Evacuation can be an instruction from authorities, or in the absence of an early warning system, it must be a self decision. Individuals must evacuate the building they are in if they feel that it will collapse due to flooding. Collapsed roofs are one of the most common causes of death due to flooding in Sudan (15).

The prepared plans should be implemented during floods. The five Ps of evacuation mentioned above should be considered: People (and pets and livestock if safety is ensured), Papers, Prescriptions, Personal needs and Priceless items that could be part of the prepared emergency bag or kit. During evacuation, it is important to turn off the gas, electricity, and water before leaving the place (112).

Individuals are instructed to avoid walking, swimming, and driving through flood waters as six inches (0.152 meter) of moving water can knock an adult down and

12 inches (0.305 meter) can sweep a vehicle away. In addition, people are instructed to stay off bridges over fast moving water, and away from downed power lines and electrical poles, immediately report downed power lines to power companies' emergency numbers, and never touch any electrical equipment if it is wet or while standing on water (112).

It is important for individuals to prepare for access to safe drinking water and sanitary latrines after floods, or to apply a method of water purification to the available water. In the absence of toilets after flooding, individuals are directed to defecate in dry places and bury their stool with sand. Returning to the flooded area should depend on the declaration of the authorities that returning is safe. However, in settings of low governance, the decision is taken by the individuals when they feel they are able to, and it seems to be safe to return. When entering a flooded building, individuals are ordered to turn off electricity if it is not off, check for loose boarders and slippery floors, keep eyes on dangerous debris and wear personal protective equipment such as gloves and boots to protect themselves from debris, scorpions, and snake bites (112).

To protect themselves from communicable diseases that can arise after floods, individuals are directed to apply anti-vector, anti-insect measures, such as mosquito nets and anti-rodent measures such as traps, and immediately fix septic tanks and latrines damaged by floods. In addition, they must ensure that their wells and drinking water are checked for bacterial and chemical contamination after flooding. Individuals are instructed as well to clean everything that gets wet by floodwater and disinfect everything that needs disinfection like clothes and throw any food that gets wet by floodwater (112).

To avoid carbon monoxide poisoning, charcoal stoves and gasoline-powered generators should not be used indoors or near open windows. Individuals are encouraged to seek psychological support when signs of mental problems are detected in self or in loved ones (17, 112).

Response to floods

Response is a crucial phase of disaster management. It includes actions taken just before, during, or immediately after the occurrence of a disaster. It mainly involves actions of rescue and saving lives, reducing health impacts, ensuring public safety, and

responding to the basic needs of the affected people. An effective and timely response depends on risk-informed preparedness, as it is the time to put the prepared plans into action. Building response capacities of the individuals, communities, organizations and countries improves response outcomes and decreases the negative impacts of the disasters (102, 122). Responses to floods may include evacuation, which is a temporary movment of people and assets into safer places before, during, or after an event to protect them. Evacuation decisions are taken by authorities or by people, especially in weak governance settings, to protect themselves from disaster impacts.

Recommended primary health care actions in response to disasters are: providing demands of preventive health care, improving the surveillance system and risk indicators, ensuring the accessibility of emergency treatment protocols, assisting survivors who have some types of diseases and providing a computerized system for processing data relevant to health care provision including psychological care (123).

Recovery from floods

Recovery refers to the restoration of normal or near-normal conditions after a disaster. Actions of recovery include repairing damages in physical, social, economic, environmental and cultural assets and sectors, restoring services, returning back to homes, cleaning up and removing debris (102, 124). The recovery phase begins soon after the end of the emergency phase, with no clear cut-off. Good recovery depends on pre-existing policies that facilitate clear institutional responsibilities and enable public participation. Recovery programs together with public awareness and engagement, offer a valuable chance to develop disaster risk reduction measures in what is known as build back better principle (93).

Build back better is a concept that refers to the use of recovery and reconstruction phases in improving resilience of the communities by integrating the disaster risk reduction measures into the restoration of infrastructure and societal systems and into livelihood, economic, and environmental revitalization.

Measuring preparedness

Measuring and evaluating preparedness is important for guiding and evaluating the efforts and campaigns aimed at increasing preparedness and decreasing the

negative impact of disasters. Measuring preparedness at both the state and individual level is challenging. There have been efforts to measure different aspects of preparedness through putting indicators, developing scales or checklists, evaluating resources and activities, checking the availability of needed equipment or through developing preparedness standards to assess intangible factors like knowledge, training and leadership or through testing the plans in exercises (125). In measuring governmental or state preparedness, Brain Jakson worked on using quantitative estimates for response reliability that is the performance of response operations linking them to preparedness inputs to assess the cost effectiveness of the preparedness policies and investments (125-127). He also worked on using exercise scenarios to evaluate and strenghthen the operation of the preparedness systems (128).

David Simpson on the other hand in his article "Disaster Preparedness measures, A test case development and application" presented and criticised some available measures in evaluating community preparedness like ISO fire rating, Community Rating System (CRS) for floods, Code Enforcement Grading System (CEGS), and FEMA's State Capability Assessment for Readiness (CAR). He also provided his own scale for community preparedness evaluation, which provided preparedness index or score in which he aimed to allow for comparison between different communities. The components of preparedness included in his scale were: a) Fire protection. b) Emergency medical service. c) Public safety / police. d) Planning and zoning. e) Emergency management office. f) Other emergency functions. g) Additional community measures. h) Hazard exposure. i) Evacuation and warning. j) Community resilience (recovery potential). Every component has sub-components with weights to deliver a preparedness index after being substituted into an equation (129).

A third prespective is the individual preparedness that Kevin et al have worked on (130). In their report which is titled "Measuring Individual Preparedness" they have criticised currently used methods in measuring individual preparedness mentioning that individual preparedness is usually measured narrowly in terms of practical to do list or confined to the emergency kit. They have also provided indicators for measuring different aspects of individual preparedness, including indicators of material preparedness such as emergency supply kits, building and vehicle, financial preparedness such as insurance and financial reserves, and the presence of cash money.

In addition, they included indicators for cognitive preparedness, such as risk knowledge (knowledge of local hazards, vulnerability, exposure and access to early warning), pre-defined response, communication and evacuation strategies, and hazard-specific behaviours and skills such as first aid, use of the fire extinguisher, swimming and driving.

Use, Importance and development of Scales in Health Sciences

Measurements are essential tools in scientific research in all fields of natural, social and health sciences (131-133). Health measurements in health are used in assessing clinical conditions such as severity of a disease, intensity of pain, psychological problems such as depression, stress, anxiety, and nutritional behaviours, in addition to attitudes and beliefs. Types of measurements include: questionnaires, rating scales, indices, subjective and objective measures (134).

A scale is a set of items (questions or components) in which each item expresses a different dimension of an attribute that cannot be measured by a single variable. Each item of the scale is assigned a weight or score and the summation of these scores describes or quantifies the attribute. Scales not only provide an easy-to-use quantitative and comparable summary of an attribute; they are also capable of addressing problems in statistical inferencing originating from synergistic effects or interactions between characteristics that express different dimensions of an attribute. Thus, scales measure complex concepts more effectively than single indicators do. Furthermore using scales enables capturing extremes in the measured attribute and allows to detect preempt possible effect modification and confounding among variables through the same scaling procedure without tendency to be biased (131).

Using a scale necessitates evaluating the process of development of that scale and identifying how well it performs in terms of the random error present in the measurement (reliability) and to which extent the scores give meaningful information about the respondent (validity).

The scale development process starts with the generation of an item pool. Item generation methods are classified into deductive and inductive methods. Deductive methods include obtaining information for items from the literature and previous research findings, or obtaining existing items from older scales. Inductive methods

include obtaining information for the items from the opinions of the target population or viewpoints of experts or patients on a clinical scale. Techniques of obtaining such information include interviews or focus groups. Mixed methods can also be used to generate item pools (134-136). Items must be made in a clear comprehensive language that requires only basic reading skills to be understood. Vague terms that accept different interpretations should be avoided. The item should include one piece of information, and incorporating two questions in one item should be avoided. Items should have the ability to discriminate between individuals. Leading questions or items that include offensive terms should not be used (134). Negatively worded items are encouraged, when possible, to avoid bias that originates from the tendency of some respondents to agree irrespective of the content of the items. This is called agreement bias and the scores of the negative items will then be reversed at the analysis stage (137). The format of measurement and response categories are determined simultaneously with the development of the item pool. One of the most commonly used response formats is the Likert scale. Other response formats include binary options, semantic differential, visual analog. Inclusion of validation items can be considered by the scale developer. These items include items that detect reponse biases such as social desirability (137).

The item pool is then displayed to a panel of experts to determine its face and content validity. The aim is to check the comprehensiveness of the scale, that it covers all aspects of the attribute and does not include irrelevant items, and it measures what it is actually supposed to measure. Clarity of the items can also be verified by the experts at this step. Experts can suggest changes in items or suggest adding or deleting items. This process can be carried out in a subjective or objective manner. Objectifying content validity involves calculating the content validity index (CVI) for each item. In one of its approaches, it is calculated by dividing the number of experts who stated that the item is content valid or requires minor changes by the total number of experts. It has to be 70% or more for the item to be included in the draft scale (138, 139). Linguistic revisions are usually performed on draft scales to ensure clarity and correctness.

Pilot studying of the draft scale is encouraged to ensure that the scale is understandable to the target population with no ambiguity (140). The draft scale should

then be administered to a development sample to evaluate the items and check for the validity and reliability of the scale. Removal of bad performing items can result from the evaluation of the draft scale. Finally, the scale length is optimized (137). (Figure 2.15) illustrates the steps or the guidelines of the scale development process.

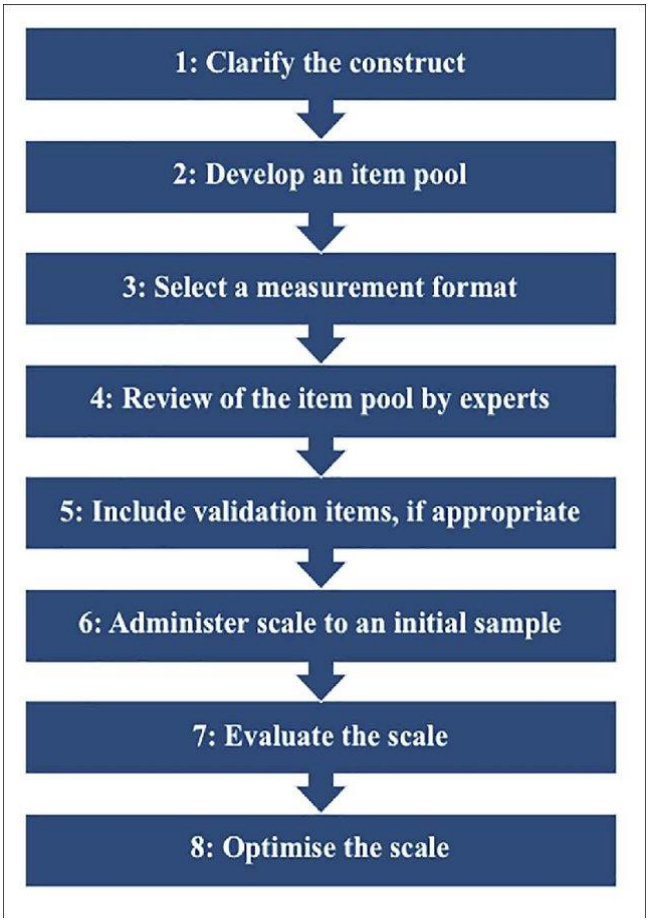


Figure 2. 15. Steps or guidelines of the scale development process (137, 141).

Validity checking is an essential step in the scale development process. In addition to the content validity that is cheked by the experts, criterion validity is another form of validity that can be checked for a newly developed scale. It correlates the scores of the new scale with an existing widely accepted scale for the same characteristics. If the evaluation was carried out for the two scales simultaneously, this is called concurrent validity. If the criterion is measured later, it is called predictive validation.

On the other hand, construct validity involves evaluating the inter-correlation matrix of the items that is usually carried out through factor analyses, resulting in

factor structures. The items should load on their factors or components by 0.3 or more and items loading on two components with a difference less than 0.1 are deleted from the scale. Thus, factor analysis allows us to generate testable hypotheses on which items are good indicators for the constructs and which are not. These predictions are evaluated in subsequent correlation and reliability analyses (142). Construct validity gains additional importance in the absence of a criterion to compare the new scale with.

Reliability of the scale is evaluated in terms of the internal consistency, that is the average correlations or consistency among the answers of the items in the measure or the scale. Internal consistency is typically expressed through Crohnbach's alpha. Provided that the construct has temporal stability, which means that the scale should give similar answers at two points in time. The time interval is recommended as 10-14 days. This is called test-retest reliability. When the scale is applied by a rater not self-administered by the respondent, a type of reliability called inter-rater reliability is ensured. That is the different raters produce the same results for the same individual using the scale (134).

Available Scales for Measuring Individual Preparedness to Floods or Disasters

A review of the literature carried out by the researcher revealed some available scales that measure individual preparedness either for disasters in general or for floods specifically. Some scales target a specific group such as nurses. The only scale found to be specific to floods was developed by Adame et al, which used components from the vested interest theory in addition to components from the extended parallel process model to develop the scale (21). The scale concentrates mainly on the attitude towards flooding preparedness with one knowledge item and some behavioural items. The language of the scale is English. Its reliability was verified in two samples from Oklahoma City in the United States. One sample was selected using a convenient technique from students of Southwestern university who responded to the scale through a provided URL. The other sample responded by telephone and was selected using a random digit dialer. The sample sizes were 425 and 258, respectively. The scale contains the following six subscales or factors under which items fall:

1) Perceived susceptibility to floods and their negative impacts (five items).

2) Response efficacy of the emergency kit, planning ahead, and alert radio message (seven items).

3) Self efficacy in preparing and using an emergency kit (six items).

4) Perceived certainty regarding the occurrence of floods and their effect (eight items).

5) Perceived outcomes and the amount of time before their occurrence (six items).

6) Perceived salience, which is the awareness of the prominence of a potentially threatening event (eight items).

The subscales were evaluated in terms of their internal consistency, which was greater than 0.75, in addition to the percentage of variance explained and regression analyses.

Another scale that evaluates beliefs and attitudes towards general disaster preparedness, with some concentration on earthquakes and fire was developed by Inal et al using the health belief model as a framework (22). The language of the scale is Turkish. Its validity and reliability were checked among 286 respondents from Yalova University's academic and administrative staff in Turkiye. The scale's construction was validated using factor analyses that revealed subscales equivalent to the six components of the health belief model theory:

1) Perceived susceptibility (3 items) with Chronbach alpha: 0.76

2) Perceived severity (3 items) with Chronbach alpha 0.74

3) Perceived benefits (6 items) with Chronbach alpha 0.80

4) Perceived barriers (6 items) with Chronbach alpha 0.75

5) Cues to action (5 items) with Chronbach alpha 0.84

6) Self efficacy (8 items) with Chronbach alpha 0.90

Most of the other scales targeted specific groups of the population, especially nurses, as key personnel in hospital disaster preparedness. A systematic review was carried out by Kalanlar B. to evaluate scales measuring the psychometric properties of nurses' preparedness from 2010 - 2021. It included six scales, four of them were adaptation of Disaster Preparedness Evaluation Tool (DPET) to different languages from the original English version, in addition to two other scales (143). The first scale was adaptation of DPET to the Chinese language (DPET-C). The validity and

reliability of the scale were checked among 1550 public health nurses in Taiwan. The scale contains 38 items distributed in the following five dimensions: knowledge of self-preparation in disaster, knowledge to respond in the workplace and in the community, post-disaster management, and skills (144).

The second scale was the adaptation of DPET in Mainland China (DPET-MC) which was carried out in two cross-sectional studies 8 months apart with sample sizes of 633 and 205 carried out among emergency department nurses in Mainland China. The scale consist of 34 items distributed into five factors namely; pre-disaster awareness, knowledge and management, knowledge and skills in the workplace in addition to the fifth factor post disaster knowledge and skills (145).

The third scale was the adaptation of DPET to the Korean language (DPET-K) in a study carried out among 497 nurses in general hospitals and public health centers. The scale consists of 28 items distributed in five factors namely: disaster knowledge and information, disaster education and training, disaster response, disaster evaluation and finally bioterrorism and emergency response (146).

The fourth scale was the adaptation of DEPT to classic Arabic (DPET-Arabic) in a study carried out among 474 registered nurses in public and university hospitals in Jordan. The scale consists of 65 items distributed in three factors: pre-disaster preparedness, disaster response and recovery (147).

The fifth scale was adapted from the Hospital Nursing Department Disaster Preparedness Scale (HNDDPS) from Sadiq's Organizational Disaster Preparedness Scale to the Chinese language and setting (Chinese-HNDDPS). The validity and reliability of the scale was verified among 2657 hospital nurses across China. The scale consists of 72 items distributed in five factors: two of them are related to disaster preparedness; one is about its perception and the other is about its actions, the third and the fourth factors are about the concerns; the third is related to the disaster event and the other is related to its impact on hospital nursing departments and the fifth factor is about the obstacles in organizing disaster preparedness (148). These five scales have reported sufficient validity and reliability psychometrics.

The sixth scale was developed by its authors to measure the preparedness, knowledge, attitude, and practice of Iranian nurses (Iranian Nurses Disaster preparedness tool DPT). The study was carried out among 112 Iranian nurses from

three public educational centers. The scale consists of 23 items. Although its exploratory factor analysis revealed 7 factors, with each of the last two factors containing only one item, Cronbach alpha was reported for knowledge, attitude and practice dimensions, and found to be 0.652, 0.610 and 0.585 respectively (149).

Another scale was adapting DEPT to the Thai language in 2022 (DPET-Thai), so it was not evaluated in the systematic review (143). The validation study of this scale was carried out among 770 registered Thai nurses. The scale included 45 items distributed in 6 factors: knowledge of preparedness, knowledge of response, post disaster management, disaster skills, in addition to the final two factors which included only two items in each factor and they were named: acquiring disaster education and sources of disaster knowledge (150).

In addition, another scale was found while reviewing the literature. It was developed in Turkiye aiming to measure disaster awareness among teachers. Its validity and reliability study were studied among 820 pre-service teachers in the Faculty of Education of Ahi Evran University in Kırşehir. The scale included 36 items distributed across four dimensions named; pre-disaster awareness, post disaster awareness, false disaster awareness, and disaster education awareness. The scale reported sufficient validity and reliability psychometrics (151).

Regarding scales that are available in the literature for measuring disaster preparedness among the general population, the researcher carried out a systematic review that targeted this area (152). There was an observed gap regarding systematic reviews of the scales that measure disaster preparedness among the general population, as there were reviews of the scales of nurses and hospital preparedness to disasters. To close this gap, the systematic review aimed to provide a summary of the domains and psychometric properties of the scales that measure preparedness, or one of its main types up to December 2022. The main types of disasters according to the classification of the Center of Research on Epidemiology of Disasters (CRED are: earthquakes and volcanoes (geophysical disasters), storms (meteorological disasters), floods and wet mass movements (hydrological disasters), extreme temperatures, droughts, and wildfires (climatological disasters), epidemics, insect infestations, and animal stampedes (biological disasters), meteorite, and asteorit (extra-terrestrial disasters). These main types were used as keywords to search for the articles, in addition to the

words: disaster, preparedness, and readiness, and the words: scale, tool, questionnaire, instrument, measure, and index. The review screened 507 articles on four search engines and included 12 articles (152).

The included articles presented 12 scales that measured preparedness of the general population for disasters or one of the disaster's main types. Among these 12 scales there was one flood preparedness scale that was mentioned above (the abbreviation used for this scale is "VIFPS"; Vested Interest Flood Preparedness Scale) (21). In addition there were one scale that measures preparedness to bushfires (Bushfire Preparedness Psychological Scale (BPPS) (153), and five earthquake scales and five general disaster preparedness scales; in chronological order they and their abreviations were Earthquake Preparedness Scale (EPS) (154), Earthquake Readiness Scale (ERS) (155), Household Earthquake Preparedness Persian Tool (HEPPT) (156), Earthquake Readiness Index (ERI) (157), and Livelihood Disaster Preparedness Tool (LDPT) (158). The final five scales among the twelve included articles were measuring general disaster preparedness and they were General Disaster Preparedness Belief Scale (GDPB) (22) which is mentioned above, Improved General Disaster Preparedness Belief Scale (IGDPB) (159), Disaster Preparedness Index (DPI) (160), Psychological Preparedness for Disaster Threat Scale (PPDTS) (161), and Household Disaster Preparedness Index (HDPI) (162). The scales that measure disaster preparedness in general seem to adopt the all-hazard approach of disaster management (163), while those which measured a single disaster type preparedness seem to adopt the top hazard approach of disaster preparedness (164).

Although these scales had factors or subscales with different wordings, many item topics were shared between them. The most commonly shared item topic was emergency or evacuation plans, which were among the items of seven scales: DPI, EPS, ERI, ERS, GDPB, HDPI, and VIFPS. Items related to having a source of information, including receiving warning messages and having a radio, were also included in seven scales: DPI, EPS, ERI, ERS, HDPI, PPDTS, and VIFPS. The third most common item topic that was not included in the sole flood scale was the fire extinguisher, which was shared among the items of six scales: DPI, EPS, ERI, ERS, GDPB, and HDPI. The emergency kit topic was among the items of the five scales: DPI, ERI, GDPB, HDPI, and VIFPS. First aid topic was also included among the items

of the five scales: EPS, ERI, ERS, GDPB, and VIFPS. Receiving early warning messages was included in four scales: DPI, HDPI, PPDTS, and VIFPS. Having a radio was also included in the four scales: DPI, EPS, ERI, and ERS. Keeping the emergency contact numbers, for example, police medical emergency, rescue, or civil defense, was included among the items of four scales: DPI, ERI, PPDTS, and VIFPS. Shutting off valves of gas, water and electricity was among the items of the three scales: DPI, EPS, and ERI. Having a torch was included in two scales: EPS and ERS (152).

The included 12 articles presented the evaluation of the validity and reliability psychometrics of the scales. In the systematic review, these psychometric properties were evaluated against the Consensus-based Standards for the Selection of Health Measurement Instrument (COSMIN) guidelines for systematic reviews of patient reporting outcome measures. These guidelines emphasize the importance of content validity checking, consider construct validity sufficient if RMSEA value was less than 0.06, or SRMR value less than 0.08, or CFI value is more than 0.95, and consider the criterion validity to be sufficient if the correlation coefficient is more than 0.7. Regarding reliability psychometrics COSMIN criteria consider the internal consistency of the subscale sufficient if Cronbach's alpha was 0.7 or more and test-retest reliability sufficient if the corelation coefficient was 0.7 or more (165). Among the 12 included articles, all the scales were rated as sufficient in content validity except LDPTS and VIFPS, for which content validity was not reported. Five scales were rated as sufficient for structural or construct validity which were ERI, ERS, IGDPB, LDPT, and PPDTS. Five scales were also rated as sufficient for internal consistency: ERS, GDPB, IGDPB, LDPT, and VIFPS. Four scales were rated as sufficient for test-retest reliability, which were: EPS, ERI, GDPB, and HDPI. Only one scale was checked for criterion validity: BPPS, and it was rated insufficient (152).

Emergency Preparedness and Response capacities in Sudan

After the occurrence of the devastating floods of 2020 in Sudan, the Global Facility for Disaster Risk Reduction (GFDRR) which is parented by the World Bank, in collaboration with the Government of Sudan and some active civil society organizations and international organizations, issued a diagnostic report for the emergency preparedness and response capacities in Sudan (166). The report was

prepared by a group of consultants from the World Bank based on stakeholder participation. The stakeholders were first identified and classified according to their authority in the process of emergency preparedness and response to floods. Firstly, the key actors who have the authority to influence the process were involved. This category includes: 1) The National Council for Civil Defense, 2) Higher Committee of Emergency, 3) Humanitarian Aid Commission, and 4) Higher Committee for Flood Mitigation. Second, primary actors who have direct inputs and effects on the process were identified. They include some governmental institutions, civil society organizations and international organizations. Third, secondary actors who participate directly or indirectly in the process were also identified. The details of the actors are shown in (figure 2.16).

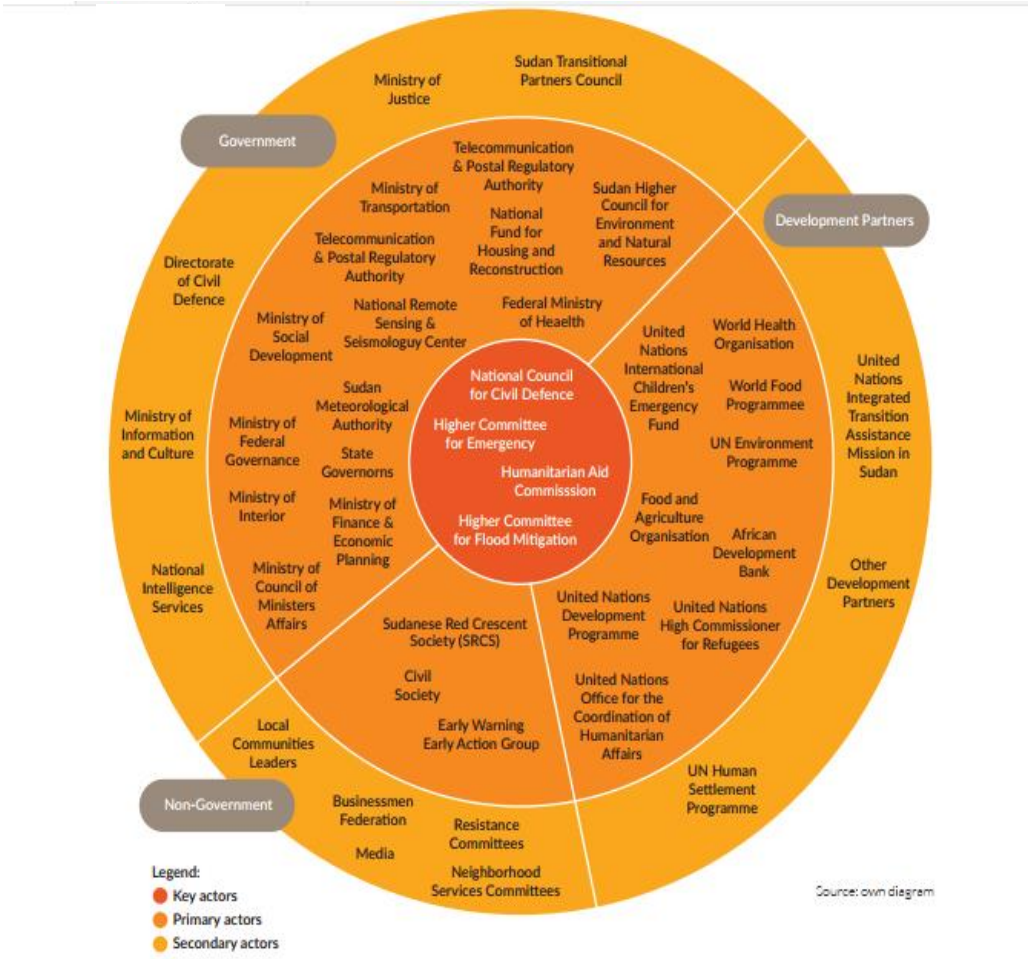


Figure 2. 16. Actors in the process of flooding preparedness and response, Sudan, 2021 (166).

The report was the output of the feedback of the stakeholders who were either interviewed or attended an interactive workshop for stakeholders, which was carried out in August 2021.The report identified the existing gaps in the policies and capacities related to emergency preparedness and response to floods in Sudan based on ready-to-respond diagnostic criteria that include: the legal and institutional framework, information, facilities, equipment, and personnel. Moreover, it suggested recommendations to address these gaps. The diagnosed problems based on these criteria are discussed in the following paragraphs.

The reported gaps in the legal and institutional framework are the absence of a clear legal framework that governs the process of preparedness and response to floods and other emergencies in addition to the ambiguity of responsibilities, the overlap of mandates and the lack of efficient coordination between actors. Slow decision-making and delays were also diagnosed among constrains to the efficient preparedness and response. The proposed recommendations targeting the gaps in all the components of the diagnostic criteria are shown in Figure 2.12.

Regarding the information component, the diagnostic report stated a deficiency in sharing information and integrating data between the actors. Moreover, stated the absence of a Disaster Management Information System (DMIS) and a Central Geographical Information System (GIS), in addition to fragmentation of the early warning system between the actors, and a lack of infrastructure for weather forecasting. Furthermore, the report noted the absence of a governmental mechanism for managing community engagement, and volunteer management and training.

The reported gaps in the facilities component were the absence of oversight on the established Emergency Operation Centers in different entities and lack of communication and coordination between them. In addition, there is a lack of national training facilities and programs for the emergency respondents, as well as the absence of a system for coordinating and storing goods received from national and international assistance. Moreover, there is absence of evacuation routes and maps, and the budget to purchase and equip shelters for the evacuees is unavailable.

Regarding documented gaps in the equipment components of the diagnostic report, lack of equipment is the feature across all the entities of emergency preparedness and response, especially the National Council of Civil Defense (NCCD), Ministry of Health (MoH), and Sudan Meteorological Authority (SMA). For instance, essential equipment to predict weather and produce alerts in SMA are either absent, worn out, or damaged. Furthermore, problems have been reported in the use of radio system communication and other information and communication technologies during disasters. In addition to the lack of backup communication systems and the absence of guidelines to manage large-scale mortalities. In addition, there is a lack of materials for public awareness regarding emerging diseases and outbreaks.

The challenges in the personnel component reported in the diagnostic report were the lack of trained staff and high turnover rates among the public sector employees in Sudan due to low wages and unfavorable working conditions. Furthermore, the governmental agencies do not take the advantage of the training programs available in other institutions to develop the skills and capacities of their employees. In addition, there are gaps in the coordination of international support to the country during disasters.

The recommendations suggested by the diagnostic report to address the gaps in the five components of Ready to Respond are shown in (Figure 2.17) (166)

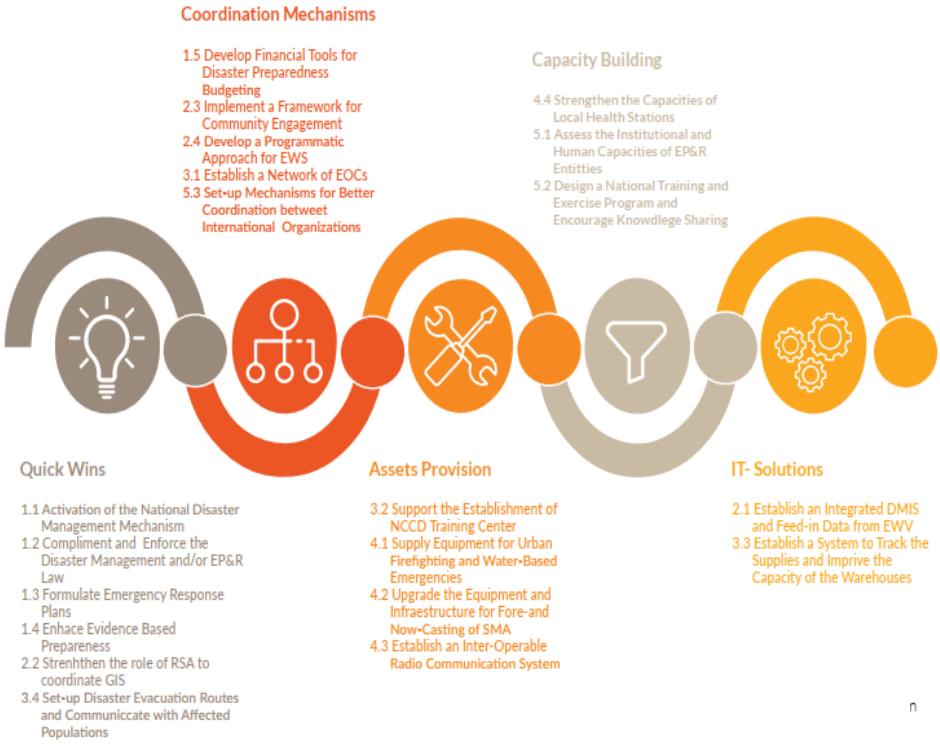


Figure 2. 17. The recommendations suggested by the diagnostic report to address gaps in the capacities of emergency preparedness and response in Sudan (166)

MATERIALS AND METHODS

Study Design

This is a population based methodological validity and reliability study

Study Area

Kassala City is the capital of Kassala state in eastern Sudan with a distance of 480 kilometers from the Khartoum the capital of Sudan and close to the Eritrean boarders of the country (Figure 3.1). The reason behind choosing Kassala city for this study is that it was the worst affected city by 2018 floods in Sudan, at the time this study was planned. Kassala had as a population of 420000 according to the last census done in Sudan in 2008. The study was carried out in the seven neighborhoods affected by 2018 floods which are Mukram, Hillat Musa, The old Khatmiia, El Shabiya, Nour neighborhood, Kadogli, Al Enkaz the east.

Figure 3. 1. Map of Sudan (167)

Study population

Study population includes all the households of the neighborhoods affected by the floods of July 2018 in Kassala city namely the households of the following neighborhoods: Mukram, Hillat Musa, The old Khatmiia, El Shabiya, Nour neighborhood, Kadogli, Al Enkaz the east**.** The affected population is estimated to be 17500 people. The criteria of inclusion into the sample are the households of Kassala city situated in the neighborhoods affected by the floods of July 2018. Only one respondent was taken from the household whose age is above 18 years and literate. The exclusion criteria are: The households of Kassala city which are outside the neighborhoods affected by the floods of July 2018, illiterates, those whose ages were below 18 years and those who have another household member who answered the questionnaire

Sampling:

To keep the sample adequately heterogenous, reflecting the diversity of the socio-demographic characteristics of Kassala city, a convenience sample was selected from the households affected by July 2018 floods in Kassala city by a rate of seven respondents for every item in the draft scale. Use of convenience sample was recommended in the preliminary application of newly developed scales as per Clark et al. (142). Convenience method was used in ten out of 12 articles in a systematic review conducted by the author to evaluate and summarize the scales that measure disaster preparedness among the general population (152). Heterogeneity is the most important criterion in the samples of validation studies (132, 142)

The number of respondents who answered the questionnaire and the scales were 428, out of which 15 were not subjected to analyses because of the poor quality of their data either due to much missing or the same answer was given to all items. We ended up in 413 respondents.This sample size enabled us to carry out factor analyses as it has to be more than 150 and it is more than 5 cases per item (168). The respondents who accepted to fill the questionnaire two times for the test retest reliability analysis, were asked to give their contact phone numbers so that the questionnaire and the scales were given to them again after 2 weeks to check for the test retest reliability of the scale. These were 31 cases. The percentage of males in the sample was 41.0% and the

females were 58.0%. The age distribution was as follows: (age group : percentage) 18-24 : 37.0%, 25-29 : 17.7%, 30-34 : 14.0%, 35-39 : 10.7%, 40-44 : 5.1%, 45-49 : 2.2%, 50-54 : 4.6%, 55-59 : 1.5%, 60-64 : 2.2%, 65 and above : 1.9%. The level of education in the sample was as follows: literate with no certificate : 9.4%, primary school graduate : 18.3%, intermediate school graduate : 10.8%, secondary school graduate : 38.5%, university graduate : 19.5% and respondents with post graduate studies : 3.6%. The marital status in the sample was as follows: those who are married : 45.6%, single : 47.6%, separated from spouse : 3.5%, spouse dead : 3.1%. More details about socio-demographic characteristics of the participants are presented in the results section of the thesis. This picture is heterogeneous in a way that is able to reflect the socio-demographic characteristics of Kassala and Sudan shown in Sudan population pyramid in Figure 3.2. More comparisons between the sample characteristics and the information of these characteristics in Sudan are presented in the discussion section of the thesis.

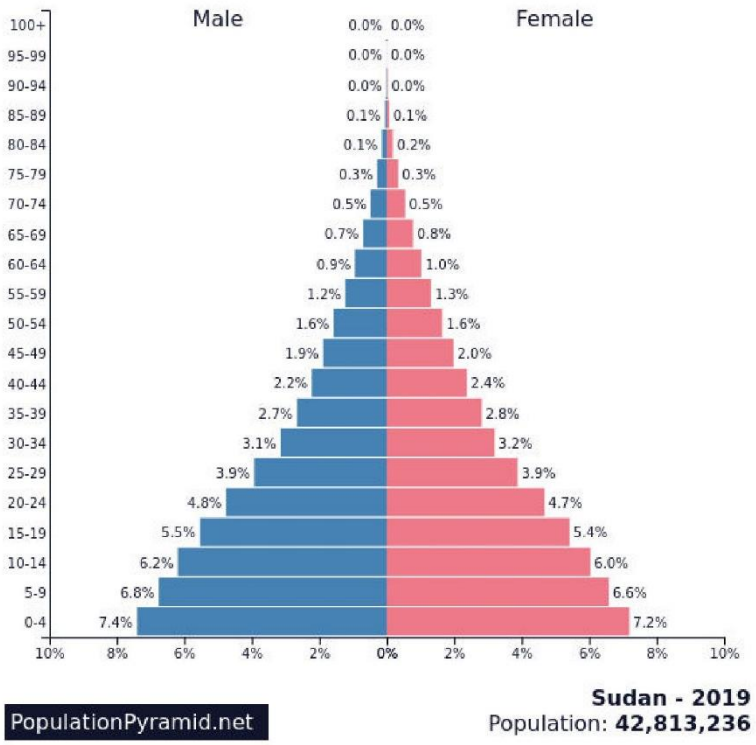


Figure 3. 2. Population Pyramid of Sudan (169)

Data Collection Tool

Data collection tool was composed of a self-administered socio-demographic data questionnaire of 21 questions, a knowledge scale of the individual flood preparedness with 13 items, and a behavior scale of individual flood preparedness with 59 items.

The study variables are Age, Sex, Educational level, Working status, Income of the house hold, Marital status, Having children, Number of children, Number of members of the household, How long the respondent has been living in Kassala city, Name of the neighborhood, Status of the ownership of the house, Previous experience of a flood, Experience of 2018 floods, Whether the respondent was affected by floods, Type of the effect, Getting chikungunya fever in epidemic of October 2018, Whether a member of the household got chikungunya fever in epidemic of October 2018, Number of the household members affected by chikungunya fever in epidemic of October 2018, Sources of information on floods, Whether the respondent was trained on flood preparedness, Name of the training, The organizer of the training, Having a certificate or diploma for the training, Feeling prepared to floods, Whether the respondent likes to be trained on flood preparedness, scores of the items of knowledge and behaviour scales, the total score of the knowledge scale, The total score of the behavior scale, Scores of the two factors or components of the knowledge scale, Scores of the three factors or components of the behavior scale, The scores of the retests of the knowledge and behavior scale.

Generation of the Item Pools of the Scales:

Item pools were generated mainly in a deductive manner by reviewing the literature and the guidelines of different countries on the topic of individual preparedness to floods (112-114). Then, we relied mainly on 1- The American guide “How to prepare for floods” produced by U.S. Department of Homeland Security (FEMA) and published in www. Ready.gov/prepare, 2- The materials produced by the ministry of health in Sudan in collaboration with the WHO to increase the awareness about the individual preparedness to floods in Sudan (Annex). Item pools were to a minimum extent generated in an inductive manner by depending on the opinions gathered from the target population.

We ended up firstly in a scale with 71 items assessing both the knowledge and the behaviors of the topic, which was later divided into two scales a scale of knowledge (with 13 items) and a scale of behavior(with 58 items) upon the advises of two scale development experts because of the use of different forms of five pointed Likert scale. The Likert scale used in the knowledge scale was in a form of: I have complete information about that (which scores 5), I have incomplete but good amount of information (scores 4), I have moderate amount of information about that (scores 3), I have minimal amount of information (scores 2) and I do not have any information (scores 1). And that used in the behavior scale was in form of: I always do that (scores 5), Most of the time (scores 4) Sometimes (scores 3), rarely (scores 2), I never do that (scores 1). The behavior scale also included the option (not applicable to me) to be chosen when the item cannot be applied to the respondent for example if the item is about driving cars and the respondent does not drive or does not have a car. This option was dealt with as empty or missing data.

Content validity of the scales

The scale was sent to eight independent experts. Seven experts in the field of public health and disaster , four of them were Turkish and three were Sudanese, in addition to one expert in the field of measurements and evaluation. The experts were asked to determine about every item in the scale interms of representativeness and clarity. They responded the items accordingly; the item is 1- suitable 2- reqires minimal changes 3-requires major changes or 4- it is not suitable and should be ommitted. We recieved responses from four experts in the field of public health and/or disaster health. Two of them were Turkish and two were Sudanese. We received a response also from the expert in the field of measurements and evaluation who approved the current form of the scale. We analyzed the findings obtained from the field experts using Davis technique (138). The content validity index (CVI) was calculated and was found 1 for almost all the items because the public health and/or disaster experts stated that the scales specially the behavior scale is comperhensive and the items are suitable, representative and clear. One of the experts stated that item 7 in the knowledge scale is not suitable and should be ommited, however its content validity index was 0.75 as the other experts stated that it is suitable, representative and

clear, thus it was not ommited at this step. Another expert suggested adding items to the knowledge scale to include all the knowledge aspects of the items mentioned in the behavior scale or cancelling the knowledge scale completely and applying only the behavior scale. This issue was decided upon by the help of the thesis follow up commitee to apply the knowledge scale in its 13 item version, which was also approved by the other three experts. Otherwise the two scales would have been too long and time taking to be filled. Details of the content validity findings and the content validity indicies are presented in (Table 3.1 and 3.2).

According to an expert opinion we added one item “I apply measures against rodents e.g (mice and rats)” to the behavior scale which was recommended by one of the experts to end up with 59 items in the behaviour scale.

Negative or reverse score items were not included in the scale because of the educational nature of the scale and so as not to create confusion in the practice for the respondents.

Table 3. 1. Content validity analysis of the knowledge scale

Item	Number of experts who deemed the item as valid	Total number of experts who commented	The Content Validity Index
1- The risks of the floods.	4	4	1.00
2- The diseases that can occur as a result of floods.	4	4	1.00
3- The months in which the floods occur.	4	4	1.00
4- How to obtain information about the possible occurrence of floods.	4	4	1.00
5- My community's local flood evacuation plan.	4	4	1.00
6- The escape routes of my location, if roads are blocked.	4	4	1.00
7- The water drainage plan of my house's street	3	4	0.75
8- How to prepare an evacuation plan.	4	4	1.00
9- How to prepare an emergency kit that can be grabbed quickly when evacuation is needed.	4	4	1.00
10- How to protect my crops and agriculture so that they are not affected by floods.	4	4	1.00
11- How I can get help, if I get trapped in floodwater in the different situations (e.g inside a building, inside a vehicle, etc...)	4	4	1.00
12- How to provide first aid, if someone is in need during flood.	4	4	1.00
13- How to get psychological support for me and loved ones after a flood, if there is a need.	4	4	1.00

Table 3. 2. Content validity analysis of the behaviour scale

Item	Number of experts who deemed the item as valid	Total number of experts	The Content Validity Index
1- I follow up the means that can inform me about the possible occurrence of floods.	4	4	1.00
2- I receive early warning message about the occurring floods.	4	4	1.00
3- During the flood season, I follow up the expected level of rains in my area.	4	4	1.00
4- During the flood season, I follow up the level of rains in the upstream areas.	4	4	1.00
5- I choose the place where I am going to live according to its safety and the possibility of it being affected by floods.	4	4	1.00
6- I choose the constituents of the building I will live in, according to their resistance and tolerance to water.	4	4	1.00
7- I speak with my family about how we would prepare for the expected floods.	4	4	1.00
8- I take the necessary measures to ensure that water will drain from my house.	4	4	1.00
9- I prepare a plan of evacuation of the flooded place to a safe place.	4	4	1.00
10- We prepare special plans to evacuate people who need help during evacuation (e.g those with disabilities, with special needs, elderly people, children.)	4	4	1.00
11- I prepare a safe place where I can go with my family enough time before the onset of floods.	4	4	1.00
12- I prepare a safe place where I can take my animals and livestock to, enough time before the onset of floods.	4	4	1.00
13- I test the effectiveness of our evacuation plan by practicing it with my family.	4	4	1.00
14- I prepare an emergency kit in which I store important things to grab quickly when evacuation is needed.	4	4	1.00

Item	Number of experts who deemed the item as valid	Total number of experts	The Content Validity Index
15- I store the electrical machines in an elevated place so that they are not affected by flood water.	4	4	1.00
16- I discuss what I have done to prepare for floods with the surrounding community other than my family.	4	4	1.00
17- I participate with my close community in the activities that can decrease negative effects of floods.	4	4	1.00
18- I have insurance against floods events and losses.	4	4	1.00
19- I immediately evacuate the building I am in if I feel it will collapse because of the flood.	4	4	1.00
20- I grab my emergency kit quickly, if evacuation is needed.	4	4	1.00
21- I turn off gas, electricity and water before evacuating a flooding place.	4	4	1.00
22- If the situation requires so, I can conduct the evacuation effectively and save myself.	4	4	1.00
23- If the situation requires so, I effectively evacuate and save my family.	4	4	1.00
24- If the situation requires so, I effectively evacuate and save my animals.	4	4	1.00
25- If the situation requires so, I effectively evacuate and save my important documents.	4	4	1.00
26- If the situation requires so, I am able to effectively evacuate and save my important belongings.	4	4	1.00
27- I avoid walking through flood waters.	4	4	1.00
28- I refrain from swimming through flood waters.	4	4	1.00
29- I refrain from driving through flood waters.	4	4	1.00
30- During floods I stay off bridges over fast-moving water.	4	4	1.00
31- If my vehicle is trapped in rapidly moving water, I stay inside the vehicle.	4	4	1.00
32- If water is rising inside the vehicle I am trapped in, I seek refuge on the roof.	4	4	1.00

Item	Number of experts who deemed the item as valid	Total number of experts	The Content Validity Index
33- If I get trapped in a building, I go to its highest level, without going into a closed attic.	4	4	1.00
34- I can find access to safe drinking water immediately after the flooding.	4	4	1.00
35- I purify the water by applying one of the purification methods if the available water is not purified.	4	4	1.00
36- I can find access to safe sanitary latrines immediately after the flooding.	4	4	1.00
37- In the absence of a toilet I make sure that I defecate in a dry place.	4	4	1.00
38- If I am forced to defecate outdoors, I make sure that I bury the stool with sand.	4	4	1.00
39- After the flooding I avoid driving, except in emergencies.	4	4	1.00
40- I return back to the flooded area after evacuation only when the authorities states that people can safely return back.	4	4	1.00
41- I check for loose boards and slippery floors when entering a flooded home or building.	4	4	1.00
42- I turn off electricity at the main breaker or fuse box when entering a flooded building.	4	4	1.00
43- When I return home after evacuation, I keep an eye on dangerous debris (e.g., broken glass, metal fragments) by using a stick or anything to check for hidden dangers so as to avoid stepping on them.	4	4	1.00
44- I wear personal protective equipments (e.g., heavy gloves and boots) to be safe from scorpion and snake bites during clean up.	4	4	1.00
45- I stay away from downed power lines.	4	4	1.00
46- I stay away from the electrical poles.	4	4	1.00
47- I report downed power lines immediately to power company’s emergency number.	4	4	1.00
48- I refrain from touching electrical equipment, if it is wet.	4	4	1.00

Item	Number of experts who deemed the item as valid	Total number of experts	The Content Validity Index
49- I refrain from touching an electrical equipment, while standing in water.	4	4	1.00
50- I use the charcoal stove, the generator or any other gasoline-powered machinery when there is a need only outdoors and away from windows.	4	4	1.00
51- I apply anti-vectors measures against mosquito, houseflies,... etc. to prevent myself from vector borne diseases.	4	4	1.00
52- I apply anti-vectors measures against mosquito, houseflies,… etc. to prevent my family from vector borne diseases.	4	4	1.00
53- I apply measures against rodents (e.g. mice and rats).	4	4	1.00
54- I immediately fix the septic tanks and the toilets damaged because of floods as soon as possible.	4	4	1.00
55- We make sure that our wells and drinking water is checked for contamination from bacteria and chemicals after flooding.	4	4	1.00
56- I clean everything that gets wet with the floods' water.	4	4	1.00
57- I disinfect everything that needs disinfection, if it gets wet during a flood .	4	4	1.00
58- I throw any food that gets wet by floods' water.	4	4	1.00
59- I suggest ways to provide psychological support for those who need after floods.	4	4	1.00

Linguistic Revisions

Linguistic revisions of the Arabic and English versions of the scales were carried out by native speaker experts who have post graduate studies in English and Arabic literature. The Turkish form was prepared for the purpose of the ethical

clearance and was reviewed by a sworn Turkish translator whose mother tounge is Arabic and have a C1 diploma in the English language.

Pilot Study

A pilot study was carried out among the study population. It included 10 respondents from the study area, 5 men and 5 women who answered the questionnaire and the scales directly without questions and they stated that the items were clear. Therefore, no changes were introduced to the questionnaire and scales after the pilot study.

Data Collection

Data collection was carried out between the 21st of January – 5th of February 2020. The data was collected by a self-administered written questionnaire and scales which were delivered to the households and recollected after filling them. In the first day, the data collection was conducted by the researcher herself which was found difficult and time consuming. The researcher then continued the data collection by the help of a group of local people from the seven neighborhoods. The neighborhoods were significantly divided by the tribes between which there were conflicts. That is why it was safer and time saving to choose data collectors to collect data only from their own neighborhoods. Two to three individuals from the local people of every neighborhood were trained on the process of data collection specially regarding not to explain anything in the scales and make the respondents answer the way they understand. These local people visited the houses at their convenience, delivered the questionnaires and the draft scales in a way that ensures heterogenity of the sample under the supervision of the researcher. Most of the selected individuals were females. That was because females were able to enter the houses comfortably in the community known to be gender sensitive. However we had three male individuals helped in collecting the data as well. Respondents who accepted to fill the questionnaire and the scale twice were dileverd them again after 10 days to check for the test retest reliability of the scales.

Data management and Analysis

Descriptive statistics of the sample included reporting means and standard deviations, medians, ranges and interquartile ranges and percentages. Exploratory factor analysis (EFA) was carried out in randomly selected participants of the sample by reporting Kaiser Meyer Olkin (KMO) index, Bartlett test significance, percentage of the total variance explained by the models, Eigenvalues, scree plots, factor loadings of the items. EFA was conducted through principal component analysis technique using Varimax rotation. Confirmatory factor analysis was carried out on another randomly selected dataset, reporting the items loadings on their factors with their T values and the following indices of goodness of fit: $\chi 2/df$, CFI, NNFI, IFI, RMSEA, SRM, PNFI, and PGFI. Internal consistency reliability analysis included reporting subscales' Cronbach alpha. Composite reliability was calculated for every factor by using the following formula:

$$p_c = \frac{(\sum_{i=1}^{m} \lambda_i)^2}{(\sum_{i=1}^{m} \lambda_i)^2 + (\sum_{i=1}^{m} (\theta_i))}$$

p_c = composite reliability index

λ_i = standardized item loading obtained from CFA

θ_i = standard error variance of the item

Test retest reliability analysis was carried out by reporting the results of Pearson product-moment correlation coefficient. Item analysis was carried out by reporting corrected total item correlation, Cronbach's alpha if item was deleted, means standard deviations, skeweness, and by comparing mean scores of the 27.0% high and low groups for every subscale or factor using the independent t test.

Data analysis was carried out using the SPSS program version 20 for the descriptive statistics of the socio-demographic data, exploratory factor analyses, reliability analyses, and item analysis. LISREL 8.7 program was used in performing the confirmatory factor analysis (CFA). Parallel analysis was carried out using Montecarlo PCA application.

Ethical Considerations

An ethical clearance for the study was obtained from the non-interventional research ethics committee in Hacettepe University before the start of the data collection (Decision Number 2020/01- 05). “Information about the study, its importance and objectives, contact e mails and phone numbers of the researchers, the statement that the participation is voluntary and participants are free to answer or quit the questionnaire the time they want, the statement that all the information obtained from the questionnaires will not be used for a purpose other than the research” were written in the front page of the questionnaire. A signed written concent was obtained from every participant. Questionnaires were unnamed. Those who participated in the retest were asked to write their phone numbers through which the matching between the test and retest questionnaires were performed.

Materials and stickers for increasing awareness of the population to prepare themselves for floods were given to volunteer members of non-governmental organizations from Kassala city to print and stick them in the places where people gather.

Study Budget

The budget of the study is presented in (Table 3.3.) The buget was covered by the researcher. (Note: US Dollar was equal to 5 Turkish Lira (TL) in 2018-2020).

Table 3. 3. The Budget of the Study *(in Turkish Lira)*

Procurements or service	Cost/TL
Printing the questionnaire and the scales	100
Cost of travelling from Turkiye to Sudan for the data collection and coming back by plane	3000
Cost of travelling from Khartoum to Kassala city by bus and coming back	400
Cost of residency for 2 weeks in Kassala city	1000
Salaries of the data collectors	4000
Total	8500 TL = 1700$

The Schedule of the Study

The schedule of the study is presented in (Table 3.4).

Table 3. 4. The Schedule of the Study

Task	September-December 2018	January-June 2019	July-December 2019	January-June 2020	July-December 2020	January-June 2021	July 2021– June 2022	July 2022- June 2023	July- December 2023
Writing of the thesis proposal									
Generation of the item pool of the scales									
Content validity study and ethical clearance									
Data collection and Data entry									
Data analysis and reporting of the results									
Writing of the thesis									
Finalizing the thesis, publishing an article and submitting another, and defending the thesis									

RESULTS

Socio- demographic characteristics and Information about the sample

The The socio - demoghraphic characteristics of the respondents include information about the age, sex, educational level, marital status, number of children, and vocation of the respondents. Socio- demographic characteristics of the respondents are presented in Table 4.1. Respondents had a variety of age ranging from 18-76. The most common age group was the 18-24 age group which represented 37% of the respondents. Females were 58.1% of the respondents. A variety of educational levels were present in the sample. The most common educational level among the respondents was the secondary school graduates which were 38.9% of the respondents. Near half of the respondents (47.3%) were single, while the married were 46.1%. The rest of the respondents were either seperated from the spouse or widowed. Near half of the respondents had children with a mean number of 4. Those who work with a source of income were 42.2% of the respondents. The most common vocation was housewife followed by free work which indicates a non fixed job.

Table 4. 1. The socio- demographic characteristics of the respondents (Kassala, Sudan, January 2020)

Characteristic		
Age	Frequency (Total: 413)	Percentage (for 400)
18-24	153	38.2
25-29	73	18.2
30-34	58	14.5
35-39	44	11.0
40-44	21	5.2
45-49	9	2.3
50-54	19	4.8
55-59	6	1.5
60-64	9	2.3
65 and above	8	2.0
Missing	13	
Mean ± Standard deviation	30.45 ± 11.64	
Median (1^{st} -3^{rd} Quartiles)	28 (22 - 35.75)	
Interquartile range	13.75	
Minimum - Maximum Range	18 - 76	
	58	
Gender	Frequency (Total: 413)	Percentage (for 410)
Males	170	41.5
Females	240	58.5
Missing	3	
Education level	Frequency (Total: 413)	Percentage (for 401)
Literate with no certificate	38	9.5
Primary school graduate	71	17.7
Intermediate school graduate	42	10.5
Secondary school graduate	156	38.9
University graduate	79	19.7
Post graduate studies	15	3.7
Missing	12	

Table 4. 2. The socio- demographic characteristics of the respondents (Kassala, Sudan, January 2020) (continue)

Charcteristic		
Marital status	Frequency (Total: 413)	Percentage (for 408)
Single	193	47.3
Married	188	46.1
Separated from the spouse	14	3.4
Spouse dead	13	3.2
Missing	5	
Having children	Frequency (Total: 413)	Percentage (for 410)
Yes	201	49.0
No	209	51.0
Missing	3	
No. of children (among those who have)		
Mean ± Standard deviation	4.04 ± 2.109	
Median (1^{st} -3^{rd} Quartiles)	4 (2-6)	
Interquartile range	4	
Minimum - Maximum	1-10	
Range	9	
Working status	Frequency (Total: 413)	Percentage (for 393)
Working	166	42.2
Not working	227	57.8
Missing	20	
Vocation	Frequency (Total: 413)	Percentage (for 318)
House wife	94	29,6
Free work	72	22.6
Student	69	21.7
Teacher	26	8.1
Worker	15	4.7
Driver	5	1.6
Tea and coffee seller	4	1.3
Other occupations	33	10.4
Missing	95	

Information about the household included the households income which ranged between 200-20000 Sudanese Pounds (SDGs) with a mean and median of 3281 and 3000 SDGs respectively. The mean and the median number of the household members were 7 with a minimum of 2 and a maximum of 16. Household characteristics of the respondents is presented in (Table 4.3).

Table 4. 3. Household characteristics of the respondents (Kassala, Sudan, January 2020)

Household's income in SDGs	
Mean ± Standard deviation	3281.36 ± 2680.847
Median (1st -3rd Quartiles)	3000 (1500 - 4000)
Interquartile range	2500
Minimum - Maximum	(200 - 20000)
Range	19800
No. of the household members	
Mean ± Standard deviation	6.88 ± 2.619
Median (1st -3rd Quartiles)	7 (5 - 9)
Interquartile range	4
Minimum - Maximum	(2 - 16)
Range	14

Information related to living in Kassala city included duration, distribution between the neighbourhoods, status of ownership of the house. The mean duration of living in Kassala was 26 years. The minimum duration was one year, while the maximum was 69. The repondents were distributed among the seven affected neighbourhood. The neighbourhood which had the largest number of respondents was Kadogli (68 respondent), while the neighbourhood with the least number was Hillat Musa (48 respondent). The respondents who owned the house in which they live were 66.2% of all the respondents. Characteristics of the respondents regarding living in Kassala city are presented in (Table 4.3).

Table 4. 4. Characteristics of the respondents regarding living in Kassala city (Kassala, Sudan, January 2020)

Duration of living in Kassala city in years		
Mean ± Standard deviation	26.06 ± 11.22	
Median (1st -3rd Quartiles)	25 (19.75 – 32)	
Interquartile range	12.25	
Minimum - Maximum	1 – 69	
Range	68	
Distribution of the respondents between the neighborhoods	Frequency (Total: 413)	Percentage (out of: 413)
Kadogli	68	16.5
Mukram	66	16
Old Khatmiya	60	14.5
Shabiye	60	14.5
Nour neighborhood	58	14
Al Enkaz the east	53	12.8
Hillat Musa	48	11.6
Status of ownership of the house	Frequency (Total: 413)	Percentage (out of 406)
Lives in an owned house	269	66.2
Lives in a rented house	92	22.7
Slum	30	7.4
Family's house	6	1.5
Other	9	2.2
Missing	7	

Characteristics of the respondents regarding flood experience include previous flood experience, experience of 2018 flood, status of being affected by floods, and the type of the effect. Those who experienced a previous flood were 94.9% of the respondents, while those who experienced 2018 flood were 93.3%. Most of those who were affected

by the floods had financial losses and their houses flooded (61.4%). Those who lost a family member were 2.6% of the respondents, while those who only witnessed the floods without being directly affected were 31.9%. Table 4.4 shows the characteristics of the repondents regrarding previous flood experience.

Table 4. 5. Characteristics of the repondents regrarding previous flood experience. (Kassala, Sudan, January 2020)

Previous flood experience	Frequency (Total: 413)	Percentage (out of 408)
Yes	387	94.9
No	21	5.1
Missing	5	
Experience of 2018 flood	Frequency (Total: 413)	Percentage (out of 367)
Yes	342	93.2
No	25	6.8
Missing	46	
Whether the respondent was affected by floods	Frequency (Total: 413)	Percentage: (out of 389)
- Yes, the house was flooded, and had financial losses	239	61.4
-Yes, lost one of the family members	10	2.6
-Yes, an injury occured to self or to one of the family	15	3.9
-Yes, other	1	0.3
-No, just witnessed the flood and the affected.	124	31.9
Missing	24	

Characteristics of the respondents regarding Chikungunya fever during 2018 epidemic included three characteristics. They were; whether the respondents was affected by Chikungunya fever, whether any of the family member was affected. Those who were

affected by Chikungunya fever were 78.9% of the respondents. Those who had at least one of the family members affected by Chikungunya fever were 88.2%. Characteristics of the respondents regarding Chikungunya fever are given in Table 4.5.

Table 4. 6. Characteristics of the respondents regarding Chikungunya fever during 2018 epidemic (Kassala, Sudan, January 2020)

Got Chikungunya fever during 2018 outbreak	Frequency (Total: 413)	Percentage: (out of 412)
Yes	325	78.9
No	87	21.1
Missing	1	
Whether any of the household members got Chikungunya fever during 2018 outbreak	Frequency (Total: 413)	Percentage (out of 408)
Yes	360	88.2
No	48	11.8
Missing	5	

Respondents were asked to tick the sources from which they get information about floods. The most common source of information about floods was the television followed by neighbours and family members. Table 4.6 presentents the reponses of the respondents regarding their source of information about floods.

Table 4. 7. Respondents' source of information about floods (Kassala, Sudan, January 2020)

Source of information about floods	Frequency (of who ticked the option)	Percentage (out of 408 for each option)
Television	210	51.5
Neighbors	191	46.8
Family members	185	45.3
Radio	184	45.1
Friends	144	35.3
Internet	112	27.5
School	85	20.8
Newspaper	48	11.8
National organizations	40	9.8
Magazine	35	8.6
International organizations	20	4.9
Other	16	3.9
Missing	5	

Respondents were asked whether they got traning related to floods and preparedness to them. They were also asked about the type of traing, duration of the training and institution which provided the training and whether they like to be trained. Those who had any traing related to floods were 5.0% of the respondents, and 87.8% would like to be trained about flood preparedness. Table 4.7. presents characteristics of respondents regarding training for floods and flood preparedness

Table 4. 8. Characteristics of respondents regarding training for floods and flood preparedness (Kassala, Sudan, January 2020)

Got related training	Frequency (Total: 413)	Percentage (out of 404)
Yes	20	5.0
No	384	95.0
Missing	9	
Name of the training	Frequency (Total: 20)	Percentages are not provided because of the small numbers
First aid	7	
Psychological support	4	
Coping strategies	1	
Disaster prevention	1	
Disaster preparedness	1	
Floods confrontation	1	
Disease control	1	
Missing	4	
Training institution	Frequency (Total:20)	Percentages are not provided because of the small numbers
Red Crescent	9	
National Organizations	7	
World Health Organization	1	
Missing	3	
Average days of training	14 days	
Document given at the end of the training	Frequency (Total:20)	Percentages are not provided because of the small numbers
Certificate of attendance	8	
Diploma	5	
None	2	
Missing	5	
Likes to be trained	Frequency (Total: 413)	Percentage (out of: 395)
Yes	347	87.8
No	46	11.6
Missing	20	

Repondents were asked about whether they feel adequately prepared to floods. The majority selected the answer of not sure (44.4%). Table 4.8. presents the distribution of the respondents according to feeling adequately prepared for future floods.

Table 4. 9. Distribution of the respondents according to feeling adequately prepared for future floods (Kassala, Sudan, January 2020)

Feeling adequately prepared for future floods	Frequency (Total 413)	Percentage (out of 381)
Yes	117	30.7
No	95	24.9
Not sure	169	44.4
Missing	32	

Note: The sample size of all the previous analyses was 413. The percentages presented are the valid percent of those who answered without including missing. The total of the frequencies and the totals out of which the percentages were calculated are put between two brackets in the tables for every characteristic

The Knowledge Scale:

Construct Validity of the Knowledge Scale:

Findings of the Exploratory Factor Analysis of the Knowledge Scale

Exploratory factor analysis was performed for the knowledge scale. After extracting the 7th item from the scale as it was loading only on a third factor, with no KMO value provided for this model. The final model of the scale with 12 items out of the 13 items was obtained after removal of item 7, with a KMO value of 0.843, Bartlett test highly significant with p value less than 0.001 and 46.7% of the total variance explained by the two-factor structure.

The scree plot supports the model of 2 factors as it showed sharp descending line from factor 1 and 2 and almost a horizontal line for the other factors. Scree plot is shown in (Figure 4.4).

Parallel analysis also supported 2 factor structure of the behavioral scale, using 210 cases of the sample for the 12 variables of the knowledge scale. Findings of the parallel analysis are shown in the Table 4.8.

The items of the two factors and their factor loadings obtained from principal component analysis technique and varimax rotation are explained in (Table 4.9). No item was loading by less than 0.3 on its factor and no item was loading on two factors by less than 0.1. We kept the 8th item which was in boundaries of factors 1 and 2 (after and during) loading mainly in factor 2 with an exactly 0.1 difference because of its importance regarding the content validity of the scale and because the support it gained from the confirmatory factor analysis, item analysis and Chronbach α.

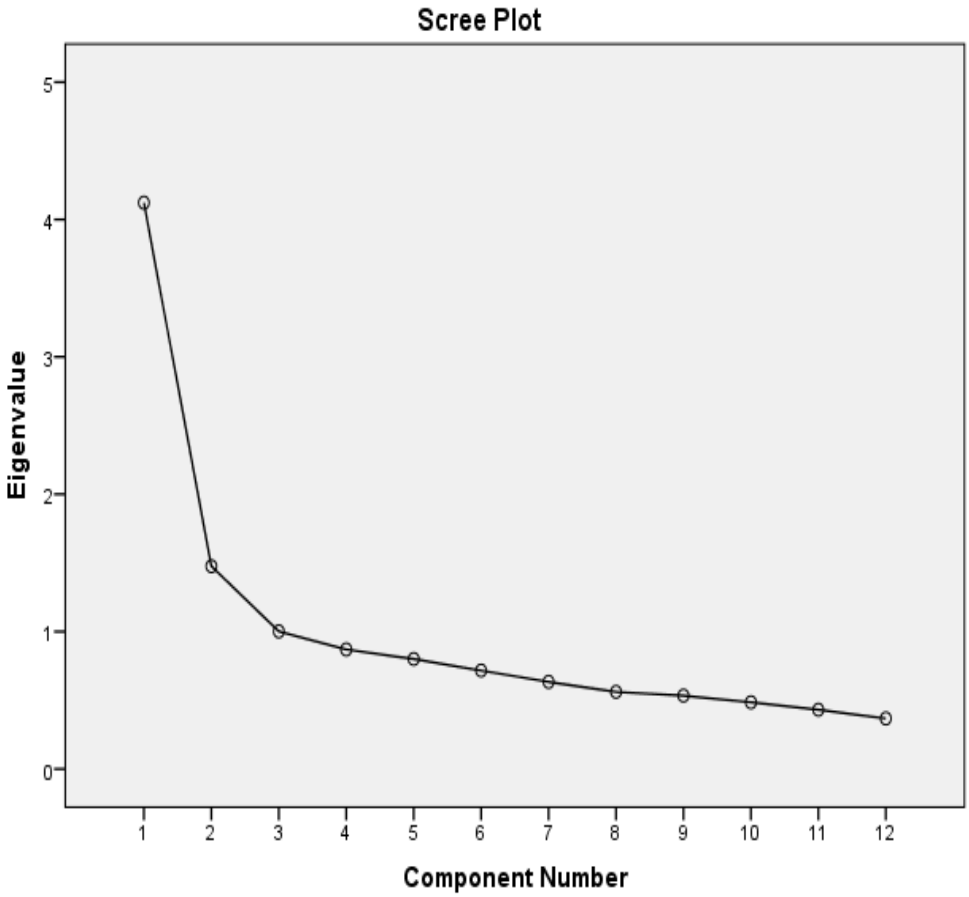


Figure 4. 1. Scree Plot for the Factors of the Knowledge Scale (Kassala, Sudan, January 2020)

As shown in (Table 4.10.) the Eigenvalues of the first two factors obtained from the actual data are greater than the Eigenvalues estimated from random data with the same sample size and number of variables.

Table 4. 10. Eigenvalues obtained from Parallel Analysis for the Knowledge Scale (Kassala, Sudan, January 2020)

Factor number	Real Eigenvalue	Eigenvalue estimated from random data
1	4.122	1.407
2	1.476	1.301
3	1.002	1.218

Table 4. 11. The items of the two factors of the knowledge scale and their loadings (kassala, sudan, january 2020)

Item	Factor1 (General knowledge)	Factor 2 (Knowledge related to what should be done)
K1- The risks of the floods.	0.788	
K2- The diseases that can occur as a result of floods.	0.738	
K3- The months in which the floods occur.	0.555	
K5- My community's local flood evacuation plan.	0.597	0.437
K4- How to obtain information about the possible occurrence of floods.	0.380	0.487
K6 The escape routes of my location, if roads are blocked.		0.612
K8- How to prepare an evacuation plan.	0.455	0.555
K9- How to prepare an emergency kit that can be grabbed quickly when evacuation is needed.		0.636

Item	Factor1 (General knowledge)	Factor 2 (Knowledge related to what should be done)
K10- How to protect my crops and agriculture so that they are not affected by floods.		0.587
K11- How I can get help, if I get trapped in flood water in the different situations (e.g inside a building, inside a vehicle, etc...)		0.689
K12- How to provide first aid, if someone is in need during flood.		0.696
K13- How to get psychological support for me and loved ones after a flood, if there is a need.		0.634

Confirmatory Factor Analysis Findings Of The Knowledge Scale:

According to the T values obtained from the confirmatory factor analysis, no item needs to be extracted from the model. T values are shown in the following (Figure 4.5.)

The loads of the items on their factors showed that no item was loading by less than 0.3. Accordingly, no fcator needs to be extracted from the model. Figure 4.6. shows the factors loadings of the items

The indices of goodness of fit for the factor structure revealed acceptable values of the indices $\chi 2$/sd, CFI, IFI, RMSEA, SMR, PNFI, PGFI as shown in (table 4.11.)

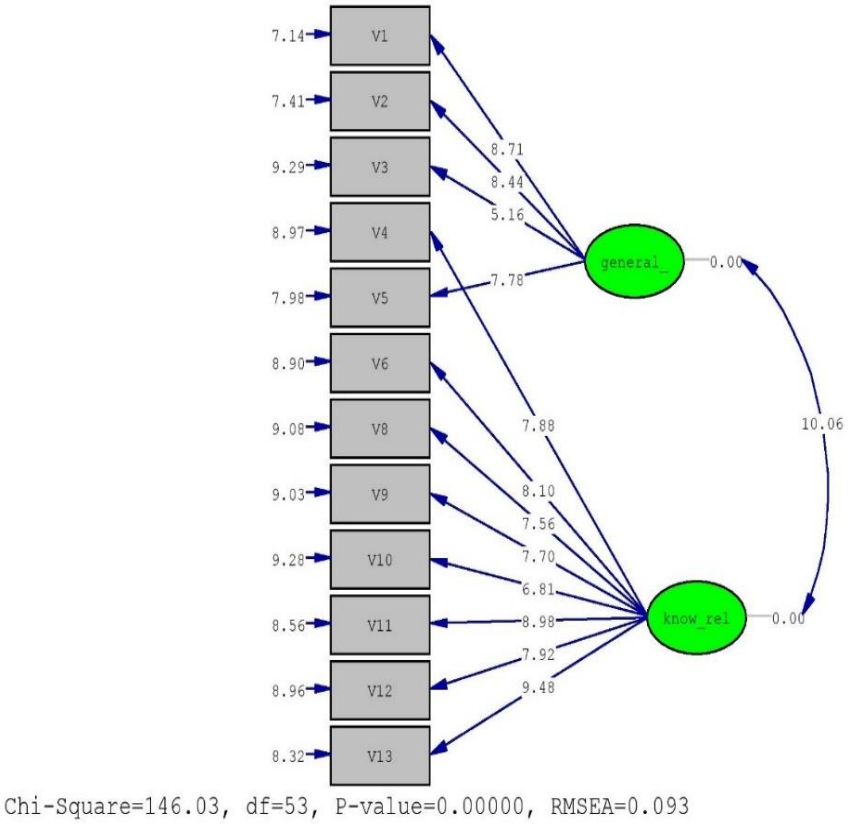


Figure 4. 2. T Values of the Items from the Confirmatory Factor Analysis of the Knowledge Scale (Kassala, Sudan, January 2020)

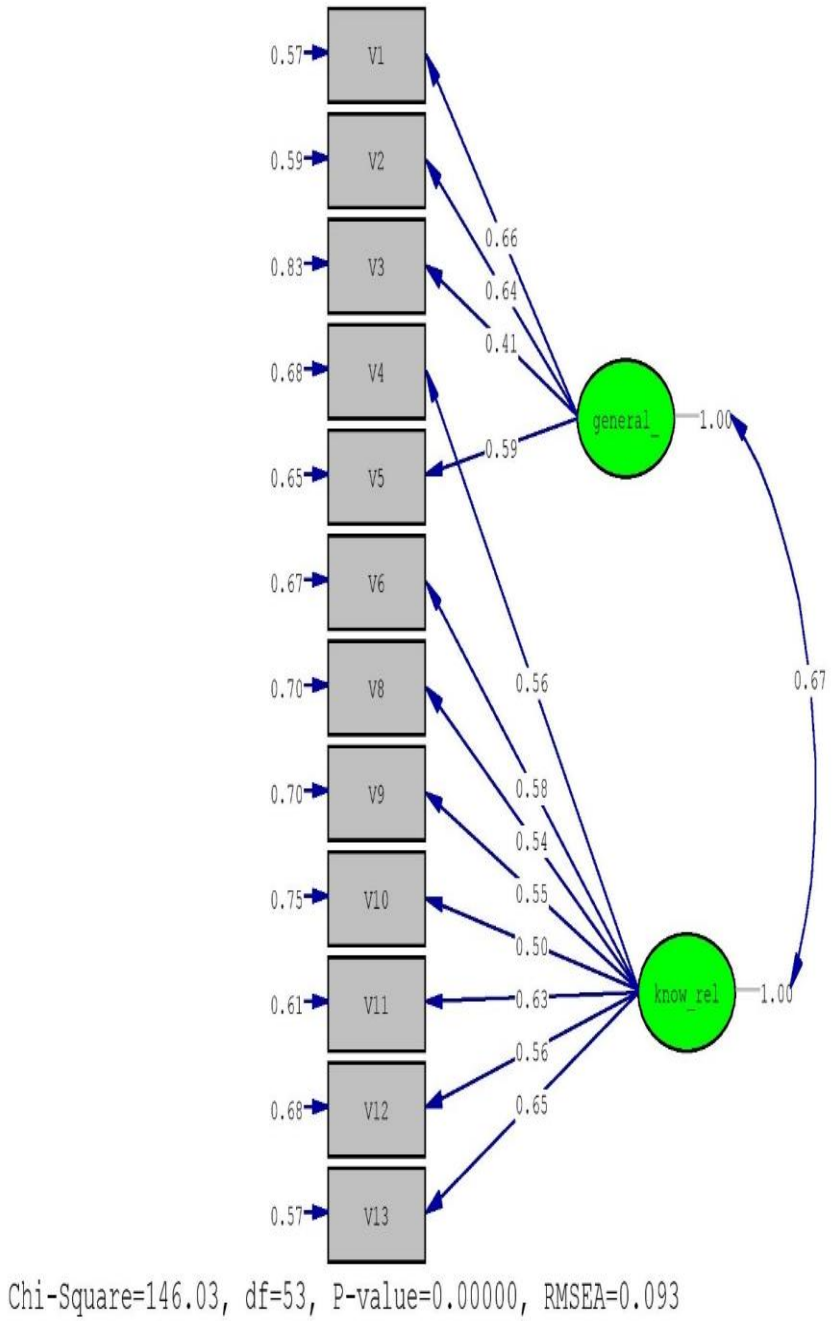


Figure 4. 3. The factors loadings of the items of the knowledge scale (Kassala, Sudan, January 2020)

Table 4. 12. The Fit Indices for the Three Factor Structure of the Knowledge Scale (Kassala, Sudan, January 2020)

Examined index	Perfect fit value	Acceptable fit value	Obtained value	Result
χ^2/df	$0 \leq \chi^2/df \leq 2$	$2 \leq \chi^2/df \leq 3$	2.755	Acceptable
CFI	$.95 \leq CFI \leq 1.00$	$.90 \leq CFI \leq .95$	0.90	Acceptable
IFI	$.95 \leq IFI \leq 1.00$	$90 \leq IFI \leq .95$	0.90	Acceptable
RMSEA	$.00 \leq RMSEA \leq .05$	$90 \leq IFI \leq .95$	0.093	Acceptable
SRMR	$00 \leq SRMR \leq .05$	$.05 \leq SRMR \leq .10$	0.079	Acceptable
PNFI	$95 \leq PNFI \leq 1.00$	$.50 \leq PNFI \leq .95$	0.69	Acceptable
PGFI	$95 \leq PGFI \leq 1.00$	$.50 \leq PGFI \leq .95$	0.61	Acceptable

Reliability analyses of the knowledge scale:

Reliability analyses of the knowledge scale namely Cronbach alpha, composite reliability and test retest reliability are shown in (Table 4.13.)

Table 4. 13. Reliability Analyses Findings of the Knowledge Scale (Kassala, Sudan, January 2020)

Factor	Cronbach alpha	composite reliability	Test re test reliability	Test re test reliability for the scale
Factor 1 (General knowledge)	0.662	0.667	0.670	0.765
Factor 2 (Knowledge related to what should be done)	0.806	0.796	0.731	

Item analysis for the knowledge scale:

Analyses were carried out for differences of the means between the two groups of the highest and lowest 27.0% according to the total scores of the three subscales. The differences between the means of the two groups in the two subscales were found significant which support the efficiency and distinctiveness of the items. This is shown in details in (Table 4.14).

Table 4. 14. The Mean Scores of the 27.0% High and Low Groups in Every Subscale of the Knowledge Scale and the P Value of the Difference (Kassala, Sudan, January 2020)

Factor or subscale	Group	Mean score of the group	P value
General knowledge	Low score group	7.991	< 0.001
	High score group	17.889	
Knowledge related to what should be done	Low score group	13.820	< 0.001
	High score group	33.020	

The corrected total items correlations with every factor were all above 0.3 which supported the power of discrimination. Cronbach alpha if item deleted were lower than the total subscale Cronbach alpha except for K3 which was higher by 0.002. (Table 4.15) shows the corrected total items correlations, Cronbach alpha if item deleted, mean score of the item with its standard deviation and skewness.

Table 4. 15. The Corrected Total Items Correlations, Cronbach Alpha if Item Deleted, Mean Score, Standard Deviation and Skewness of the Items of the Knowledge Scale (Kassala, Sudan January 2020)

Factor	Item	Cronbach's alpha if item deleted	Corrected total item correlation	Mean	Standard deviation	Skewness	P values
1	1	0.550	0.509	3.81	1.384	-0.835	p<0.001
	2	0.540	0.527	3.59	1.351	-0.502	
	3	0.664	0.340	3.72	1.492	-0.759	
	5	0.618	0.410	2.61	1.535	0.378	
2	4	0.787	0.495	2.90	1.424	0.098	p<0.001
	6	0.784	0.521	3.16	1.525	0.183	
	8	0.784	0.522	2.71	1.466	0.310	
	9	0.785	0.514	2.65	1.543	0.372	
	10	0.789	0.489	2.46	1.602	0.563	
	11	0.779	0.552	3.12	1.472	-0.134	
	12	0.785	0.510	3.23	1.513	-0.163	
	13	0.780	0.543	3.47	1.469	-0.468	

The Behavioral Scale Analyses:

Construct Validity of the Behavioral Scale:

Findings of the Exploratory Factor Analysis of the Behavior Scale:

Exploratory factor analysis was performed for the behavioral scale. After many trials of extracting items we reached the final model of the scale with 25 items out of the 59 items with a KMO value of 0.850, Bartlett test highly significant (p value less than 0.001) and 41.0% of the total variance explained by the 3 factors.

The scree plot supports the model of 3 factors as it showed sharp descending line between factor 1, 2 and 3 and almost a horizontal line for the other factors. Scree plot is shown in (Figure 4.4.) Parallel analysis also supported 3 factor structure of the behavioral scale, using 250 cases of the sample for the 25 variables of the behavioral scale. Findings of the parallel analysis are shown in (Table 4.16)

Table 4. 16. Eigenvalues Obtained from Parallel Analysis for the Behaviour Scale (Kassala, Sudan, January 2020)

Factor number	Real Eigenvalue	Eigenvalue estimated from random data
1	6.101	1.6207
2	2.399	1.5232
3	1.738	1.4532
4	1.207	1.3845

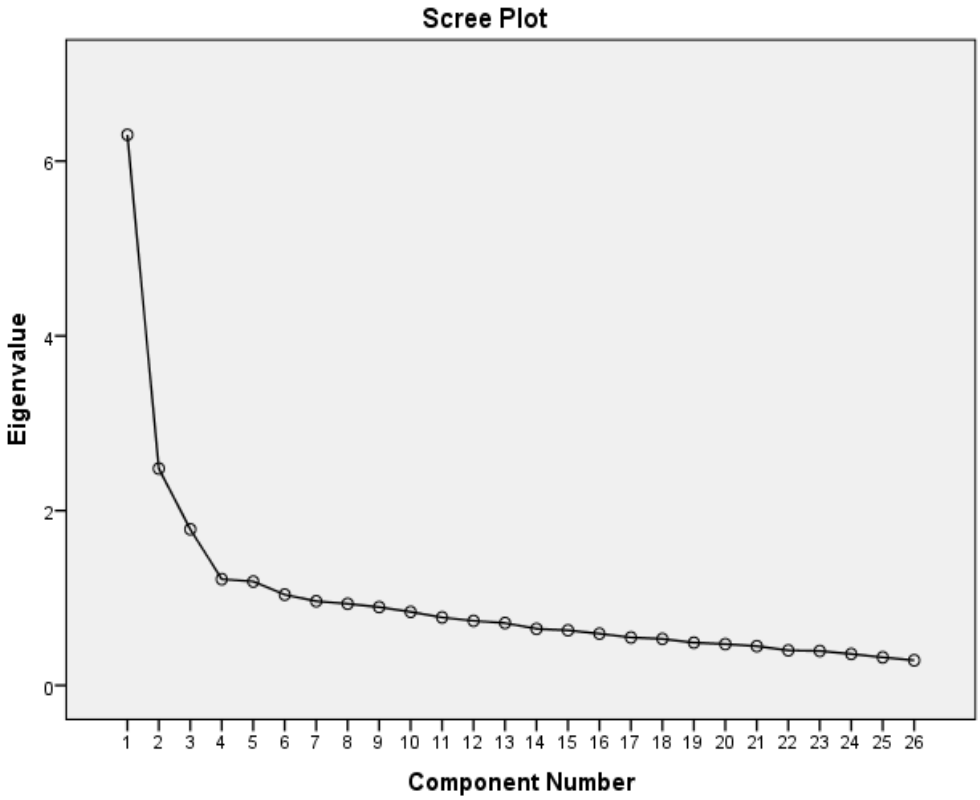


Figure 4. 4. Scree Plot of the Factors of the Behavior Scale (Kassala, Sudan, January 2020)

As shown in (Table 4.8.) the Eigenvalues of the first three factors obtained from the actual data were greater than the Eigenvalues estimated from random data with the same sample size and number of variables.

The items of the three factors and their factor loadings obtained from principal component analysis technique and varimax rotation were explained in Table 4.3. We kept the forty second item which was in boundaries of factors 3 and 2 (after and during) loading mainly on factor 3 with 0.09 difference because of its importance regarding the content validity of the scale and because the support it gained from the confirmatory factor analysis, item analysis and Chronbach α.

Table 4. 17. Findings Obtained from the Exploratory Factor Analysis of the Behaviour Scale (Kassala, Sudan, January 2020)

Item	Factor1 (Before)	Factor2 (During)	Factor3 (After)
B2- I receive early warning message about the occurring floods.	.538		
B4- During the flood season, I follow up the level of rains in the upstream areas.	.426		
B9- I prepare a plan of evacuation of the flooded place to a safe place.	.602		
B10- We prepare special plans to evacuate people who need help during evacuation (e.g those with disabilities, with special needs, elderly people, children.)	.611		
B11- I prepare a safe place where I can go with my family enough time before the onset of floods.	.701		
B13- I test the effectiveness of our evacuation plan by practicing it with my family.	.677		

Item	Factor1 (Before)	Factor2 (During)	Factor3 (After)
B14- I prepare an emergency kit in which I store important things to grab quickly when evacuation is needed.	.693		
B19- I immediately evacuate the building I am in if I feel it will collapse because of the flood.		.596	
B21- I turn off gas, electricity and water before evacuating a flooding place.		.671	
B22- If the situation requires so, I can conduct the evacuation effectively and save myself.		.654	
B23- If the situation requires so, I effectively evacuate and save my family.		.741	
B25- If the situation requires so, I effectively evacuate and save my important documents.		.601	
B27- I avoid walking through flood waters.		.522	
B28- I refrain from swimming through flood waters		.542	
B41- I check for loose boards and slippery floors when entering a flooded home or building.		.367	.520
B42- I turn off electricity at the main breaker or fuse box when entering a flooded building.		.405	.495
B47- I report downed power lines immediately to power companys' emergency number.			.736

Item	Factor1 (Before)	Factor2 (During)	Factor3 (After)
B48- I refrain from touching electrical equipment, if it is wet.			.352
B49- I refrain from touching an electrical equipment, while standing in water.			.618
B54- I immediately fix the septic tanks and the toilets damaged because of floods as soon as possible.			.535
B55- We make sure that our wells and drinking water is checked for contamination from bacteria and chemicals after flooding.			.451
B56- I clean everything that gets wet with the floods' water.			.570
B57- I disinfect everything that needs disinfection, if it gets wet during a flood.			.646
B58- I throw any food that gets wet by floods' water.		.372	.548
B59- I suggest ways to provide psychological support for those who need after floods.			.541

Confirmatory Factor Analysis Findings of the Behavioral Scale:

According to the T values obtained from the confirmatory factor analysis of this model of the behavior scale, no item needed to be extracted from the model. T values are shown in (figure 4.5).

Accoring to the load of the items on the factors shown in (Figure 4.3). no item is loading by less than 0.3, so no factor needs to be extracted from the model.

Statistics of goodness of fit obtained from the confirmatory factor analysis of the behavior scale revealed acceptable values of the indices $\chi 2$/sd, CFI, NNFI, IFI,

RMSEA, SMR, PNFI, PGFI. the fit indices for the three factor structure of the behaviour scale is shown in Table 4.10.

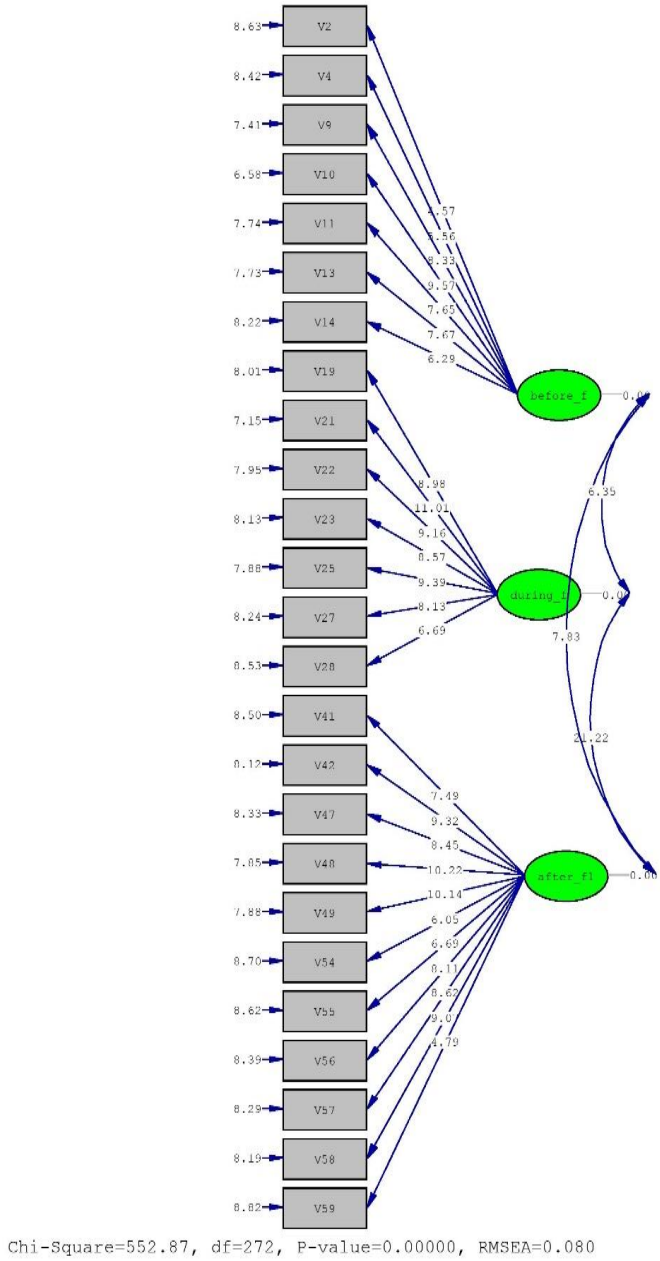


Figure 4. 5. T Values Obtained From The Confirmatory Factor Analysis of Behaviour Scale (Kassala, Sudan, January 2020)

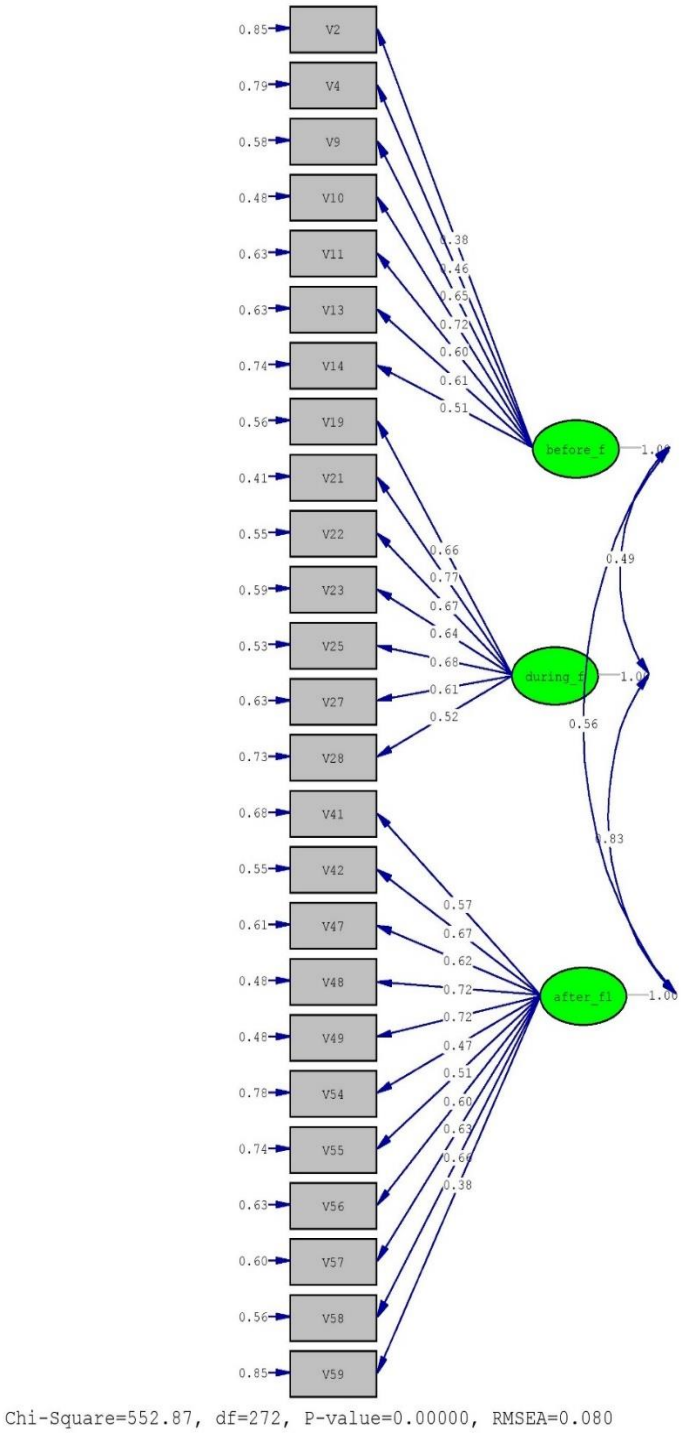


Figure 4. 6. The Factor Loadings of The Items Of The Behavior Scale (Kassala, Sudan, January 2020)

Table 4. 18. The Fit İndices for the Three Factor Structure of the Behavior Scale (Kassala, Sudan, January 2020)

Examined index	Perfect fit value	Acceptable fit value	Obtained value	Result
χ^2/df	$0 \leq \chi^2/df \leq 2$	$2 \leq \chi^2/df \leq 3$	2.033	Acceptable
CFI	$.95 \leq CFI \leq 1.00$	$.90 \leq CFI \leq .95$	0.93	Acceptable
IFI	$.95 \leq IFI \leq 1.00$	$90 \leq IFI \leq .95$	0.93	Acceptable
RMSEA	$.00 \leq RMSEA \leq .05$	$90 \leq IFI \leq .95$	0.08	Acceptable
SRMR	$00 \leq SRMR \leq .05$	$.05 \leq SRMR \leq .10$	0.082	Acceptable
PNFI	$95 \leq PNFI \leq 1.00$	$.50 \leq PNFI \leq .95$	0.80	Acceptable
PGFI	$95 \leq PGFI \leq 1.00$	$.50 \leq PGFI \leq .95$	0.66	Acceptable

Reliability Analyses of the Behavior Scale

Reliability analyses of the behavior scale namely Cronbach alpha, composite reliability and test retest reliability are shown in (Table 4.19).

Table 4. 19. Reliability Analyses Findings for the Behavior Scale (Kassala, Sudan, dates of data gathering)

Factor	Cronbach alpha	Composite reliability	Test retest reliability	Test re test reliability for the scale
Factor 1 (before)	0.800	0.767	0.671	0.633
Factor 2 (During)	0.811	0.838	0.593	
Factor 3 (after)	0.862	0.860	0.585	

Item Analysis for Behavior Scale

Analyses were carried out for differences of the means between the two groups of the highest and lowest 27.0% according to the total scores of the three subscales. The differences between the means of the two groups in the three subscales were found significant which support the efficiency and distinctiveness of the items. This is shown in details in (Table 4.19). While Table 4.19. shows the corrected total items correlations in every factor all of which were above 0.3 which supported the ability of distinction of the item. Cronbach alpha if item deleted were lower than the total subscale Cronbach alpha except for B28 which was higher only by 0.002. (Table 4.20.) also shows the mean score every item and its standard deviation and skewness.

Table 4. 20. The Mean Scores of the 27.0% High and Low Groups in Every Subscale of the Behaviour Scale and the P Value of the Difference (Kassala, Sudan, dates of January 2020)

Factor or subscale	Group	Mean score of the group	P value
Before flooding	Low score group	15.47	< 0.001
	High score group	31.76	
During flooding	Low score group	23.71	< 0.001
	High score group	34.74	
After flooding	Low score group	37.39	< 0.001
	High score group	54.25	

Table 4. 21. The Corrected Total Items Correlations, Cronbach Alpha if Item Deleted, Mean Score, Standard deviation and Skewness of the Items of the Scale (Kassala, Sudan, January 2020)

Factor	Item	Corrected total item correlation	Cronbach alpha if item deleted	Mean score of the item	Standard deviation	Skewness
Factor Before flooding	B2	0.463	0.786	2.92	1.335	0.245
	B4	0.440	0.790	3.25	1.458	-0.139
	B9	0.535	0.773	3.56	1.488	-0.496
	B10	0.563	0.770	3.83	1.357	-0.797
	B11	0.601	0.761	3.58	1.530	-0.593
	B13	0.587	0.764	3.04	1.512	-0.057
	B14	0.536	0.774	3.07	1.603	-0.016
Factor During flooding	B19	0.501	0.795	4.14	1.371	-1.334
	B21	0.620	0.773	4.26	1.201	-1.538
	B22	0.621	0.772	4.16	1.221	-1.361
	B23	0.613	0.777	4.43	1.067	-1.966
	B25	0.614	0.774	4.22	1.262	-1.481
	B27	0.491	0.795	4.27	1.194	-1.512
	B28	0.405	0.813	4.14	1.411	-1.413
Factor After flooding	B41	0.486	0.856	4.28	1.167	-1.536
	B42	0.485	0.855	4.37	1.177	-1.829
	B47	0.729	0.836	4.18	1.289	-1.304
	B48	0.681	0.841	4.45	1.122	-2.062
	B49	0.695	0.840	4.48	1.108	-2.115
	B54	0.490	0.855	3.95	1.279	-0.937
	B55	0.452	0.860	3.79	1.406	-0.816
	B56	0.515	0.853	4.41	1.072	-1.072
	B57	0.676	0.843	4.35	1.110	1.110
	B58	0.551	0.852	4.59	0.912	1.302
	B59	0.445	0.860	4.00	-2.373	-1.030

DISCUSSION

This study aimed to develop a scale to measure individual preparedness for floods, however during the course of the study it appeared that two scales were likely; a knowledge and a behaviour scale. So, we presented the psychometric properties of these scales. Discussion will be divided to discussion of the sociodemographic characteristics, Discussion of the construction of the knowledge scale, Discussion of the construction of the behaviour scale, Discussion of the psychometric properties of the two scales, and comparison with the previous scales.

Discussion of the socio- demographic characteristics of the sample

The samples of the validity and reliability (methodological) studies are recommended to be large enough and heterogenous (135, 142). The sample size was discussed in the methodology chapter, and the hetrogenity of the sample was reflected in the diversity and representation of different age-groups , gender, educational levels, marital status, presence of children, home ownership status, previous flood experience and the degree of vulnerability to it. It is important to collect data regarding these factors, because they influence both risk and preparedness to floods (170-172).

The distribution of age groups in the sample mimiced that shown in the population pyramid of Sudan (Fig. 3.1) with the same regressive nature, where young age was more prevalent than the elderly age. However, males were less than females in the sample by about 17.0%, which could have been due to the dominant female gender among the local residents who helped the researcher in data collection, and some of the times of data collection were when the men were at work. Despite this, the males were still well represented in the sample by more than 40.0%.

Most of the respondents were secondary school graduates (38.9%). This level represents the middle level in the educational ladder in Sudan between the literate without a certificate and the primary school graduate in a proximity and the university and higher education graduate in another proximity. The literacy rate is defined as the population aged 15 and above who are able to read and write. In Sudan literacy rate was estimated by 60.7%, (65.4% among males and 56.1% among females) (173, 174). In Kassala state, the literacy rate was thought to be below the country’s average, in addition to other developmental indicators. This made the place and the people living

there more vulnerable to floods. For example, the percentage of literate women whose age between 15-24 in Kassala was 48.4% compared to 59.8% of the nation, and the percentage of chronic moderate and severe malnutrition among children under 5 years of age was 48.8% compared to national value of 38.2%. However the percentage of children who completed the primary school and continued to the secondary school was high (89.5% in Kassala and 90.7% nationally) (175). The primary school enrolment in Sudan was estimated by 60.0% (61.0% in males and 59.0% in females) (174).

There was an approximately equal married to single ratio in the sample with nearly half of the sample reported having children. The mean number of children was four, with a standard deviation of two. This can be compared by the fertility rate in Sudan that was estimated by 4.3 according to the World Bank data (174). The minimum number of children in the sample was one and the maximum was ten. The mean number of household members was 6.9 with a standard deviation of 2.6. This can also be compared by the average household size in Kassala state that was estimated by 5.5 (176).

More than half of the respondents reported that they were not working with an income source at the time of data collection. This can also be reflected in the vocations reported by the respondents that about 30.0% of the respondents were housewives and 22.0% were students. Unemployment is defined as the share of labour force that is without work and seeks employment. In Sudan, it was estimated to be 19.8% (14.6% among males and 30.7% among females) according to World Bank data (174). The most commonly reported vocations among the respondents were: free work (no fixed job), teachers, workers, drivers, tea - coffee sellers, and other occupations accounted for about 11.0%. Most of these jobs are of low income. The mean income of respondents was about 3300 SDGs with a standard deviation of 2700 SDGs. The minimum reported income was 200 SDGs with a maximum of 20000 SDGs.

The sample was distributed between the seven neighbourhoods approximately evenly, with a percentage ranging from 16.5 at a maximum to 11.6 at a minimum. The neighbourhoods are divided by ethnic groups of Kassala; for example, Kadogli and Nour neighbourhoods are migrants to Kassala from western Sudan. Kadogli itself is the name of a big city in the west of Sudan. The rest of neighbourhoods are of the local ethnic groups of Kassala. Conflicts tend to occur between different neighbourhoods.

On the 8th of May 2020, there were conflicts between Kadogli and Mukram neighbourhoods inhabitants which resulted in eight deaths, 80 injuries and tens of burned houses.

Most of the respondents (66.0%) owned the houses they lived in, and 23.0% reported that they lived in rented houses. The rest of the respondents reported living in a slum or family house or reported other option without specification. The respondents tended to live their entire lives in Kassala. The mean duration of living in Kassala city was 26 years $\pm$ 11.22 although this depended on the age of the respondents. It can be compared by the mean age of the respondents, which was 30 years $\pm$ 11.6.

About 95.0% of the respondents reported a previous flooding experience, and 93.0% experienced the 2018 flood. However, the degree to which they were affected by these floods varied. The majority of the respondents reported flooding of their houses and financial losses (61.9%), while 32.0% reported that they were not directly affected by the floods and just witnessed them. Unfortunately, 2.5% reported that they lost one of their family members in a flood, and 4.0% reported an injury to themselves or to a family member.

A Chikungunya outbreak occurred in Kassala 3 months after the flooding event. Residents described the epidemic as so widespread that it left no one uninfected in Kassala city. All family members could get sick at the same time and no one could serve them during illness, as one of the most prominent features of the disease was joint pain and inability to walk. Chikungunya was mysterious and unlike malaria, is not an endemic disease in Sudan. No epidemic had been reported before in previous years and apart from some sporadic cases it did not recur up to now after 2018 (14). However, hemorrhagic fever epidemics have been reported in subsequent years, especially in 2019 after the rainy season and flood events in Kassala. Reports have shown an increase in number of mosquitoes that transmit hemorrhagic fever in Kassala state with a weak state capacity for vector control (16, 59). Therefore, the item pool of the scale included measuring the individual efforts of vector control. The percentage of the study participants who reported having Chikungunya fever during the October 2018 outbreak was 79.0%, and 88.0% reported that at least one of their household members had contracted the disease during the outbreak. The number of affected members in the household was compared with the total number of the household

members, as many respondents reported that 100.0% of the household members were affected by the disease during the outbreak. The mean percentage of the affected household members was 69.1%. As mentioned in the introduction, the outbreak has strained the already weak health system in Kassala. This made the activists launch Hashtag ‘Kassala is dying’.that prevailed on social networking sites in Sudan for some time.

Television was the most popular and common source of information about flooding among the respondents (51.5%). It was followed by the “neighbours” and the “family members” and the “radio” (47,4, 45.0% respectively). This was a result that is consistent with the rural nature of the community of the respondents. “Friends” constituted a source of information for 35.0% of the respondents followed by the “internet” 27.0% and that was consistent with the percentage of internet users in Sudan that accounted for 28.0% of the population according to the world fact book data (173).

Although Kassala’s risk of flooding is high due to flash floods, and /or flooding of Gash River, or other water courses, only 20 respondents (5.0%) reported having training related to disaster preparedness. Of these seven respondents had training on first aid, five respondents had their training on psychological support and coping strategies, while only two respondents had training on disaster preparedness and floods confrontation. Nine respondents) were trained by the Red Crescent organization. The Sudanese Red Crescent, with its branches in most of the states, is an active organization that responds to floods in Sudan. Other national organizations trained seven respondents, in addition to one repondent reported to be trained by the World Health Organization. Of the 20 respondents who had training, 13 reported having either a certificate of attendance or a diploma for the training. The mean number of training days were 14.

Thirty percent of the respondents reported feeling adequately prepared for previous floods. This percentage was closely similar to the 31.0% of those who witnessed previous floods without being affected by them in a previous question. On the other hand, the majority of the respondents (45.0%) reported being unsure about their preparedness status. In addition, 25.0% reported that they were not prepared for future floods. Regarding the willingness of the respondents to be trained on individual preparedness for floods, 88.0% of the respondents reported their willingness to be

trained, and 12.0% on the other hand reported unwillingness. No clear causes have been reported for most cases. The reported reasons were questioning the benefits and expressing disappointment.

Discussion of the resulting construction of the knowledge scale

As per the definition knowledge is an essential aspect of preparedness (177). This aspect was included in most of the previous scales including those which primarily measured attitudes. The scales of Adame et al and Inal et al included items adressing knowledge of the respondents (21, 22). Most of the scales that targeted nurses' disaster preparedness also included knowledge in one or more of the scales factors. For example the Chinese version of DPET (DPET-C) had three of the total five factors of the scale measuring knowledge (knowledge of self preparation in disaster, knowledge to respond in the workplace, and knowledge to respond in the community) (144). DPET- MC which was adapted in Mainland China, DPET-K which was adapted in Korea and the Iranian-DPT that was developed in Iran had one or more of their factors or components measuring Knowledge (143, 144, 147).

The item pool of the knowledge scale was reviewed by the experts. The CVI for the items was 1, except for the 7^{th} item it was 0.75 for which one of experts recommended deleting this item. The draft scale was applied to 412 respondents, who were then divided randomly into 210 and 202 for the explaratory and confirmatory factor analyses, respectively. The data were analyzable through factor analysis as per the KMO and the Bartlett's test, and the exploratory factor analysis revealed that the items are distributed in two factors after deleting item 7, which had the least CVI in the content validity analysis. Item 7 evaluated the respondents' knowledge of the water drainage plan on his or her house's street. Although this is difficult to know in sewered areas, it is easily known in unsewered areas that drain by ephemeral water courses such as in Sudan.

The two resulting factors were named as 1) general knowledge (of the time, impacts of floods and the community's local evacuation plan). 2) knowledge related to what shoud be done or practical knowledge (most of them start by How to: obtain information about occurrence of floods, prepare an evacuation plan, prepare an emergency kit, protect crops and agriculture, get help if trabbed, provide first aid and

get psychological support. In addition to knowing how to escape from the location, if the roads are blocked by knowing the escape routes). The two-factor structure was confirmed by the scree plot and the parallel analysis results, which is the gold standard technique for determining the number of factors (168).

All the items were loading on their factors by more than 0.3 and were not loading on to two items with a difference of less than 0.1. Item 9 primarily loaded on the second factor and the first factor with a difference of exactly 0.1. We kept this item in the scale because of the support it gained from the content validity, the confirmatory factor analysis and reliability analyses.

Discussion of the resulting construction of the behaviour scale

All the items of the behaviour scale had a CVI of 1 at the level of the content validity analysis. However, factor analyses helped to produce a summarized and focused scale by retaining 25 items structure out of the 59 item pool. At the same time, it is a comperhensive scale that includes the most important aspects of flood preparedness behaviour. The items according to their content were distributed in three factors: measures to be done before the onset of the flooding event, measures to be done during the flooding event, and measures to be done after the flooding event. The items which were not included by the factor analysis and were deleted from the scale are discussed in detail in the following paragraphs.

Regarding the first factor or subscale (measures to be done before the flood), the first item of the draft scale was not included. However, the essential meaning of this item was included in the included second item, as the aim of following up the means that can inform about the occurrence of floods is to receive an early warning. In the same regard, those who follow up the level of rain in the upstream area most probably follow it up the level of rain in the area they live in as well, so the first can be more inclusive.

Among the items which were not retained were the items related to choosing the place of living according to its safety during floods, choosing the water-resistant and resilient building constituents, taking the measures that ensure the drainage of water from the house, and elevating the electrical machines, tend to be items adressing long-term preventive and mitigative measures compared to the included items that are more

related to preparedness measures. These included items adress preparing an evacuation plan including a special plan for evacuating vulnerable populations, practicing the plan with the family to test its effectiveness, and preparing the emergency kit. The scale did not include the item that is related to speaking with the family about prepareness, which can be implicitly included in practicing the evacuation plan with the family. Discussing preparedness with the close community and participating in the community activities were not included in the scale. The items that include activities which are not generally practiced by the community such as insurance and preparing safe place for the animals were not discriminating items and were excluded by the exploratory factor analysis.

Regarding the second factor (measures to be taken during flooding), the item that include taking the decision to evacuate if the respondent felt that the building would collapse was included. Grabbing the emergency kit if it was prepared is something related to the consideration of the emergency situations if it is safely possible to grab it, this can be done. This item was not included in the scale. The items that included carrying out evacuation effectively and saving oneself, family, and important documents were included in the scale, and they constitute the most important items to be saved by evacuation. Items that included avoiding walking and swimming through floodwaters were also included.

All the items related to cars and driving were excluded by the factor analysis, as most of the respondents stated that these items were not applicable to them, either they cannot drive or they did not have cars. The option (not applied to me) was found to improve the validity of the scales, as it enables them to measure what they are actually supposed to measure.

Regarding the third factor (measures to be taken after floods), all items related to the communicable disease control were excluded. Namely, the items related to finding access to safe drinking water and sanitary latrines immediately after floods and measures to be taken if they were not found, in addition to items related to applying anti-vector and anti- rodent measures. Although these items were beneficial, deleting them provided a brief scale concentrated on the issue of preparedness rather than disease or epidemic prevention and control. It is worth mentioning that one item related to clean water (that is making sure that wells and drinking water are checked

for absence of contamination), and one item related to latrines (that is the immediate fixing of the damaged latrines and septic tanks) were included in the scale.

Items related to the most common causes of death due to floods in Sudan, collapsed buildings and electrocusion were included (15). Those related to cleanup of debris and wearing personal protective measures were excluded. However, items about cleaning every thing that gets wet by flooding water and disinfecting what needs disinfection were included. The final item related to suggesting ways to provide psychological support was included in the final version of the behaviour scale, in consistency with the knowledge scale.

The knowledge and the behaviour generally included the three most important aspects of disaster preparedness definded by the American Red Cross (get a kit, make a plan, and stay informed) (21, 178).

Discussion of the psychometric properties of the two scales

This study aimed to provide valid and reliable scales for measuring the self-perception of knowledge and behaviour of individuals regarding flood preparedness. The KMO of the exploratory factor analysis for both were more than 0.6 and the Bartlett's tests were highly significant whivh means that the data is eligible for factor analysis (168). The 12 items structure of the knowledge scale and the 25 items structure of the behaviour scale explained 46.6% and 41.0% of the total variances respectively. These percentages are greater than 30.0%, which is considered acceptable (179, 180).

Confirmatory factor analysis CFA confirmed the construct obtained from the exploratory factor analysis with all the items were loading on their factors by more than 0.3 which is the limit of acceptable loading (168, 181). All the t values obtained from the confirmatory factor analysis were more than 2.58, indicating significance at 0.01 level. The presented fit indices obtained from confirmatory factor analysis were also within the acceptable limits (182-184). RMSEA did not exceed the maximum of 0.1 put by Browne et al for employing a model in confirmatory factor analysis (185).

Regarding the reliability, Cronbach's alpha is a coefficient that indicates the average correlation between the items in the subscale, indicateing internal consistency. Cronbach's alpha is sensitive to the number of items, and tends to increase as the

number of items increases. Values of Cronbach's alpha of the subscales were close to or greater than 0.7, which indicate acceptable internal consistency (168, 186). Values of Cronbach alpha if an item was deleted were less than the total cronbach's alpha of the subscale, thus no item was considered for deletion. Values of corrected total item correlation for all the items were more than 0.3, which indicates that the items of the subscale have acceptable power of discrimination. Test retest correlation coefficient was average to strong (187). Items of the two scales had good discriminatory power as per the corrected total item correlation, and the test of significance of the comparisons between the mean scores of the upper and lower 27.0% subgroups.

Comparison of the scales with the Previous Scales and Studies:

The retained items on both scales included information that should be known in Sudan and similar settings to decrease the impacts of floods. Twelve out of 13 items were retained on the knowledge scale, with one item deleted. On the other hand, 25 out of 59 items retained in the behaviour scale, with 34 items deleted.

The Knowledge scale included items related to knowing the risks of floods, such as drowning and falling, and diseases that occur as a result of floods, such as malaria and hemorrhagic fevers. Information relevant to this was also included in PPDTS the scale, which included knowledge about the impact of relevant disasters on the respondent (161). Another included item was related to the time of occurrence of floods, which is essential information in Sudan and other similar settings. It is from July to September in Sudan, and the risk is zero to minimal in the other months of the year (7). The fifth retained item was related to community's local evacuation plan to the highest-reachable area, such as a mountain; this was also included in the DPI scale (160). Another retained item was items related to knowing how to get help when trapped in water and keeping the emergency contact numbers were included in four other scales: DPI, ERI, PPDTS, and VIFPS (21, 157, 160, 161).

The tenth retained item of the knowledge scale was related to knowing the right ways to protect crops during floods, which can be part of individual preparedness in agricultural areas. Fadul et al. conducted a study in Kassala Sudan to evaluate measures to cope with uncertain high- and low-water supplies, including floods. They found that preparedness was one of the most effective measures. There are measures

that should be taken by farmers before flooding, such as land preparation and making small earth bunds. Measures to be taken during floods include digging small ditches to distribute the water. And measures to be done after floods include increasing the seeding rate for fodder production and double tillage (118).

The final knowledge scale covered the three most important aspects of individual preparedness: getting a kit, making a plan, and staying informed, which are part of the all-hazards approach of disaster preparedness (163, 178). These item topics were among the most shared item topics in the previous scales, for instance, plan of evacuation was included in seven previous scales [DPI (160), EPS (154), ERI (157), ERS (155), GDPB (22), HDPI (162), and VIFPS (21)], staying informed was included in seven previous scales [DPI, EPS, ERI, ERS, HDPI, PPDTS (161), and VIFPS], and having a kit was included in five previous scales (DPI, ERI, GDPB, HDPI, and VIFPS). The retained items also included an item related to first aid, which was included in five previous scales: (EPS, ERI, ERS, GDPB, and VIFPS), and an item related to psychological support was also included in the GDPB scale (22).

Regarding the behaviour scale, the topics of most of the included items were also included in the items of previous general disaster or earthquake preparedness measuring scales or the sole attitude measuring flood preparedness scale (VIFPS). The first item's topic was receiving early warning messages. This topic was also included in four previously published scales. They are DPI (160), HDPI (162), PPDTS (161), and VIFPS (21). The second item is related to following up the level of rain in the upstream area of a river which was found effective in Kassala in 2007 floods (11). Items related to turning off valves of electricity, water, and gas were included in three previous scales DPI (160), EPS (154), and ERI (157). Items related to loose boarders, collapse of building and powerlines and power poles which were retained are of special importance in Sudan as most of the deaths of floods in Sudan are related to them (48). The number of damaged septic tanks or latrines is an important indicator in reporting the magnitude of flooding in Sudan (188). An item related to this was retained on the behaviour scale. An item related to psychological support was retained on the behaviour scale, which is consistent with the knowledge scale and GDPB scale (22). Items of the knowledge and behaviour scales are consistent in contents and can complement each other. The included or retained items were found to be specific and

inclusive of the most important items regarding flood preparedness. These included items were also consistent with the items recommended in all hazard approaches of disaster preparedness, as they include the triad of: having a kit, preparing a plan, and staying informed (163, 178). They are also consistent to top hazard approach of disaster management being specific to floods (164).

Interpretation of the of the scores

Knowledge scale consisted of 12 items. To simplify and improve the utility of the scale, all the items were given the same weight. In the five-point scale measuring the self-perception of knowledge, and ranging from “I have complete information about that” that scores 5, “I have incomplete but good information” that scores 4. “I have moderate amount of information” that scores 3, “I have minimal information” that scores 2, and “I do not have any information” that scores 1. The scores vary between 60 which is the highest score of the scale and indicates high knowledge or high perception of knowledge regarding flooding preparedness and 12 which is the lowest score of the scale and indicates low knowledge or low perception of knowledge.

The behaviour scale consisted of 25 items. Similar to the knowledge scale, all the items were assigned the same weight. In the five-point scale measuring behaviour of flooding preparedness and ranging from “I always do that” that scores 5, “Most of the time” that scores 4, “Sometimes” that scores 3, “Rarely” that scores 2 and “Never” that scores 1. The scores vary between 125, which is the highest score of the scale and indicates excellent preparedness behviour regarding flooding preparedness, and 25, which is the lowest score of the scale and indicates poor preparedness behviour.

The option ‘not applicable to me’ was an option put in the behaviour scale during the validation study and was agreed upon by the experts. Putting such an option increases the validity of the scale to measure what it is actually supposed to measure. This option was analysed as missing and most of the responses of that option were the items related to cars or vehicle driving, which were already removed by the Exploratory Factor Analysis EFA. Thus, the final version of the scale does not need to include this option, as all its items are applicable to every adult individual.

Study Limitations

The study has a limititation of not being able to carry out criterion validity, because there are no previous scales in the literature that measure knowledge and behaviour of flood preparedness to carry out the comparison. Another limitation is the inability to help the study population in a way other than provding information and leaflets about floods preparedness after data collection.

Study Strenghth

Although these two scales were designed for the low-income countries, the final versions of the scales are flexible and can be used in different settings. They can be used directly in all Arabic-speaking countries and can be adapted to other settings. The items of the scales can be used to develop other scales and measurement tools. Evaluation of knowledge and behaviour is essential in measuring preparedness and in providing topic-oriented knowledge and skills, stressing the points of least knowledge and poor behviour in awareness campaigns and in the evaluation of the outputs of these campaigns. These scales showed acceptable levels of validity and reliability and can be used or adapted for different settings.

CONCLUSION & RECOMMENDATIONS

Conclusions

- Two scales were designed to measure knowledge and behaviours regarding the flooding preparedness of the individuals.
- The knowledge scale consists of 2 factors or subscales named as: 1) General knowledge (4 items), 2) Knowledge related to practice (How to do)s (8 items)
- The behaviour scale consists of 3 factors named as: 1) measures to be taken before flooding (7 items), 2) measures to be taken during flooding (7 items), 3) measures to be taken after flooding (11 items)
- The results support the hypothesis that the two scales are instruments that produce valid and reliable measures that can be used for measuring individual's knowledge and behavior regarding flood preparedness in Kassala, Sudan.
- The maximum score that can be obtained from the flood preparedness knowledge scale is 60 which indicates perfect knowledge regarding individual flood preparedness. The minimum score that can be obtained is 12 which indicates poor knowledge. The higher the score the better the preparedness
- The maximum score that can be obtained from the flood preparedness behaviour scale is 125 which indicates perfect behaviour regarding individual flood preparedness. The minimum score that can be obtained is 25 which indicates poor behaviour. The higher the score the better the preparedness
- These scales will help in measuring flooding preparedness in a quantitative comparable way. They can be used by individuals to measure their own preparedness knowledge and behaviour, as well as by researchers in surveys conducted to evaluate flood preparedness. They can also be used to evaluate the outcomes of the training programs if applied before and after them. In addition they can help in directing awareness campaigns towards areas of poor knowledge and behaviour and can serve as tools for evaluating these campaigns. These scales can improve (through evaluation) the decisions that can be made for flood preparedness.

Recommendations

- The developed knowledge and behaviour scales are recommended tools to measure the individual preparedness to floods in Kassala and similar Arabic speaking settings.
- They can also be adapted for measuring individual flood preparedness in settings of different languages.
- Further validation studies in different settings other than Kassala, Sudan may be done in future studies to empower the evidence of the validity and reliablity of the scales.
- Items of the scales can be beneficial in designing national guidelines for individual flood preparedness in Sudan.
- The same scales can be validated among illiterate groups using interview and inter-observer reliability tools.
- Illiterate groups are very important to be included in studies that evaluate the preparedness.
- Working among tribal gender sensitive communities need special considerations for the safety of the research team. Opinions of the local people and experiences from the previous researches are recommended to be considered.
- More scales regarding flood preparedness are recommended to be deloped considering different aspects in different settings.

REFERENCES

1. Antosia RE, Cahill JD. Handbook of bioterrorism and disaster medicine: Springer; 2006.
2. World Health Organization. Floods [Internet]. 2021 [Access date: 11 December 2021]. Available from: https://www.who.int/health-topics/floods#tab=tab_1.
3. Centre for Research on Epidemiology of Disasters CRED. Guidelines [Internet]. 2014 [Access date: 11 December 2021]. Available from: https://www.emdat.be/guidelines.
4. Berz G, Kron W, Loster T, Rauch E, Schimetschek J, Schmieder J, et al. World map of natural hazards–a global view of the distribution and intensity of significant exposures. Natural hazards. 2001;23(2):443-65.
5. Jonkman SN. Global perspectives on loss of human life caused by floods. Natural hazards. 2005;34(2):151-75.
6. Alderman K, Turner LR, Tong S. Floods and human health: a systematic review. Environment international. 2012;47:37-47.
7. United Nations Office for the Coordination of Humanitarian Affairs (OCHA). All Sudan Disasters [Internet]. 2021 [Access date: 18 December 2021]. Available from: https://reliefweb.int/disasters?advanced-search=%28C220%29.
8. International Federation of Red Cross and Red Crescent. Sudan: 2020 Floods [Internet]. 2021 [Access date: 20 December 2021]. Available from: https://www.ifrc.org/emergency/sudan-2020-floods.
9. United Nations Office for the Coordination of Humanitarian Affairs (OCHA). Sudan: Floods - Jul 2020 [Internet]. 2021 [Access date: 22 December 2021]. Available from: https://reliefweb.int/disaster/fl-2020-000176-sdn.
10. International Federation of Red Cross and Red Crescent. Sudan: Floods in Kassala state [Internet]. 2005 [Access date: 11 December 2018]. Available from:. Available from: http://www.ifrc.org/docs/appeals/03/1903fr.pdf.
11. Bashir K. Gash river flash floods challenges to Kassala town: mitigation and risk management. Associate Professor, UNESCO Chair in Water Resource. 2007.
12. United Nations Office for the Coordination of Humanitarian Affairs (OCHA). Sudan: Floods - Jul 2018 [Internet]. November 2018 [Access date: 23 December 2021]. Available from: https://reliefweb.int/disaster/fl-2018-000128-sdn.
13. International Federation of Red Cross and Red Crescent. Emergency plan of action Sudan floods 2018 [Internet]. 2018 [Access date: 02 December 2018]. Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/MDRSD026do.pdf.
14. World Health Organization. Disease Outbreak News Chikungunya – Sudan October 2018 [Internet]. 218 [Access date: 08 December 2018]. Available from: https://www.who.int/emergencies/disease-outbreak-news/item/15-october-2018-chikungunya-sudan-en.
15. International Federation of Red Cross and Red Crescent. Sudan Floods 2019 [Internet]. 2019 [Access date: 24 December 2021]. Available from: https://go.ifrc.org/emergencies/3728.
16. United Nations Office for the Coordination of Humanitarian Affairs (OCHA). Sudan: Dengue Fever Outbreak 2019 [Internet]. 2020 [Access date: 22 December 2021]. Available from: https://reliefweb.int/disaster/ep-2019-000155-sdn.

17. U.S. Department of homeland security FEMA. Floods [Internet]. 2021 [Access date: 12 December 2021]. Available from: https://www.ready.gov/floods.
18. Paton D. Disaster preparedness: a social-cognitive perspective. Disaster Prevention and Management: An International Journal. 2003 Aug 1;12(3):210-6
19. Ejeta LT, Ardalan A, Paton D. Application of behavioral theories to disaster and emergency health preparedness: A systematic review. PLoS currents. 2015;7.
20. Ejeta LT, Ardalan A, Paton D, Yaseri M. Predictors of community preparedness for flood in Dire-Dawa town, Eastern Ethiopia: Applying adapted version of Health Belief Model. International Journal of Disaster Risk Reduction. 2016;19:341-54.
21. Adame B, Miller CH. Vested interest: developing scales for assessing flooding preparedness. Disaster Prevention and Management. 2016 Jun 6;25(3):282-97
22. Inal E, Altintas KH, Dogan N. The development of a general disaster preparedness belief scale using the health belief model as a theoretical framework. International Journal of Assessment Tools in Education. 2018;5(1):146-58.
23. Keim ME. The epidemiology of extreme weather event disasters (1969-2018). Prehospital and disaster medicine. 2020;35(3):267-71.
24. Centre for Research on Epidemiology of Disasters CRED. Disasters 2018: year in Review [Internet]. 2019 [Access date: 27 December 2021]. Available from: https://www.cred.be/publications?page=1.
25. Centre for Research on Epidemiology of Disasters CRED. Natural disasters 2019 [Internet]. 2020 [Access date: 27 December 2021]. Available from: https://www.cred.be/publications?page=1.
26. Centre for Research on Epidemiology of Disasters CRED. Disaster 1 Year in Review 2020 [Internet]. 2021 [Access date: 27 December 2021]. Available from: https://www.cred.be/publications.
27. University of Colorado Dartmouth Flood Observatory. Space-based Measurement, Mapping, and Modeling of Surface Water [Internet]. 2012 [Access date: 14 January 2024]. Available from: https://floodobservatory.colorado.edu/.
28. United Nations Office for Disaster Risk Reduction UNDRR. Understanding Disaster Risk [Internet]. 2022 [Access date: 02 January 2022]. Available from: https://www.preventionweb.net/understanding-disaster-risk.
29. Jun Rentschler MS. People in Harm's Way Flood Exposure and Poverty in 189 Countries [Internet]. 2020 [Access date: 30 December 2021]. Available from: https://documents1.worldbank.org/curated/en/669141603288540994/pdf/People-in-Harms-Way-Flood-Exposure-and-Poverty-in-189-Countries.pdf
30. Hardy JT. Climate change: causes, effects, and solutions. New York: John Wiley & Sons; 2003.
31. Haines A, Patz JA. Health effects of climate change. JAMA. 2004;291(1):99-103.
32. Rocque RJ, Beaudoin C, Ndjaboue R, Cameron L, Poirier-Bergeron L, Poulin-Rheault R-A, et al. Health effects of climate change: an overview of systematic reviews. BMJ open. 2021;11(6):e046333.
33. Choudhary MP, Chauhan GS, Kushwah YK, editors. Environmental degradation: causes, impacts and mitigation. National Seminar on Recent Advancements in Protection of Environment and Its Management Issues (NSRAPEM-2015); 2015.
34. Boussalis C. Political, economic and social determinants of vulnerability to natural disasters: Doctoral dissertation, The Claremont Graduate University; 2011.

35. Bhattacharjee K, Behera B. Determinants of household vulnerability and adaptation to floods: Empirical evidence from the Indian State of West Bengal. International journal of disaster risk reduction. 2018;31:758-69.
36. Rubin O, Rossing T. National and Local Vulnerability to Climate-Related Disasters in Latin America: The Role of Social Asset-Based Adaptation. Bulletin of Latin American Research. 2012;31(1):19-35.
37. Murray N. Urban disaster risk governance: A systematic review [Internet]. 2020 [Access date: 05 January 2022]. Available from: https://eppi.ioe.ac.uk/CMS/Portals/0/PDF%20reviews%20and%20summaries/Urban%20disaster%20risk%202017%20Murray%20report.pdf
38. Organisation for Economic Co-operation and Development OECD. Investments in Weak Governance Zones [Internet]. 2005 [Access date: 07 January 2022]. Available from: https://www.oecd.org/corporate/mne/35397593.pdf.
39. Menne B, Murray V, Organization WH. Floods in the WHO European Region. health effects and their prevention. Copenhagen: WHO European Region office; 2013.
40. World Bank Group. Sudan Current Climate Climatology [Internet]. 2021 [Access date: 08 January 2022]. Available from: https://climateknowledgeportal.worldbank.org/country/sudan/climate-data-historical
41. Mohmmed A, Li J, Elaru J, Elbashier MM, Keesstra S, Artemi C, et al. Assessing drought vulnerability and adaptation among farmers in Gadaref region, Eastern Sudan. Land use policy. 2018;70:402-13.
42. Zakieldeen S, Elhassan N. Climate Change Impacts, Vulnerability and Adaptation in Sudan. Sudan Academy of Sciences Journal. 2015;11:217-33.
43. Zakieldeen SA. Adaptation to climate change: A vulnerability assessment for Sudan. Gatekeeper series/International Institute for Environment and Development, Sustainable Agriculture and Rural Livelihoods Programme; 142. 2009.
44. Saad SA, Seedahmed AM, Ahmed A, Ossman SA, Eldoma AM. Combating desertification in Sudan: experiences and lessons learned. Outlook. 2018:10.
45. Mohamed NAH, Bannari A, Fadul HM, Zakieldeen S. Ecological zones degradation analysis in central Sudan during a half century using remote sensing and GIS. Advances in remote sensing. 2016;5(4):355-71.
46. Hamid Faki, Eltahir Mohamed Nur, Abdelaziz Abdelfattah, Aden A Aw-Hassan. Poverty Assessment Northern Sudan. Syria: ICARDA; 2012. 62p.
47. Mahmood MI, Elagib NA, Horn F, Saad SA. Lessons learned from Khartoum flash flood impacts: An integrated assessment. Science of the Total Environment. 2017;601:1031-45.
48. United Nations Office for Coordination of Humanitarian Affairs. Sudan Situation Report [Internet]. 2019 [Access date: 12 January 2022]. Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/Situation%20Report%20-%20Sudan%20-%203%20Oct%202019%20%281%29_0.pdf.
49. Davies H, Walsh R. Historical changes in the flood hazard at Khartoum, Sudan: lessons and warnings for the future. Singapore Journal of Tropical Geography. 1997;18(2):123-40.
50. Savage P. The crisis of governance and the challenge to peace in Sudan: United Kingdom: Christian Aid; 2003.

51. Bashier Abbas, H. and K. Routray, J. (2014), "Vulnerability to flood-induced public health risks in Sudan", Disaster Prevention and Management, Vol. 23 No. 4, pp. 395-419.
52. Du W, FitzGerald GJ, Clark M, Hou X-Y. Health impacts of floods. Prehospital and disaster medicine. 2010;25(3):265-72.
53. Saulnier DD, Ribacke KB, von Schreeb J. No calm after the storm: a systematic review of human health following flood and storm disasters. Prehospital and disaster medicine. 2017;32(5):568-79.
54. Di Baldassarre G, Montanari A, Lins H, Koutsoyiannis D, Brandimarte L, Blöschl G. Flood fatalities in Africa: from diagnosis to mitigation. Geophysical Research Letters. 2010;37(22).
55. Ahern M, Kovats RS, Wilkinson P, Few R, Matthies F. Global health impacts of floods: epidemiologic evidence. Epidemiologic reviews. 2005;27(1):36-46.
56. Centers for Disease Control and Prevention (CDC. Morbidity surveillance following the Midwest flood--Missouri, 1993. MMWR. Morbidity and mortality weekly report. 1993 Oct 22;42(41):797-8.56.
57. Centers for Disease Control and Prevention. Carbon monoxide poisoning from hurricane-associated use of portable generators--Florida, 2004. MMWR: Morbidity and mortality weekly report. 2005;54(28):697-700.
58. Coalson JE, Anderson EJ, Santos EM, Madera Garcia V, Romine JK, Luzingu JK, et al. The Complex Epidemiological Relationship between Flooding Events and Human Outbreaks of Mosquito-Borne Diseases: A Scoping Review. Environmental health perspectives. 2021;129(9):096002.
59. Hussien HH. Epidemiological Descriptive Analysis of Disease Outbreaks in 2019 in Sudan. Open Journal of Epidemiology. 2020;10(04):419.
60. Centers for Disease Control (CDC. Health assessment of the population affected by flood conditions--Khartoum, Sudan. MMWR. Morbidity and mortality weekly report. 1989 Jan 6;37(51-52):785-8.
61. Elsanousi YEA, Elmahi AS, Pereira I, Debacker M. Impact of the 2013 floods on the incidence of malaria in Almanagil locality, Gezira State, Sudan. PLoS currents. 2018;10.
62. Sideeq K, Jan R, Rather H, Bhat F, Khan SS, Qurieshi MA, Rafiq M. Impact on health care delivery system due to the worst flood of the century in Kashmir, India: an observational analysis. Journal Of Evolution of Medical And Dental Sciences-Jemds. 2014 Dec 15;3(70):15022-5.
63. Global Facility for Disaster Reduction and Recovery TWB, United Nations, Emergency operation centre. Sudan Rapid Post Disaster Needs and Recovery Assessment Sudan [Internet]. 2021 [Access date: 26 January 2022]. Available from: https://www.gfdrr.org/sites/default/files/Sudan_RPDNRA-English_HighRes.pdf.
64. Zhong S, Yang L, Toloo S, Wang Z, Tong S, Sun X, et al. The long-term physical and psychological health impacts of flooding: a systematic mapping. Science of the total environment. 2018;626:165-94.
65. Chen L, Liu A. The incidence of posttraumatic stress disorder after floods: a meta-analysis. Disaster medicine and public health preparedness. 2015;9(3):329-33.
66. Bich TH, Quang LN, Thanh Ha LT, Duc Hanh TT, Guha-Sapir D. Impacts of flood on health: epidemiologic evidence from Hanoi, Vietnam. Global health action. 2011;4(1):6356.

67. Ng J, Thorpe J, Walton C, Atkin S, Kilpatrick E. The effect of extensive flooding in Hull on the glycaemic control of diabetes patients: P239. Diabetic Medicine. 2010;27.

68. Sharma AJ, Weiss EC, Young SL, Stephens K, Ratard R, Straif-Bourgeois S, et al. Chronic disease and related conditions at emergency treatment facilities in the New Orleans area after Hurricane Katrina. Disaster medicine and public health preparedness. 2008;2(1):27-32.
69. Rodriguez-Llanes JM, Ranjan-Dash S, Degomme O, Mukhopadhyay A, Guha-Sapir D. Child malnutrition and recurrent flooding in rural eastern India: a community-based survey. BMJ open. 2011;1(2):e000109.
70. Muttarak R, Dimitrova A. Climate change and seasonal floods: potential long-term nutritional consequences for children in Kerala, India. BMJ global health. 2019;4(2):e001215.
71. Tong VT, Zotti ME, Hsia J. Impact of the Red River catastrophic flood on women giving birth in North Dakota, 1994–2000. Maternal and child health journal. 2011;15(3):281-8.
72. Sanguanklin N, McFarlin BL, Park CG, Giurgescu C, Finnegan L, White-Traut R, et al. Effects of the 2011 flood in Thailand on birth outcomes and perceived social support. Journal of Obstetric, Gynecologic & Neonatal Nursing. 2014;43(4):435-44.
73. Wieslander G, Norbäck D, Venge P. Changes of symptoms, tear film stability and eosinophilic cationic protein in nasal lavage fluid after re-exposure to a damp office building with a history of flooding. Indoor Air. 2007;17(1):19-27.
74. Wimalasena NN, Chang-Richards A, Wang KI-K, Dirks KN. Housing Risk Factors Associated with Respiratory Disease: A Systematic Review. International Journal of Environmental Research and Public Health. 2021;18(6):2815.
75. Pekkanen J, Hyvärinen A, Haverinen-Shaughnessy U, Korppi M, Putus T, Nevalainen A. Moisture damage and childhood asthma: a population-based incident case–control study. European Respiratory Journal. 2007;29(3):509-15.
76. Guo Y, Wu Y, Wen B, Huang W, Ju K, Gao Y, et al. Floods in China, COVID-19, and climate change. The Lancet Planetary Health. 2020;4(10):e443-e4.
77. Mahanta R, Das D. Flood induced vulnerability to poverty: evidence from Brahmaputra Valley, Assam, India. International journal of disaster risk reduction. 2017;24:451-61.
78. Bui AT, Dungey M, Nguyen CV, Pham TP. The impact of natural disasters on household income, expenditure, poverty and inequality: evidence from Vietnam. Applied Economics. 2014;46(15):1751-66.
79. Cappelli F, Costantini V, Consoli D. The trap of climate change-induced "natural" disasters and inequality. Global Environmental Change. 2021;70:102329.
80. Alexander D. From civil defence to civil protection–and back again. Disaster Prevention and Management: An International Journal. 2002 Aug 1;11(3):209-13.80.
81. Rajabi E, Bazyar J, Delshad V, Khankeh HR. The evolution of disaster risk management: historical approach. Disaster medicine and public health preparedness. 2021:1-5.
82. UNISDR, Sendai framework for disaster risk reduction 2015–2030. Switherland: UNISDR; 2015.

83. Vanneuville W, Kellens W, De Maeyer P, Reniers G, Witlox F. Is “flood risk management” identical to “flood disaster management”. Earthzine. 2011;8.
84. Asghar S, Alahakoon D, Churilov L. A comprehensive conceptual model for disaster management. Journal of Humanitarian Assistance. 2006;1360(0222):1-15.
85. Nojavan M, Salehi E, Omidvar B. Conceptual change of disaster management models: A thematic analysis. Jàmbá: Journal of Disaster Risk Studies. 2018;10(1):1-11.
86. Khan H, Vasilescu LG, Khan A. Disaster management cycle-a theoretical approach. Journal of Management and Marketing. 2008;6(1):43-50.
87. Coetzee C, Van Niekerk D. Tracking the evolution of the disaster management cycle: A general system theory approach. Jàmbá: Journal of Disaster Risk Studies. 2012;4(1):1-9.
88. Sawalha IH. A contemporary perspective on the disaster management cycle. foresight. 2020 Aug 25;22(4):469-82.
89. Rana IA, Asim M, Aslam AB, Jamshed A. Disaster management cycle and its application for flood risk reduction in urban areas of Pakistan. Urban Climate. 2021;38:100893.
90. Bosher L, Chmutina K, van Niekerk D. Stop going around in circles: towards a reconceptualisation of disaster risk management phases. Disaster Prevention and Management: An International Journal. 2021 Oct 25;30(4/5):525-37.90.
91. Chmutina K, Von Meding J. A dilemma of language:“Natural disasters” in academic literature. International Journal of Disaster Risk Science. 2019;10(3):283-92.
92. Wright DB. Methods in flood hazard and risk assessment. New York: World Bank; 2015. Report No. 100086.
93. Bosher L, Chmutina K. Disaster risk reduction for the built environment. New York: John Wiley & Sons; 2017.
94. UNISDR. Words into Action Guidelines: National Disaster Risk Assessment. The United Nations Office for Disaster Risk Reduction Geneva, Switzerland; 2017.
95. Ali E, Zeinelabdein KAE, Rahamtallah KA. Flash floods risk assessment of Sharg Alneel area, Khartoum State, Sudan using remote sensing, GIS and geophysical techniques. AlNeelain J Geosci (AJGS) ISSN. 2017;7801(1):1.
96. Colombo A, Hervás J, Vetere Arellano AL. NEDIES Project: Guidelines on flash flood prevention and mitigation. Italy: European Commission Joint Research Centre (JRC); 2002. Report No. EUR 20386 EN.
97. Allen Institute for Artificial Intelligence. Best Practices on flood prevention, protection and mitigation. [Internet] 2003. [Access date: 21 January 2024] available from: https://iwhw.boku.ac.at/LVA816343/Background_Material_2022/flooding_mitigation_prevention_EU_bestpractice_document_water_Directors_2003.pdf.
98. Subia EGS, Jocson EJC, Florencondia ENT. Flood prevention and mitigation initiatives towards a flood-free city. American Academic Scientific Research Journal for Engineering, Technology, and Sciences. 2019;58(1):215-24.
99. United Nations Spider Knowledge Portal. Early Warning Systems [Internet]. 2022 [Access date: 3 June 2022]. Available from: https://www.un-spider.org/risks-and-disasters/early-warning-systems#no-back

100. Christoph A, Dilek ÖA, Joachim K, Sérgio F. Future-oriented activities as a concept for improved disaster risk management. Disaster Advances. 2013;6(12):1-10.
101. Shoyama K, Cui Q, Hanashima M, Sano H, Usuda Y. Emergency flood detection using multiple information sources: Integrated analysis of natural hazard monitoring and social media data. Science of the total environment. 2021;767:144371.
102. United Nations Disaster Risk Reduction (UNDRR). Terminology [Internet]. 2022 [Access date: 3 June 2022]. Available from: https://www.undrr.org/terminology.
103. United Nations. Key Elements of Flood Disaster Management [Internet]. 2000 [Access date: 6 June 2022]. Available from: https://www.un.org/esa/sustdev/publications/flood_guidelines_sec02.pdf
104. Tingsanchali T. Urban flood disaster management. Procedia engineering. 2012;32:25-37.
105. Poussin JK, Botzen WW, Aerts JC. Effectiveness of flood damage mitigation measures: Empirical evidence from French flood disasters. Global Environmental Change. 2015;31:74-84.
106. Shih S-S, Kuo P-H, Lai J-S. A nonstructural flood prevention measure for mitigating urban inundation impacts along with river flooding effects. Journal of environmental management. 2019;251:109553.
107. Islam R, Kamaruddin R, Ahmad SA, Jan S, Anuar AR. A review on mechanism of flood disaster management in Asia. International Review of Management and Marketing. 2016;6(1):29-52.
108. Madan A, Routray JK. Institutional framework for preparedness and response of disaster management institutions from national to local level in India with focus on Delhi. International Journal of Disaster Risk Reduction. 2015;14:545-55.
109. Keim ME. Building human resilience: the role of public health preparedness and response as an adaptation to climate change. American journal of preventive medicine. 2008;35(5):508-16.
110. Hudson P, Botzen W, Poussin J, Aerts JC. Impacts of flooding and flood preparedness on subjective well-being: A monetisation of the tangible and intangible impacts. Journal of Happiness Studies. 2019;20(2):665-82.
111. Girons Lopez M, Di Baldassarre G, Seibert J. Impact of social preparedness on flood early warning systems. Water Resources Research. 2017;53(1):522-34.
112. United States Department of Homeland Security (FEMA). How to prepare for a flood [Internet]. 2018 [Access date: 25 October 2018]. Available from: https://www.fema.gov/media-library-data/1409002852888-3c5d1f64f12df02aa801901cc7c311ca/how_to_prepare_flood_033014_508.pdf
113. United Kingdom Environment Agency. What to do before, during and after a flood [Internet]. [Access date: 26 June 2022]. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/403213/LIT_5216.pdf.
114. Emergency Management Australia. What to do before, during & after a flood [Internet]. [Access date: 29 June 2022]. Available from: http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf.
115. Yusoff IM, Ramli A, Alkasirah NAM, Nasir NM. Exploring the managing of flood disaster: A Malaysian perspective. Geografia. 2018;14(3).

116. Canadian Red Cross. Floods: Before, During & After [Internet]. 2022 [Access date: 29 June 2022]. Available from: https://www.redcross.ca/how-we-help/emergencies-and-disasters-in-canada/types-of-emergencies/floods.
117. United States Department of Homeland Security. Build A Kit 2022 [Internet]. 2022 [Access date: 2 July 2022]. Available from: https://www.ready.gov/kit.
118. Fadul E, Masih I, De Fraiture C. Adaptation strategies to cope with low, high and untimely floods: Lessons from the Gash spate irrigation system, Sudan. Agricultural Water Management. 2019;217:212-25.
119. Eltahir MM. Power of Place-Making in The Creation of Resilient Places In Sudan. Second Arab land Conference; 22-24 February 2021; Cairo; Arab Land initiative;2021. Available from: https://arablandinitiative.gltn.net/wp-content/uploads/2021/03/TechnicalSession4b_Place-making_Muna-Eltahir_TSS_Paper.pdf
120. Warner K, Ranger N, Surminski S, Arnold M, Linnerooth-Bayer J, Michel-Kerjan E, et al. Adaptation to climate change: Linking disaster risk reduction and insurance. Geneva: United Nations International Strategy for Disaster Reduction; 2009.30p.
121. United Nations International Strategy for Disaster Reduction (UNISDR). Disaster Risk Reduction in the United Nations [Internet]. 2009 [Access date: 4 July 2022]. Available from: https://www.unisdr.org/files/9866_DisasterRiskReductionintheUnitedNat.pdf.
122. Ahadzie D, Proverbs D. Flooding and post flooding response strategies in Ghana. WIT Transactions on Ecology and the Environment. 2010;133:281-91.
123. Manfrini GC, Treich RS, Rumor PCF, Magagnin AB, Moncada MA, Furtado JR. Primary health care actions in natural disasters. Texto & Contexto-Enfermagem. 2020;29.
124. Los Angeles Fire Department. The Nine Steps of Flood Recovery [Internet] 2021. [Access date: 15 August 2022]. Available from: https://www.lafd.org/news/nine-steps-flood-recovery.
125. Jackson BA. The problem of measuring emergency preparedness [Internet] 2008.[Access date: 21 January 2024] available from: https://www.rand.org/content/dam/rand/pubs/occasional_papers/2008/RAND_OP234.pdf
126. Jackson BA, Faith KS, Willis HH. Evaluating the reliability of emergency response systems for large-scale incident operations. RAND; 2010 Jan 1.
127. Jackson BA, Sullivan Faith K, Willis HH. Are we prepared? Using reliability analysis to evaluate emergency response systems. Journal of Contingencies and Crisis Management. 2011;19(3):147-57.
128. Jackson BA, McKay S. Preparedness Exercises 2.0: Alternative Approaches to Exercise Design That Could Make Them More Useful for Evaluating-and Strengthening-Preparedness. Homeland Security Affairs. 2011;7(1).
129. Simpson DM. Disaster preparedness measures: a test case development and application. Disaster Prevention and Management: An International Journal. 2008 Nov 7;17(5):645-61.
130. Kohler K, Hauri A, Roth F, Scharte B. Measuring Individual Disaster Preparedness report. ETH Zurich; 2020.
131. Panagiotakos D. Health measurement scales: methodological issues. The open cardiovascular medicine journal. 2009;3:160.

132. Streiner DL, Norman GR, Cairney J. Health measurement scales: a practical guide to their development and use: Oxford University Press, USA; 2015.
133. Chyung SY, Swanson I, Roberts K, Hankinson A. Evidence-based survey design: The use of continuous rating scales in surveys. Performance Improvement. 2018;57(5):38-48.
134. Keszei AP, Novak M, Streiner DL. Introduction to health measurement scales. Journal of psychosomatic research. 2010;68(4):319-23.
135. Morgado FF, Meireles JF, Neves CM, Amaral A, Ferreira ME. Scale development: ten main limitations and recommendations to improve future research practices. Psicologia: Reflexão e Crítica. 2017 Mar 20;30.
136. Zamanzadeh V, Ghahramanian A, Rassouli M, Abbaszadeh A, Alavi-Majd H, Nikanfar A-R. Design and implementation content validity study: development of an instrument for measuring patient-centered communication. Journal of caring sciences. 2015;4(2):165.
137. DeVellis RF. Scale Development: Theory and application. Fouth Edition. Los Angeles: Sage publications; 2017.
138. Rubio DM, Berg-Weger M, Tebb SS, Lee ES, Rauch S. Objectifying content validity: Conducting a content validity study in social work research. Social work research. 2003;27(2):94-104.
139. Zamanzadeh V, Rassouli M, Abbaszadeh A, Majd HA, Nikanfar A, Ghahramanian A. Details of content validity and objectifying it in instrument development. Nursing Practice Today. 2014;1(3):163-71.
140. Carpenter S. Ten Steps in Scale Development and Reporting: A Guide for Researchers. Communication methods and measures. 2018 Jan 2;12(1):25-44.
141. Watts GJ, Lewis AJ, Serfaty IG. “Bumps in the Road”: A pilot study of a therapeutic technique for the integration of unresolved family loss and trauma. Frontiers in psychology. 2021;12:635574.
142. Clark LA, & Watson, D. Constructing validity: Basic issues in objective scale development. Psychological Assessment. 1995:309-19.
143. Kalanlar B. Psychometric properties of disaster preparedness tools in nurses: a systematic literature review. Prehospital and disaster medicine. 2022 1-6.
144. Chen TF, Chou KR, Liao YM, Ho CH, Chung MH. Construct validity and reliability of the Chinese version of the Disaster Preparedness Evaluation Tool in T aiwan. Journal of clinical nursing. 2015 Apr;24(7-8):1132-43.
145. Wang J, Lu S, Sun X, Wang F, Wan M, Chen H, et al. Psychometric evaluation of the Disaster Preparedness Evaluation Tool (DPET) on emergency nurses in mainland China: two cross-sectional studies. Disaster medicine and public health preparedness. 2022;16(3):1083-90.
146. Han SJ, Chun J. Validation of the disaster preparedness evaluation tool for nurses—the Korean version. International Journal of Environmental Research and Public Health. 2021;18(3):1348.
147. Al Khalaileh MA, Bond AE, Beckstrand RL, Al-Talafha A. The disaster preparedness evaluation tool: psychometric testing of the classical Arabic version. Journal of advanced nursing. 2010;66(3):664-72.
148. Shi L, Li M, Xu X, Wang Z, Li S, Feng X. Adaptation and evaluation of the Chinese hospital nursing department disaster preparedness scale: a cross-sectional scale development study. BMJ open. 2021;11(4):e043636.

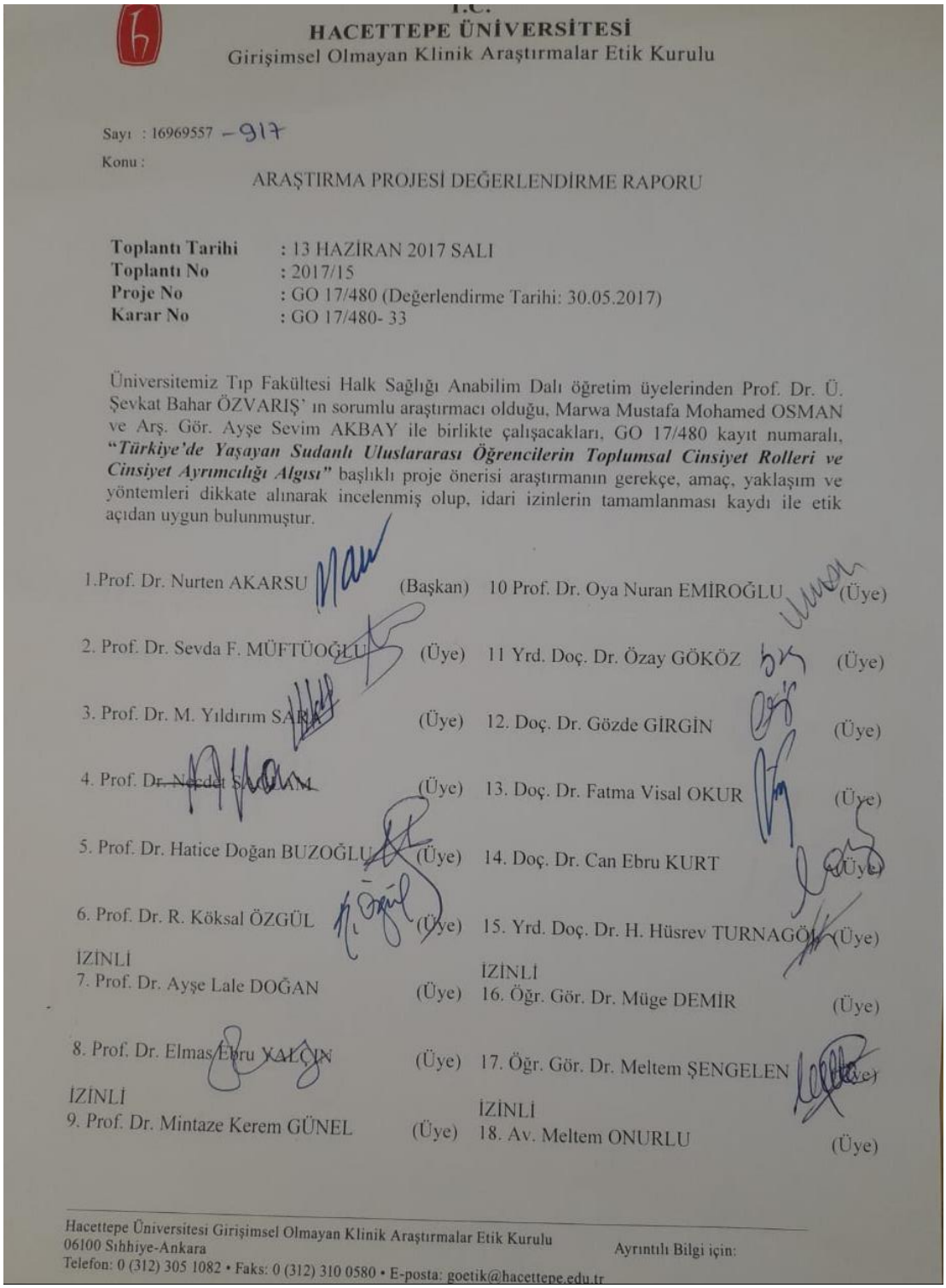
149. Tavan H, Menati W, Azadi A, Sayehmiri K, Sahebi A. Development and validation of a questionnaire to measure Iranian nurses' knowledge, attitude and practice regarding disaster preparedness. Journal of Clinical and Diagnostic Research: JCDR. 2016;10(8):IC06.
150. Krongthaeo S, Partiprajak S, Piaseu N. Psychometric properties of the Disaster Preparedness Evaluation Tool (DPET) Thai version among Thai registered nurses. International Journal of Disaster Risk Reduction. 2022;76:102987.
151. Dikmenli Y, Yakar H, Konca AS. Development of disaster awareness scale: A validity and reliability study. Review of International Geographical Education Online. 2018;8(2):206-20.
152. Osman M, Altıntaş KH. Domains and Psychometric Properties of Scales Measuring Disaster Preparedness among General Population: A Systematic Literature Review. Prehospital and Disaster Medicine. 2023 Sep 29:1-9.
153. Boylan JL, Lawrence C. The development and validation of the bushfire psychological preparedness scale. International journal of disaster risk reduction. 2020;47:101530.
154. Mulilis J-P, Duval TS, Lippa R. The effects of a large destructive local earthquake on earthquake preparedness as assessed by an earthquake preparedness scale. Natural hazards. 1990;3:357-71.
155. Spittal MJ, Walkey FH, McClure J, Siegert RJ, Ballantyne KE. The earthquake readiness scale: The development of a valid and reliable unifactorial measure. Natural Hazards. 2006;39:15-29.
156. Ardalan A, Sohrabizadeh S. Assessing households preparedness for earthquakes: an exploratory study in the development of a valid and reliable Persian-version tool. PLoS currents. 2016;8.
157. Kolathayar S, Anupa S, Prakash EL. Development of earthquake readiness index tool to assess individual earthquake preparedness level. Urbanization Challenges in Emerging Economies: Resilience and Sustainability of Infrastructure: American Society of Civil Engineers Reston, VA; 2018. p. 149-55.
158. Kwazu GC, Chang-Richards A. A tool to assess livelihood preparedness for disasters: a study of Kaikōura earthquake in New Zealand. Natural Hazards. 2022;113(1):745-66.
159. Inal E, Dogan N. Improvement of general disaster preparedness belief scale based on health belief model. Prehospital and disaster medicine. 2018;33(6):627-36.
160. Rohith V, Kolathayar S, Priyatham K, Kumar VK, Nikil S. Disaster preparedness index: a valid and reliable tool to comprehend disaster preparedness in India. Urbanization Challenges in Emerging Economies: Resilience and Sustainability of Infrastructure: American Society of Civil Engineers Reston, VA; 2018. p. 156-63.
161. McLennan J, Marques MD, Every D. Conceptualising and measuring psychological preparedness for disaster: The Psychological Preparedness for Disaster Threat Scale. Natural Hazards. 2020;101:297-307.
162. Najafi M, Khankeh H, Soltani A, Atighechian G. Reliability and Validity of Household Disaster Preparedness Index (HDPI). Iranian Red Crescent Medical Journal. 2020;22(12).

163. CDC. All Hazards Preparedness Guide [Internet]. 2013 [Access date: 13 April 2023]. Available from: https://www.cdc.gov/orr/documents/ahpg_final_march_2013.pdf.
164. Bodas M, Kirsch TD, Peleg K. Top hazards approach–Rethinking the appropriateness of the All-Hazards approach in disaster risk management. International journal of disaster risk reduction. 2020;47:101559.
165. Prinsen CA, Mokkink LB, Bouter LM, Alonso J, Patrick DL, De Vet HC, et al. COSMIN guideline for systematic reviews of patient-reported outcome measures. Quality of life research. 2018;27:1147-57.
166. Global Facility for Disaster Risk Reduction (GFDRR). Diagnostic Report on Emergency Preparedness and Response capacities in Sudan [Internet]. 2021 [Access date: 8 June 2022]. Available from: https://www.gfdrr.org/sites/default/files/Sudan_EPR_Report.pdf
167. World Atlas. Maps of Sudan [Internet]. 2024 [Access date: 17 January 2024] available from: https://www.worldatlas.com/maps/sudan.
168. Pallant J. EBOOK: SPSS Survival Manual. New York: McGraw-Hill Education; 2016.
169. Population Pyramid. Sudan [Internet]. 2019 [access date 11 December 2021] available from https://www.populationpyramid.net/sudan/.
170. Miceli R, Sotgiu I, Settanni M. Disaster preparedness and perception of flood risk: A study in an alpine valley in Italy. Journal of environmental psychology. 2008;28(2):164-73.
171. Levac J, Toal-Sullivan D, OSullivan TL. Household emergency preparedness: a literature review. Journal of community health. 2012;37(3):725-33.
172. Thomas M. Disaster Preparedness: Factors That Influence Texans' Preparation for Flooding [PhD thesis]. Minneapolis: Capella University; 2018.
173. United States Central Intelligence Agency. World Fact Book, Sudan [Internet]. 2022 [Access date: 6 September 2022]. Available from: https://www.cia.gov/the-world-factbook/countries/sudan/.
174. World Bank. The World Bank Data, Sudan 2022 [06 September 2022]. Available from: https://data.worldbank.org/country/SD.
175. UN Office for the Coordination of Humanitarian Affairs. Sudan: Kassala State Profile [Internet]. 2022 [Access date: 06 September 2022]. Available from: https://reliefweb.int/report/sudan/sudan-kassala-state-profile-updated-march-2022.
176. Unicef. State profile, Kassala [Internet]. 2022 [Access date: 6 September 2022]. Available from: https://www.unicef.org/sudan/media/8661/file/Kassala.pdf.
177. United Nations Office for Disaster Risk Reduction UNDRR. Preparedness [Internet] 2020. [Access date: 21 April 2022]. Available from: https://www.undrr.org/terminology/preparedness#:~:text=The%20knowledge%20and%20capacities%20developed,likely%2C%20imminent%20or%20current%20disasters.
178. The American National Red Cross. How to prepare for emergencies, Be Red Cross Ready [Internet] [Access date: 29 April 2022]. Available from: https://www.redcross.org/get-help/how-to-prepare-for-emergencies.html.
179. Bayram. N. Sosyal bilimlerde SPSS veri analizi. Bursa, Turkey: Ezgi kitabevi; 2009.

180. Büyüközturk. Ş. Sosyal bilimler için veri analizi el kitabı. Ankara: Pegem Akademi Yayınlar; 2010.
181. Costello AB, Osborne J. Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Practical assessment, research, and evaluation. 2005;10(1):7.
182. Browne MW, Cudeck R. Alternative ways of assessing model fit. Sociological methods & research. 1992;21(2):230-58.
183. Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural equation modeling: a multidisciplinary journal. 1999;6(1):1-55.
184. Lai K, Green SB. The problem with having two watches: Assessment of fit when RMSEA and CFI disagree. Multivariate behavioral research. 2016;51(2-3):220-39.
185. Chen F, Curran PJ, Bollen KA, Kirby J, Paxton P. An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in structural equation models. Sociological methods & research. 2008;36(4):462-94.
186. Tavakol M, Dennick R. Making sense of Cronbach's alpha. International journal of medical education. 2011;2:53.
187. British Medical Journal. Corelation and Regression [Internet] 2022. [Access date: 15 June 2022]. Available from: https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression.
188. Unicef. Flash Update: Sudan Flood Response [Internet] 2022. [Access date: 21 January 2024] Available from: https://www.unicef.org/sudan/media/9481/file/UNICEF%20Sudan_flood%20response_flash%20update_V2_24.08.2022.pdf.

Annexes

Annex 1: Ethical Approval Document



T.C.
HACETTEPE ÜNİVERSİTESİ
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu

Sayı : 16969557 -917
Konu :

ARAŞTIRMA PROJESİ DEĞERLENDİRME RAPORU

Toplantı Tarihi : 13 HAZİRAN 2017 SALI
Toplantı No : 2017/15
Proje No : GO 17/480 (Değerlendirme Tarihi: 30.05.2017)
Karar No : GO 17/480- 33

Üniversitemiz Tıp Fakültesi Halk Sağlığı Anabilim Dalı öğretim üyelerinden Prof. Dr. Ü. Şevkat Bahar ÖZVARIŞ' ın sorumlu araştırmacı olduğu, Marwa Mustafa Mohamed OSMAN ve Arş. Gör. Ayşe Sevim AKBAY ile birlikte çalışacakları, GO 17/480 kayıt numaralı, ***"Türkiye'de Yaşayan Sudanlı Uluslararası Öğrencilerin Toplumsal Cinsiyet Rolleri ve Cinsiyet Ayrımcılığı Algısı"*** başlıklı proje önerisi araştırmanın gerekçe, amaç, yaklaşım ve yöntemleri dikkate alınarak incelenmiş olup, idari izinlerin tamamlanması kaydı ile etik açıdan uygun bulunmuştur.

1.Prof. Dr. Nurten AKARSU	(Başkan)	10 Prof. Dr. Oya Nuran EMİROĞLU	(Üye)
2. Prof. Dr. Sevda F. MÜFTÜOĞLU	(Üye)	11 Yrd. Doç. Dr. Özay GÖKÖZ	(Üye)
3. Prof. Dr. M. Yıldırım SARAÇ	(Üye)	12. Doç. Dr. Gözde GİRGİN	(Üye)
4. Prof. Dr. Nezdet SAĞLAM	(Üye)	13. Doç. Dr. Fatma Visal OKUR	(Üye)
5. Prof. Dr. Hatice Doğan BUZOĞLU	(Üye)	14. Doç. Dr. Can Ebru KURT	(Üye)
6. Prof. Dr. R. Köksal ÖZGÜL	(Üye)	15. Yrd. Doç. Dr. H. Hüsrev TURNAGÖL	(Üye)
İZİNLİ 7. Prof. Dr. Ayşe Lale DOĞAN	(Üye)	İZİNLİ 16. Öğr. Gör. Dr. Müge DEMİR	(Üye)
8. Prof. Dr. Elmas Ebru YALÇIN	(Üye)	17. Öğr. Gör. Dr. Meltem ŞENGELEN	(Üye)
İZİNLİ 9. Prof. Dr. Mintaze Kerem GÜNEL	(Üye)	İZİNLİ 18. Av. Meltem ONURLU	(Üye)

Hacettepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu
06100 Sıhhiye-Ankara
Telefon: 0 (312) 305 1082 • Faks: 0 (312) 310 0580 • E-posta: goetik@hacettepe.edu.tr
Ayrıntılı Bilgi için:

Annex 2.A: Questionnaire in Turkish Language (Anket Soruları)

‘Sele Bireysel Hazırlığı Değerlendirme Ölçeği Geliştirme Çalışması (Kassala, Sudan)’ Anket Soruları

Sevgili Katılımcı

“Sele Bireysel Hazırlığı Değerlendirme Ölçeği Geliştirme Çalışması (Kassala, Sudan)” başlıklı bu araştırma, Hacettepe Üniversitesi Halk Sağlığı Anabilim Dalı tarafından yapılmaktadır. Araştırma Kassala (Sudan) ve benzer bölgelerde kullanılmak üzere geçerli ve güvenilir bir sele bireysel hazırlık ölçeği geliştirmek amacıyla planlanarak hazırlanmıştır. Yanıtlarınızdan elde edilecek verilerle ölçek hazırlanacaktır ve buna yönelik gelecek çalışmalar ve hızmetler planlanabilecektir. Bu nedenle soruların tümünü büyük önem taşımakta olduğunu ifade eder içtenlikle cevap vermenizi rica ederiz.

Araştırmaya katılmanız gönüllülük esasına dayalıdır. Çalışmada adınız ve soyadınız alınmayacaktır. Bu form aracılığı ile elde edilecek bilgiler gizli kalacaktır ve sadece araştırma amacıyla veya bilimsel amaçlar için kullanılacaktır. Çalışmaya katılmamayı tercih edebilirsiniz veya anketi doldururken fikrinizi değiştirip son verebilirsiniz.

Ölçeğin güvenirliğini belirlemek amacıyla 2 hafta sonra cevap verenlerin bir kısmı tarafından tekrar cevaplaması gerekmektedir. Anketi 2 hafta sonra tekrar doldurmayı kabul ediyorsanız telefonunuzu belirlenen yerde yazınız.

Anketimiz 2 bölümden oluşmaktadır. Birinci bölümünde sosyo-demografik özelliklerinize yönelik 21 soru yer alırken, bilgi ve davranış olmak üzere ikiye ayrılan ikinci bölümünde ise Sel İçin Bireysel Hazırlık Ölçeği’ne yönelik 72 soru bulunmaktadır. Bu anket çalışması, yaklaşık 20 dakikanızı alacaktır**.** Yanıtlarınızı sorularla ilgili seçenekler arasından seçerek işaretleyiniz ve/veya açık uçlu sorularda yanıtınızı yazınız. Birden fazla seçenek işaretleyebileceğiniz sorularda, size uygun gelen bütün seçenekleri işaretleyiniz. Eğer sorunun yanıtları arasında “diğer” seçeneği mevcut ise ve yanıtınız var olan seçenekler arasında yer almıyorsa, “diğer” seçeneğini seçiniz ve kısaca açıklayınız. (Bana uygulanamaz) seçeneği, davranış ölçeğinde yalnızca soru sizin durumunuzda geçerli olmadığında seçebilirsiniz. Mesela, soru sürüşle ilgili ve siz araba sürmüyorsunuz, v.b…

Ankete verdiğiniz samimi cevaplar için teşekkür ederiz.

Çalışma ile ilintili herhangi bir sorunuz olduğunda aşağıdaki kişi(ler) ile iletişim kurabilirsiniz:

Sorumlu Araştırmacı: Prof. Dr. Kerim Hakan ALTINTAŞ

Hacettepe Üniversitesi Halk Sağlığı Anabilim Dalı

Telefon:

Yrd. Araştırmacılar

Dr. Gülşen TAŞDELEN TEKER, Hacettepe University, Hacettepe Üniversitesi tıp eğitimi ve bilişimi Anabilim Dalı

E-posta:

Dr. Marwa Mustafa Mohamed OSMAN, Hacettepe Üniversitesi Halk Sağlığı Anabilim Dalı

Telefon:

Sosyo-Demografik Veriler:

1. Doğum yılınız nedir? (Lütfen rakamlarla yazınız)……
2. Cinsiyetiniz ile ilgili olarak uygun seçeneği işaretleyiniz:
   ( ) Erkek ( ) Kadın
3. Eğitim durumunuz nedir? (En son diploma aldığınız okulu işaretleyiniz)
   ( ) Okur yazarım ama okula gitmedim ya da bıraktım.
   ( ) İlk okul ( ) Orta okul
   ( ) Lise ( ) Üniversite
   ( ) Lisansüstü
4. Herhangi bir gelir getiren işte çalışıyor musunuz?
   ( ) Evet (Çalıştığınız iş nedir? ……
   ( ) Hayır
5. Mesleğiniz nedir? ……
6. SDG (Sudan Para Birimi) olarak ailenizin aylık toplam geliri ne kadardır?.....
7. Medeni durumunuz nedir?
   ( ) Evli ( ) Bekar
   ( ) Eşinden ayrılmış ( ) Eşi ölmüş
8. Kaç çocuğunuz var?

( ) Benim çocuğum yok

( ) Çocuğum / Çocuklarım var (Sayısını belirtiniz) ……

9. Hanehalkınızın şuanki toplam kişi sayısı nedir? .....
10. Ne zamandır Kassala şehrinde yaşıyorsunuz?.....
11. Yaşadığınız mahallenin adı nedir?.....
12. Halihazırda nerede yaşıyorsunuz?

( ) Kendi evimde

( ) Kirada

( ) Diğer (Lütfen Belirtiniz)…… …

13. Bu güne kadar herhangi bir sel olayını yaşadınız mı?

( ) Evet (14. Soruya geçiniz.)

( ) Hayır (16. Soruya geçiniz.)

14. Temmuz 2018 selini yaşadınız mı?

( ) Evet (15. Soruya geçiniz.)

( ) Hayır (16. Soruya geçiniz.)

15. Temmuz 2018 selinden etkilendiniz mi? (Birden çok seçenek işaretlenebilir)

( ) Evet, evimi su bastı, maddi kayıplarım oldu

( ) Evet, akrabalarımdan yaşamını yitirenler oldu

( ) Evet, bana veya ailemden birine bir yaralanma oldu. (Lütfen yaralanmanın türünü belirtin .....

( ) Evet, diğer (Açıklayınız)……

( ) Hayır, yalnızca sele ve etkilenenlere tanık oldum.

16. Ekim 2018'de meydana gelen son salgın sırasında Chikungunya ateşine yakalandınız mı?

( ) Evet

( ) Hayır

17. Ekim 2018'de meydana gelen son salgın sırasında hanehalkınızdan herhangi biri Chikungunya ateşine yakalandı mı?

( ) Evet, (kaç kişi yakalandı? .....

( ) Hayır

18. Sel konusunda bilgi edindiğiniz kaynakları işaretleyiniz. (Birden çok seçenek işaretlenebilir)

( ) Televizyon ( ) Radyo ( ) İnternet

( ) Gazete ( ) Dergi ( ) Aile üyeleri

( ) Arkadaşlar ( ) Komşular ( ) Okul

( ) Ulusal kuruluşlar ( ) Uluslar arası kuruluşlar

( ) Diğer: (Yazınız)……

19. Sele hazırlıklı olma konusunda herhangi bir eğitim aldınız mı?

( ) Hayır (19. Soruya geçiniz.)

( ) Evet (Bu eğitimle ilintli olarak aşağıdaki bilgileri yazınız)

Eğitimin adı: …….

Eğitimi veren kuruluş: ……

Eğitimin süresi (saat, gün, hafta vb birimi ile yazınız): ……

Eğitim sonunda verilen belge: ( ) Yok ( ) Katılım belgesi

( ) Sertifika

20. Gelecekteki olası sellere kendinizi yeterince hazırlıklı hissediyor musunuz?

( ) Evet

( ) Emin değilim

( ) Hayır

21. Sele bireysel hazırlık konusunda eğitim almak ister misiniz?

( ) Evet,

( ) Hayır (nedeni belirtiniz).....

Sele Bireysel Hazırlılık - Bilgi Ölçeği:

Lütfen aşağıdaki maddelerde bilgi seviyenize en iyi uyan seçeneği karesine (✓) koyarak seçiniz:

Maddeler	Tam bilgim var	Tam olmayan ama iyi derecede bilgim var	Orta derecede bilgim var	Az derecede bilgim var	Hiç fikrim yok
14- Sellerin riskleri.					
15- Sellerin neticesi olarak meydana gelen hastalıkları.					
16- Sellerin meydana geldiği ayları.					
17- Sellerin meydan gelme olasılığı hakkında nasıl haberdar olacağımı.					
18- İçinde yaşadığım toplumun yerel sel tahliye planı.					
19- Bulunduğum yerde yollar kapalıysa, alternatif kaçış yolları.					
20- Evimin bulunduğu sokaktaki sel suyunun drenaj planı.					
21- Tahliye planının nasıl hazırlanacağı.					
22- Tahliye gerektiğinde hızlı bir şekilde alınabilecek acil durum çantasının nasıl hazırlanacağı.					
23- Bitkilerimi ve tahıllarımı selden nasıl koruyacağımı, böylece sellerden nasıl etkilenmeyecekleri.					
24- Farklı durumlarda sel suyu ile hapsolursam nasıl yardım alabileceğimi (örneğin, bir binanın içinde, bir aracın içinde, vb ...).					
25- Sel sırasında birinin ihtiyaç duyması halinde, ilk yardımın nasıl yapılacağı.					
26- Sel sonrasında benim ya da sevdiklerim için ihtiyaç duyulan psikolojik desteğin nasıl alınacağı.					

Sele Bireysel Hazırlılık Davranış Ölçeği:

Lütfen aşağıdaki maddelerde sele hazırlıklı olma davranışınıza en uygun seçeneği karesine (✓) koyarak seçininiz:

Madde	Her zaman	Çoğu zaman	Bazen	Nadiren	Hiç bir zaman	Bana uygulana
1- Sellerin meydana gelme olasılığı hakkında beni bilgilendirebilecek araçları takip ederim.						
2- Sellerin meydana gelme olasılığı hakkında erken uyarı mesajı alırım.						
3- Sel mevsiminde yaşadığım bölgenin beklenen yağmur seviyesini takip ederim.						
4- Sel mevsiminde suyun akıntısının karşı bölgelerindeki yağmur seviyesini takip ederim.						
5- Güvenliği ve sellerdan etkilenme olasılıklarına göre yaşayacağım yeri seçiyorum.						
6- Yaşayacağım binanın bileşenlerini, suya dayanıklılıklarına ve toleransına göre seçerim.						
7- Ailemle, olası sellere yönelik nasıl hazırlanacağımız hakkında konuşurum.						
8- Suyun evimden boşalması için gerekli önlemleri alırım.						

Madde	Her zaman	Çoğu zaman	Bazen	Nadiren	Hiç bir zaman	Bana uygulana
9- Sula basılan yerin güvenli bir yere tahliyesi için plan hazırlarım.						
10- Tahliye sırasında yardıma ihtiyaç duyanları (örneğin: engelli insanları, özel ihtiyaçları olanları, yaşlıları, çocukları) tahliye etmek için özel planlar hazırlarız.						
11- Sel başlamadan önce, ailemle yeterince zaman geçirebileceğimiz güvenli bir yer hazırlarım.						
12- Sel başlamadan önce, hayvancılık servetimi götürebileceğim güvenli bir yer hazırlarım.						
13- Sel Tahliye planını, ailemle birlikte uygulayıp değerlendiririz.						
14- İçinde önemli eşyaları bulundurduğum ve tahliye gerektiğinde hızla alıp çıkabileceğim bir acil durum çantası hazırlarım.						
15- Elektrikli cihazları selin suyundan etkilenmeyecek şekilde yüksek bir yerde saklarım.						
16- Ailemin dışında, yakın çevremdeki insanlarla sel için yaptığım hazırlıkları tartışırım.						

Madde	Her zaman	Çoğu zaman	Bazen	Nadiren	Hiç bir zaman	Bana uygulana
17- Selin olumsuz etkilerini azaltabilecek faaliyetlere yakın çevremdeki insanlarla birlikte katılırım.						
18- Sel olaylarına ve kayıplara karşı sigortamı yaptırırım.						
19- Sel yüzünden çökeceğini hissedersem, bulunduğum binayı hemen tahliye ederim.						
20- Tahliye gerektiğinde acil durum çantamı hızla alırım.						
21- Selden etkilenmiş bir binayı boşaltmadan önce gazı, elektriği ve suyu tamamen keserim.						
22- Eğer durum gerektirirse tahliyeyi etkili bir biçimde yapıp kendimi kurtarabilirim.						
23- Eğer durum gerektirirse ailemi etkili bir şekilde tahliye edip kurtarabilirim.						
24- Eğer durum gerektirirse, hayvancılık servetimi etkili bir şekilde tahliye edip kurtarabilirim.						
25- Eğer durum gerektirirse, belgelerimi etkili bir şekilde tahliye edip kurtarabilirim.						

Madde	Her zaman	Çoğu zaman	Bazen	Nadiren	Hiç bir zaman	Bana uygulana
26- Eğer durum gerektirirse, önemli eşyalarımı etkili bir şekilde tahliye edip kurtarabilirim.						
27- Sel sularında yürümekten kaçınırım						
28- Sel sularında yüzmekten sakınırım						
29- Sel sularında araba sürmekten sakınırım						
30- Sel esnasında hızla hareket eden suyun üzerindeki köprülerden uzak dururum.						
31- Aracım hızla hareket eden suda sıkışırsa, araç içinde kalırım.						
32- Eğer sıkışıp kaldığım aracın içinde su yükseliyorsa, aracın tavanı üstüne çıkarım.						
33- Sel esnasında, bir binada mahsur kalırsam, kapalı tavan arasına girmeden, binanın en üst seviyesine giderim.						
34- Su baskınından hemen sonra güvenli içme suyuna erişebilirim.						
35- Mevcut su saflaştırılmadığı takdirde saflaştırma metotlarından birini kullanarak suyu arıtırım.						
36- Selden hemen sonra güvenli temiz tuvaletlere erişebilirim.						

Madde	Her zaman	Çoğu zaman	Bazen	Nadiren	Hiç bir zaman	Bana uygulana
37- Tuvaletin yokluğu durumunda kuru bir yerde dışkıladığımdan emin olurum.						
38- Eğer dış mekanda dışkılamak zorunda kalırsam, dışkıyı toprağa gömdüğümden emin olurum.						
39- Selden sonra acil durumların dışında araç kullanmaktan kaçınırım.						
40- Tahiliye sorasında yetkililer güvenli bir şekilde geri dönebileceğimizi beyan ettiktan sonra, ancak o zaman selden etkilenmiş alana geri dönerim.						
41- Sel basmış bir ev veya binaya girerken gevşek panoları ve kaygan zeminleri kontrol ederim.						
42- Sel basmış bir ev ya da binaya girerken ana anahtardan/sigorta kutusundan elektriği kapatırım.						
43- Tahliyeden sonra eve dönünce, bir çubuk veya benzeri cisimler kullanarak tehlikeli cisimleri (örneğin kırık cam, metal parçaları) inceleyip gizlenmiş tehlikelerine basmamak için varlığını kontrol ederim.						

Madde	Her zaman	Çoğu zaman	Bazen	Nadiren	Hiç bir zaman	Bana uygulana
44- Temizlik sırasında yılan ve akrep ısırıklarından korunmak için kişisel korucu ekipmanlar giyerim (örneğin kalın eldivenler ve botlar).						
45- Sel sularına düşmüş elektrik tellerinden uzak dururum.						
46- Elektrik direklerinden uzak dururum.						
47- Sel sularına düşmüş elektrik tellerini derhal elektrik şirketinin acil durum numarasını arayarak bildiririm.						
48- Sel suyu ile ıslanmış elektrikli cihazlara dokunmaktan sakınırım.						
49- Sel sularında dururken elektrikli cihazlara dokunmaktan sakınırım.						
50- Sel sonrasında ihtiyaç duyulan kömür ocağı, jeneratör veya benzinle çalışan makineleri dış mekanlarda ve pencerelerden uzak yerlerde kullanırım.						
51- Sel sonrasında kendimi korumak için, hastalık taşıyıcı sineklere (örneğin; sivrisinek) karşı koruyucu önlemler alırım.						

Madde	Her zaman	Çoğu zaman	Bazen	Nadiren	Hiç bir zaman	Bana uygulana
52- Sel sonrasında ailemi korumak için, hastalık taşıyıcı sineklere (örneğin; sivrisinek) karşı koruyucu önlemler alırım.						
53- Kemirgenlere karşı tedbirler uyguluyorum, örneğin (fareler ve sıçanlar)						
54- Sel nedeniyle zarar görmüş tuvaletleri ve fosseptik çukurlarını mümkün olan en kısa sürede tamir ettiririm.						
55- Selden sonra, kuyularımızın ve içme suyunun bakterilerden ve kimyasallardan kaynaklanan kirlilik açısından kontrol ettiririz.						
56- Sel suyundan ıslanan her şeyi temizlerim.						
57- Sel sırasında ıslanıp dezenfeksiyon gerektiren her şeyi dezenfekte ederim.						
58- Sel suyuyla ıslanan yiyecekleri atarım.						
59- Sel sonrasında, ihtiyaç duyanlara psikolojik destek sağlanmasını öneririm.						

* Bu anketi iki hafta sonra tekrar cevaplamayı kabul ediyorsanız, lütfen size ulaşabileceğimiz iletişim bilgileri aşağıya yazınız

Telefon : ……..

Annex 2.B: Questionnaire in English Language

Development of a scale to evaluate individual preparedness to floods (Kassala, Sudan)

Dear Participant

This study is being conducted by Hacettepe University Department of Public Health. The study is planned to develop a valid and reliable scale for the individual preparedness to floods in Kassala (Sudan) and similar environments. Based on the results of your responses the scale will be prepared and future studies and services can be planned. For these reasons, it is very important that you answer all the questions accurately and sincerely.

Participation in the study is voluntary. The information to be obtained through this form will remain confidential and will only be used for research purposes. You can choose not to participate in the study or you can end the questionnaire at the time you want.

Names and surnames will not be taken. In order to determine the reliability of the scale, it is necessary to fill in this same form again after 2 weeks. If you can refill the questionnaire after 2 weeks, please add your e-mail or telephone number in the bottom of the form.

Our survey consists of 2 parts. In the first part, there are 21questions about your socio-demographic characteristics, while the second part consist of the Individual Preparedness Scale for Flood which is also composed of 2 parts the knowlege scale and the behaviour scale with a total of 72 questions. In this questionnaire, which will take you about 20 minutes, mark your answers by selecting the option you find most suitable to you or give answer by writing in the open-ended questions. In the questions that you can answer with more than one option, please mark all the options that are appropriate for you. If your answer to a question was not written among the options and you choosed (other), please specify your answer in further detail in the space provided. You can choose the option (not applied to me) in the behavior scale only when the question is not applicable in your situation e.g. the question is about driving and you do not drive and so on

Thank you for your sincere answers to the survey.

You can contact one of the reseachers given below, if you have any questions or inquiries about the research study:

Principal Researcher: Prof. Dr. Kerim Hakan ALTINTAŞ
Hacettepe University, Department of Public Health
Telephone: +90312 - 305 15 90

Assistant Researchers:

Dr. Gülşen TAŞDELEN TEKER, Hacettepe University, Department of Medical Education and Informatics
E-mail:

Dr. Marwa Mustafa Mohamed OSMAN, Hacettepe University, Department of Public Health. Phone:

Please indicate your acceptance to participate in the study by ticking on one of the options.

I accept. I do not accept.

Questionnaire of socio- demographic data

Please answer the multiple-choice questions by putting (✓)between the brackets in front of the option that is suitable for you:

1- What is your year of birth? (Please write in figures) ……

2- Select the appropriate option for your gender:

( ) Male

( ) Female

3- What is your educational level? (Mark the school of your latest certificate.)

( ) Literate but did not go to or left school

( ) Primary school

( ) Secondary school

( ) University graduate

( ) Post graduate studies

4- Are you working with a source of any income?

( ) Yes (Please write your job) ……

( ) No

5- What is your vocation? .....

6- What is your households' income per month in SDGs? .....

7- What is your marital status?

( ) Married ( ) Single

( ) Separated from the spouse

( ) Spouse is dead

8- Do you have children?

( ) Yes (Please specify the number) ……

( ) No, I don't have children

9- What is the current number of your households members? ……

10- How long have you been living in Kassala city? ……

11- What is the name of the neighborhood you live in?.....

12- Where do you live now?

( ) In my own house

( ) In a rented house

( ) Other please specify……

13- Have you experienced the occurrence of any flood?

( ) Yes (go to question 14.)

( ) No (go to question 16.)

14- Did you experience the 2018 floods?

( ) Yes (go to question 15.)

( ) No (go to question 16.)

15- Were you affected by a previous flood? (Multiple options can be marked)

( ) Yes, my house was flooded, I had financial losses

( ) Yes, I lost one of my family members

( ) Yes, an injury occured to me or to one of my family. (Please specify the type of the injury.....

() Yes, other (Explain)…… ……

( ) No, I just witnessed the flood and the affected.

16- Did you get Chikungunya fever during the last epidemic in October 2018?

( ) Yes ( ) No

17- Did anyone in your household get Chikungunya fever during the last epidemic in October 2018?

( ) Yes (how many persons were affected? .....

( ) No

18- Mark your sources of information on the flood. (Multiple options can be marked)

( ) Television ( ) Radio ( ) Internet

( ) Newspaper ( ) Magazines ( ) Family members

( ) Friends ( ) Neighbors ( ) School

( ) National organizations ( ) International organizations

( ) Other: (explain) …….....

19- Did you have any training related to preparedness for floods?

( ) No (please move to question 19)

( ) Yes (answer the following questions if it applies please)

Name of the training ……

Institution that provided the training……

Duration of the training with its units (hours, days etc.)……

Document given at the end of the training:

( ) None ( ) Certificate of participation ( ) Diploma

20- Do you feel yourself adequately prepared for the possible coming floods?

( ) Yes ( ) I'm not sure

( ) No

21- Would you like to be trained about individual preparation to floods?

( ) Yes ( ) No

Scale of knowledge about individual preparedness to floods

Please select the option that best fits your information level for the following items by putting (✓) inside its square:

Item	I have complete information about that	I have incomplete but good amount of information	I have a moderate amount of information	I have minimal of information	I do not have any information
27- The risks of the floods.					
28- The diseases that can occur as a result of floods.					
29- The months in which the floods occur.					
30- How to obtain information about the possible occurrence of floods.					
31- My community's local flood evacuation plan.					
32- The escape routes of my location, if roads are blocked.					
33- The water drainage plan of my houses' street					

34- How to prepare an evacuation plan.						
35- How to prepare an emergency kit that can be grabbed quickly when evacuation is needed.						
36- How to protect my crops and agriculture so that they are not affected by floods.						
37- How I can get help, if I get trapped in floodwater in the different situations (e.g inside a building,inside a vehicle, etc...)						
38- How to provide first aid, if someone is in need during flood.						
39- How to get psychological support for me and loved ones after a flood, if there is a need.						

Scale of the behavior of the individual preparedness to floods

Please select the option that best fits your behavior of flood preparedness for the following items by putting (✓) inside its square:

Item	I always do that	Most of the time	Sometimes	Rarely	I never do that	Not applied to me
60- I follow up the means that can inform me about the possible occurrence of floods.						
61- I receive early warning message about the occurring floods.						
62- During the flood season, I follow up the expected level of rains in my area.						
63- During the flood season, I follow up the level of rains in the upstream areas.						
64- I choose the place where I am going to live according to its safety and the possibility of it being affected by floods.						

Item	I always do that	Most of the time	Sometimes	Rarely	I never do that	Not applied to me
65- I choose the constituents of the building I will live in, according to their resistance and tolerance to water.						
66- I speak with my family about how we would prepare for the expected floods.						
67- I take the necessary measures to ensure that water will drain from my house.						
68- I prepare a plan of evacuation of the flooded place to a safe place.						
69- We prepare special plans to evacuate people who need help during evacuation (e.g those with disabilities, with special needs, elderly people, children.)						
70- I prepare a safe place where I can go with my family enough time before the onset of floods.						
71- I prepare a safe place where I can take my animals and livestock to, enough time before the onset of floods.						
72- I test the effectiveness of our evacuation plan by practicing it with my family.						
73- I prepare an emergency kit in which I store important things to grab quickly when evacuation is needed.						
74- I store the electrical machines in an elevated place so that they are not affected by flood water.						
75- I discuss what I have done to prepare for floods with the surrounding community other than my family.						
76- I participate with my close community in the activities that can decrease negative effects of floods.						

Item	I always do that	Most of the time	Sometimes	Rarely	I never do that	Not applied to me
77- I have insurance against floods events and losses.						
78- I immediately evacuate the building I am in if I feel it will collapse because of the flood.						
79- I grab my emergency kit quickly, if evacuation is needed.						
80- I turn off gas, electricity and water before evacuating a flooding place.						
81- If the situation requires so, I can conduct the evacuation effectively and save myself.						
82- If the situation requires so, I effectively evacuate and save my family.						
83- If the situation requires so, I effectively evacuate and save my animals.						
84- If the situation requires so, I effectively evacuate and save my important documents.						
85- If the situation requires so, I am able to effectively evacuate and save my important belongings.						
86- I avoid walking through flood waters.						
87- I refrain from swimming through flood waters.						
88- I refrain from driving through flood waters.						
89- During floods I stay off bridges over fast-moving water.						
90- If my vehicle is trapped in rapidly moving water, I stay inside the vehicle.						
91- If water is rising inside the vehicle I am trapped in, I seek refuge on the roof.						

Item	I always do that	Most of the time	Sometimes	Rarely	I never do that	Not applied to me
92- If I get trapped in a building, I go to its highest level, without going into a closed attic.						
93- I can find access to safe drinking water immediately after the flooding.						
94- I purify the water by applying one of the purification methods if the available water is not purified.						
95- I can find access to safe sanitary latrines immediately after the flooding.						
96- In the absence of a toilet I make sure that I defecate in a dry place.						
97- If I am forced to defecate outdoors, I make sure that I bury the stool with sand.						
98- After the flooding I avoid driving, except in emergencies.						
99- I return back to the flooded area after evacuation only when the authorities states that people can safely return back.						
100- I check for loose boards and slippery floors when entering a flooded home or building.						
101- I turn off electricity at the main breaker or fuse box when entering a flooded building.						
102- When I return home after evacuation, I keep an eye on dangerous debris (e.g., broken glass, metal fragments) by using a stick or anything to check for hidden dangers so as to avoid stepping on them.						

Item	I always do that	Most of the time	Sometimes	Rarely	I never do that	Not applied to me
103- I wear personal protective equipments (e.g., heavy gloves and boots) to be safe from scorpion and snake bites during clean up,.						
104- I stay away from downed power lines.						
105- I stay away from the electrical poles.						
106- I report downed power lines immediately to power companys' emergency number.						
107- I refrain from touching electrical equipment, if it is wet.						
108- I refrain from touching an electrical equipment, while standing in water.						
109- I use the charcoal stove, the generator or any other gasoline-powered machinery when there is a need only outdoors and away from windows.						
110- I apply anti-vectors measures against mosquito,houseflies,... etc. to prevent myself from vector borne diseases.						
111- I apply anti-vectors measures against mosquito, houseflies,… etc. to prevent my family from vector borne diseases.						
112- I apply measures against rodents e.g (mice and rats).						
113- I immediately fix the septic tanks and the toilets damaged because of floods as soon as possible.						

Item	I always do that	Most of the time	Sometimes	Rarely	I never do that	Not applied to me
114- We make sure that our wells and drinking water is checked for contamination from bacteria and chemicals after flooding.						
115- I clean everything that gets wet with the floods' water.						
116- I disinfect everything that needs disinfection, if it gets wet during a flood e.g. clothes						
117- I throw any food that gets wet by floods' water.						
118- I suggest ways to provide psychological support for those who need after floods.						

*If you accept to fill in this questionnaire again after 2 weeks please write your contact information below

Phone number: .....

Another phone number: ……

Annex 2.C: Questionnaire in Arabic Language

دراسة لتصميم مقياس لتقييم الاستعداد الفردي للفيضانات (كسلا ، السودان)

عزيزي المشارك

يتم إجراء هذه الدراسة من قبل قسم الصحة العامة بجامعة هاجيتبي بتركيا بالتعاون مع قسم طب المجتمع بجامعة الخرطوم. تهدف الدراسة لتصميم مقياس صحيح وموثوق لتقييم الإستعداد الفردي للفيضانات في مدينة كسلا بالسودان و البيئات المشابهة. بناء" على نتائج إجاباتك سيتم إعداد المقياس كما سيتم التخطيط لدراسات مستقبلية وخدمات أخرى تعود بالنفع على المجتمع بناء" على هذا المقياس لذلك من المهم للغاية أن تجيب على جميع الأسئلة بدقة وإخلاص.

المشاركة في هذه الدراسة طوعية، والمعلومات التي يتم الحصول عليها من خلال هذا النموذج سرية وسيتم إستخدامها فقط لغرض البحث العلميكما أنه لن يتم أخذ الأسماء والألقاب في الإستبيان . ويمكنك إختيار عدم المشاركة في البحث أو إنهاء الإستبيان في الوقت الذي تريد.

من أجل تحديد مدى موثوقية المقياس ، من الضروري ملء هذا النموذج مرة أخرى بعد أسبوعين .إذا كان يمكنك إعادة ملء الاستبيان بعد أسبوعين ، فيرجى كتابة رقم هاتفك في أسفل النموذج وسيتم الإتصال بك.

يتكون استطلاعنا من جزئين . في الجزء الأول ، هناك 21 سؤالًا حول خصائصك الاجتماعية والديموغرافية ، بينما يتكون الجزء الثاني الذي ينقسم بدوره لجزئين من مقياس المعلومات والسلوككللاستعداد الفردي للفيضان ويتكون في مجمله من 72 سؤال. في هذا الاستبيان ، الذي سيستغرق حوالي 20 دقيقة ، حدد إجاباتك عن طريق تحديد الخيار الذي تجده الأنسب لك أو قم بإعطاء إجابة عن طريق الكتابة في الأسئلة المفتوحة.في الأسئلة التي يمكنك الإجابة عليها بأكثر من خيار ، يرجى وضع علامة على جميع الخيارات المناسبة لك .إذا لم تجد إجابتك على سؤال ما ضمن الخيارات المكتوبة واخترت خيار (أخرى) ، فيرجى تحديد إجابتك بمزيد من التفصيل في المساحة المتوفرة.يمكنك اختيار الخيار (لا ينطبق علي) في مقياس السلوك للإستعداد الشخصي للفيضانات فقط عندما يكون السؤال غير قابل للتطبيق في حالتك ، على سبيل المثال السؤال يدور حول القيادة وأنت لا تقود السيارة وما إلى ذلك.

شكرا لإجاباتك المخلصة على الاستبيان.

يمكنك الاتصال بأحد الأشخاص الموجودين أدناه ، إذا كان لديك أي أسئلة أو استفسارات حول الدراسة البحثية:

الباحث الرئيسي: البروفيسور د. كريم هاكان ألتينطاش :جامعة هاجيتبي ، قسم الصحة العامة

هاتف:

الباحثون المساعدون:

الدكتورة جلشان تاشديلان تكير جامعة هاجيتيبي، قسم التعليم الطبي والمعلوماتية

هاتف:

مروة مصطفى محمد عثمان ، جامعة هاجيتبي ، قسم الصحة العامة وجامعة الخرطوم، قسم طب المجتمع

هاتف:

يرجى الإشارة إلى موافقتك على المشاركة في الدراسةعن طريق وضع علامة(✓) :

أقبل المشاركة في الدراسة ☐ لا أقبل المشاركة في الدراسة ☐

استبيان البيانات الاجتماعية والديموغرافية

يرجى الإجابة على الأسئلة متعددة الخيارات عن طريق وضع (✓) بين الأقواس أمام الخيار المناسب لك:

1- ما هي سنة ميلادك؟ يرجى كتابة السنة

بالأرقام .....

2- حدد الخيار المناسب لجنسك :

( ) ذكر

( ) أنثى

3- ما هو المستوى التعليمي الخاص بك ؟ حدد المستوى الذي حصلت منه على أحدث شهادة

( ) أعرف القراءة والكتابة ولكن لم أذهب إلى مدرسة أو تركتها

( ) المدرسة الابتدائية

( ) المدرسة الثانوية
( ) خريج جامعي
( ) دراسات عليا

4- هل تمارس عمل يدر عليك دخلا"؟
( ) نعم (من فضلك اكتب عملك.....
( ) لا

5- ما هي مهنتك؟ ....

6- ما هو دخل أسرتك الشهري بالجنيه السوداني ؟ ....

7- ما هي حالتك االإجتماعية ؟
( ) متزوج/ة
( ) عازب/ة
( ) منفصل/ة عن الزوج/ة
( ) الزوج/ة متوفي/ة

8- هل لديك أطفال؟
( ) نعم (يرجى تحديد عددهم).....
( ) لا ، ليس لدي أطفال

9- ما هو العدد الحالي لأفراد أسرتك ؟ .. ..

10- منذ متى وأنت تعيش في مدينة كسلا؟.....

11- ما اسم الحي الذي تعيش فيه الآن؟ ....

12- ما هو نوع المنزل الذي تعيش فيه الآن؟
( ) في منزل أملكه
( ) في منزل مستأجر
( ) غير ذلك (يرجى التحدي.....

13- هل شهدت حدوث أي فيضانات من قبل؟
( ) نعم (انتقل إلى السؤال 14)
( ) لا (انتقل إلى السؤال 16)

14- هل شهدت فيضانات عام 2018؟
( ) نعم (انتقل إلى السؤال 15)
( ) لا (انتقل إلى السؤال 16)

15- هل تأثرت بالفيضانات السابقة؟ (يمكنك تحديد أكثر من خيار)
( ) نعم ، لقد غمر منزلي ، وكانت لدي خسائر مالية
( ) نعم ، فقدت أحد أفراد عائلتي
( ) نعم ، حدثت إصابة لي أو لأحد أفراد عائلتي، من فضلك حدد نوع الإصابة.....
( ) نعم ، أخرى (اشرح).....
( ) لا ، لقد شاهدت الفيضان والمتضررين فقط.

16- هل أصبت بحمى الشيكونغونيا (الكنكشة) خلال وباء عام 2018 ؟
( ) نعم
( ) لا

17- هل أصيب أي شخص في منزلك بحمى شيكونغونيا (الكنكشة) خلال خلال وباء عام 2018 ؟
( ) نعم (كم عدد الأشخاص الذين تأثروا؟ ....
( ) لا

18- حدد مصادر المعلومات الخاص بك عن الفيضانات، يمكنك تحديد أكثر من خيار

( ) التلفزيون ( ) الراديو

( ) الإنترنت ( ) الصحف

( ) المجلات ( ) أفراد الأسرة

( ) الأصدقاء ( ) الجيران

( ) المدرسة

( ) المنظمات الوطنية ( ) المنظمات الدولية

( ) أخرى (حدد).....

19- هل تلقيت أي تدريب يتعلق بالإستعداد للفيضانات؟

( ) لا (يرجى الانتقال إلى السؤال 20)

( ) نعم (أجب عن الأسئلة التالية من فضلك إذا كانت تنطبق عليك)

اسم التدريب.....

المؤسسة التي قدمت التدريب.....

مدة التدريب مع وحدته الزمنية (ساعات ، أيام ، إلخ).....

وثيقة مقدمة في نهاية التدريب:

( ) لا يوجد ( ) شهادة مشاركة ( ) دبلوما

20- هل تشعر بأنك على استعداد تام لمواجهة الفيضانات القادمة؟

( ) نعم

( ) لست متأكدا"

( ) لا

21- هل ترغب في الحصول على تدريب حول الاستعداد الفردي للفيضانات؟

( ) نعم

( ) لا (لماذا :.....

مقياس المعرفة حول الاستعداد الفردي للفيضانات

من فضلك قم بتحديد الخيار المناسب لمستوى معلوماتك فيما يلي عن طريق وضع علامة (✓) داخل المربع الخاص بذلك الخيار:

البند	لدي معلومات كاملة عن ذلك	لدي معلومات غير كاملة لكن بقدر جيد	لدي قدر متوسط من المعلومات	لدي معلومات قليلة	ليس لدي أي معلومة
1- مخاطر الفيضانات.					
2- الأمراض التي يمكن أن تحدث نتيجة للفيضانات .					
3- الأشهر التي تحدث فيها الفيضانات.					
4- كيفية الحصول على معلومات حول احتمال حدوث الفيضانات.					
5- خطة الإخلاء في مجتمعي المحلي.					
6- طرق الهروب من موقعي ، إذا أغلقت الطرق.					
7- خطة تصريف المياه في شارع منزلي.					
8- كيفية إعداد خطة الإخلاء.					
9- كيفية إعداد شنطة الطوارئ التي يتم أخذها بسرعة عند الحاجة للإخلاء.					
10- كيفية حماية محاصيلي وزراعتي حتى لا تتأثر بالفيضانات .					
11- كيفية الحصول على المساعدة ، إذا علقت في مياه الفيضان في المواقف المختلفة (مثل داخل بناء،داخل عربة..الخ) .					
12- كيفية تقديم الإسعافات الأولية ، إذا كان شخص ما في حاجة أثناء الفيضانات.					
13- كيفية الحصول على الدعم النفسي لي ولأحبائي بعد الفيضانات، إذا كانت هنالك حاجة لذلك.					

مقياس سلوك الاستعداد الفردي للفيضانات:

من فضلك قم بتحديد الخيار المناسب لسلوكك في الإستعداد الشخصي للفيضانات فيما يلي عن طريق وضع علامة (✓) داخل المربع الخاص بذلك الخيار:

البند	أفعل ذلك دائما"	معظم الوقت	أحيانا"	نادرا"	لا أفعل ذلك أبدا"	لا ينطبق علي
1- أتابع الوسائل التي يمكن أن تنبهنني لاحتمال حدوث الفيضانات.						
2- أتلقى إنذارًا مبكرًا بحدوث الفيضانات .						
3- خلال موسم الفيضانات ، أتابع مستوى هطول الأمطار المتوقع في منطقتي						
4- خلال موسم الفيضان ، أتابع مستوى هطول الأمطار في المناطق التي تنحدر منها المياه.						
5- أختار المكان الذي أعيش فيه وفقا" لأمانه وإحتمالية تأثره بالفيضان.						
6- أختار مكونات المبنى الذي أعيش فيه وفقا" لقوة تحمله ومقاومته للمياه.						
7- أتحدث مع عائلتي حول كيف سنستعد للفيضانات المتوقعة.						
8- أقوم بما يلزم من التدابير لأضمن أن المياه ستتصرف من بيتي.						
9- أعد خطة لإخلاء المكان الذي غمرته الفيضانات إلى مكان آمن.						
10- نقوم بإعداد خطط خاصة لإجلاء الأشخاص الذين يحتاجون لمساعدة أثناء الإخلاء (مثل ذوي الإعاقة،ذوي الاحتياجات الخاصة،كبار السن،الأطفال).						
11- أقوم بإعداد مكان آمن يمكنني الذهاب إليه مع عائلتي قبل وقت كاف من الفيضان.						
12- أقوم بإعداد مكان آمن يمكنني نقل ثروتي الحيوانية إليه ، قبل وقت كاف من حدوث الفيضان.						
13- أختبر مدى فعالية خطة الإخلاء التي أعددتها من خلال ممارستها مع عائلتي .						
14- أجهز شنطة طوارئ أضع فيها أشياء مهمة لأخذها بسرعة عند الحاجة للإخلاء.						
15- أضع الآلات الكهربائية في مكان مرتفع حتى لا تتأثر بمياه الفيضان.						
16- أناقش ما فعلته للتحضير للفيضان مع المجتمع المحيط خارج عائلتي.						
17- أشارك مع مجتمعي المقرب في الأنشطة التي يمكن أن تقلل من الآثار السلبية للفيضانات.						

البند	أفعل ذلك دائما"	معظم الوقت	أحيانا"	نادرا"	لا أفعل ذلك أبدا"	لا ينطبق علي
18- أقوم بالتأمين على ممتلكاتي عند شركات التأمين ضد أحداث وخسائر الفيضانات.						
19- أخلي على الفور المبنى الذي أقيم فيه إذا شعرت أنه سينهار بسبب الفيضان.						
20- آخذ شنطة الطوارئ التي أعددتها بسرعة عند الحاجة لإخلاء المكان.						
21- أغلق الغاز والكهرباء والمياه قبل الإخلاء لمكان الفيضان .						
22- إذا تطلب الوضع ذلك، يمكنني تنفيذ الإخلاء بفعالية وإنقاذ نفسي.						
23- إذا تطلب الوضع ذلك ، يمكنني تنفيذ الإخلاء بفعالية وإنقاذ أسرتي.						
24- إذا تطلب الوضع ذلك ، يمكنني تنفيذ الإخلاء بفعالية وإنقاذ ثروتي الحيوانية.						
25- إذا تطلب الوضع ذلك ، يمكنني تنفيذ الإخلاء بفعالية وإنقاذ مستنداتي المهمة.						
26- إذا تطلب الوضع ذلك ، يمكنني تنفيذ الإخلاء بفعالية وإنقاذ أشيائي المهمة.						
27- أتجنب المشي في مياه الفيضان.						
28- أمتنع عن السباحة في مياه الفيضان .						
29- أمتنع عن قيادة السيارة في مياه الفيضان.						
30- أبقى بعيدًا عن الجسور فوق الماء سريع الحركة .						
31- إذا كانت سيارتي محاصرة بمياه سريعة الحركة ، أبقى داخل السيارة .						
32- إذا كان مستوى الماء يرتفع داخل السيارة التي حوصرت فيها ، فإني ألجأ إلى سقف السيارة.						
33- إذا حاصرني الماء داخل مبنى، أذهب إلى أعلى مكان في المبنى دون الدخول إلى مكان مغلق						
34- يمكنني الحصول على مياه شرب آمنة بعد حدوث الفيضان فورا".						
35- أقوم بتنقية المياه بتطبيق أحد طرق التنقية إذا كانت المياه المتوفرة غير منقاة.						
36- أجد إمكانية للوصول إلى مراحيض صحية آمنة بعد حدوث الفيضان فورا".						
37- في حالة عدم وجود مرحاض آمن أتأكد من أنني أتبرز في مكان جاف						

البند	أفعل ذلك دائما"	معظم الوقت	أحيانا"	نادرا"	لا أفعل ذلك أبدا"	لا ينطبق علي
38- إذا أضطررت للتبرز في العراء فإنني أتأكد من أني دفنت البراز بالتراب .						
39- بعد الفيضان أتجنب القيادة ، إلا في حالات الطوارئ .						
40- أعود إلى المنطقة التي غمرتها الفيضانات بعد الإخلاء فقط عندما تذكر السلطات أنه يمكن للناس العودة بأمان						
41- أتحقق من الحوائط القابلة للسقوط والأرضيات الزلقة عند الدخول إلى المنزل أو المبنى الذي غمرته المياه.						
42- أطفئ الكهرباء من المصدر الرئيسي عند دخول مبنى غمرته المياه.						
43- عندما أعود إلى المنزل بعد الإخلاء ، استخدم عصا أو أي شيئ للتحقق من الأخطار المخفية والحطامً الخطيرً(مثل الزجاج المكسور أو الأجزاء المعدنية) حتى أتجنب المشي عليها.						
44- أرتدي معدات الوقاية الشخصية (مثل القفازات والأحذية المغلقة) لكي أكون آمنًا من لدغات العقارب و الثعابين أثناء التنظيف.						
45- أبقى بعيدا" عن أسلاك الكهرباء التي سقطت.						
46- أبقى بعيدا" عن أعمدة الكهرباء.						
47- أبلغ فورا" عن أسلاك الكهرباء التي سقطت بالإتصال برقم الطوارئ الخاص بشركة الكهرباء.						
48- أمتنع عن لمس جهاز كهربائي عندما يكون مبللا".						
49- أمتنع عن لمس أي جهاز كهربائي أثناء وقوفي في الماء.						
50- أستخدم موقد الفحم (الكانون) المولدً (الجنريتور) أو آلة أخرى تعمل بالبنزين عندما تكون هناك حاجة فقط في الهواء الطلق وبعيدًا عن النوافذ.						
51- أتخذ تدابير مضادة لنواقل الأمراض (مثل البعوض ،الذباب... إلخ) لأحمي نفسي من الأمراض التي تنقلها.						
52- أتخذ تدابير مضادة للنواقل الأمراض الأمراض (مثل البعوض ،الذباب... إلخ) لأحمي عائلتي من الأمراض التي تنقلها.						
53- أطبق تدابير ضد القوارض (مثل الفئران والجرذان).						

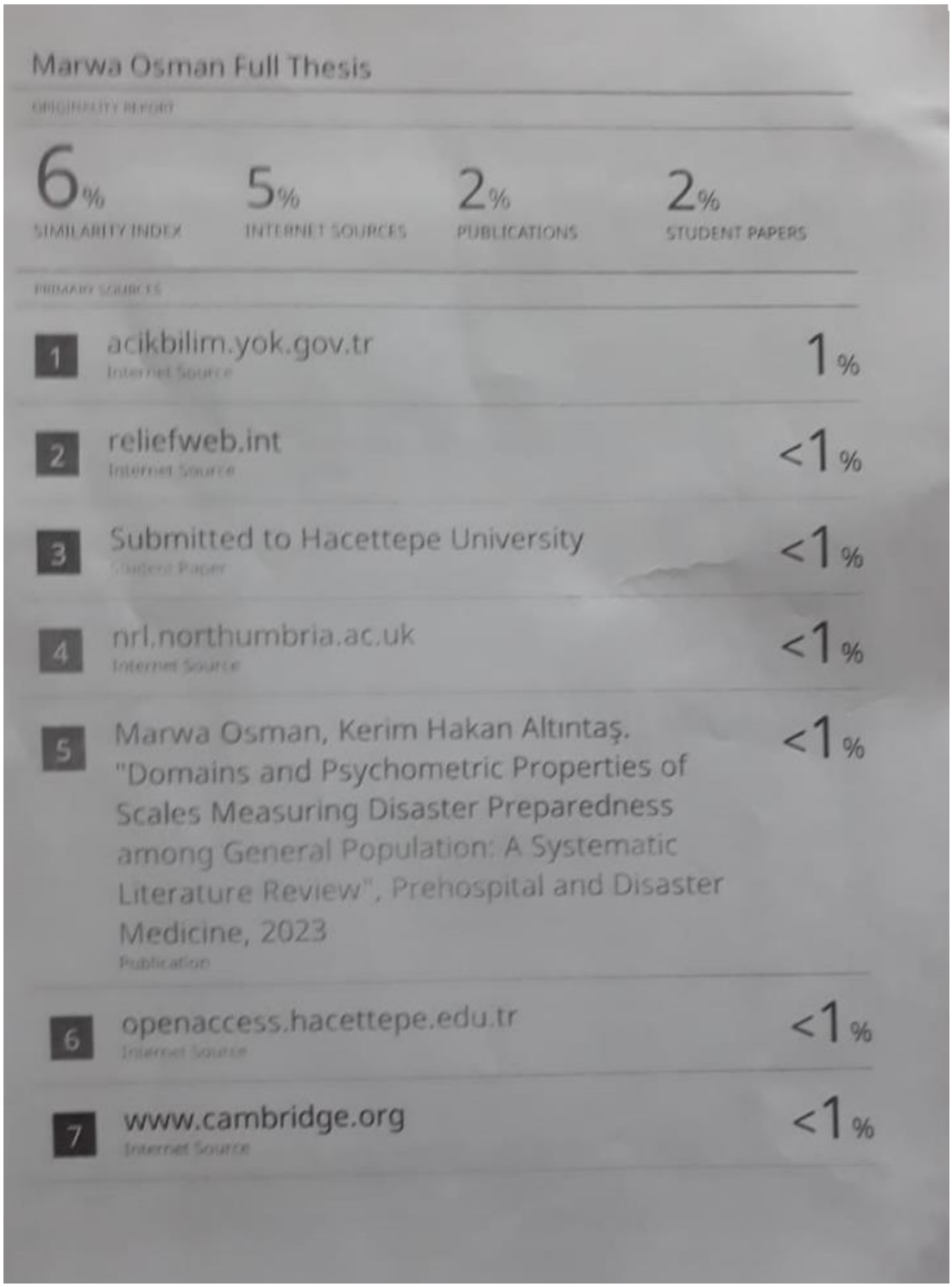
البند	أفعل ذلك دائما"	معظم الوقت	أحيانا"	نادرا"	لا أفعل ذلك أبدا"	لا ينطبق علي
54- أقوم بإصلاح خزانات الصرف الصحي (السيبتك تانك) والمراحيض التي لحقت بها أضرار بسبب الفيضان في أسرع وقت ممكن .						
55- نتأكد من أن آبارنا ومياه الشرب التي تصلنا يتم فحصها للتأكد من خلوها من التلوث بالبكتيريا والمواد الكيميائية بعد الفيضان.						
56- أقوم بتنظيف كل ما يتبلل بماء الفيضان .						
57- أقوم بتطهير كل ما يحتاج إلى تطهير ، إذا تبلل أثناء الفيضان.						
58- ألقي أي طعام يبتل بمياه الفيضان.						
59- أقترح وسائل لتقديم الدعم النفسي للذين هم في حاجة لذلك بعد الفيضان.						

*إذا كنت توافق على ملء هذا الاستبيان مرة أخرى بعد أسبوعين ، يرجى كتابة معلومات الاتصال الخاصة بك أدناه

رقم الهاتف..... .....

رقم هاتف آخر .....

Annex 3: THESIS ORIGINALTY REPORT



Marwa Osman Full Thesis

ORIGINALITY REPORT

6%	5%	2%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	acikbilim.yok.gov.tr Internet Source	1%
2	reliefweb.int Internet Source	<1%
3	Submitted to Hacettepe University Student Paper	<1%
4	nrl.northumbria.ac.uk Internet Source	<1%
5	Marwa Osman, Kerim Hakan Altıntaş. "Domains and Psychometric Properties of Scales Measuring Disaster Preparedness among General Population: A Systematic Literature Review", Prehospital and Disaster Medicine, 2023 Publication	<1%
6	openaccess.hacettepe.edu.tr Internet Source	<1%
7	www.cambridge.org Internet Source	<1%

Annex4 : Digital Recetipt

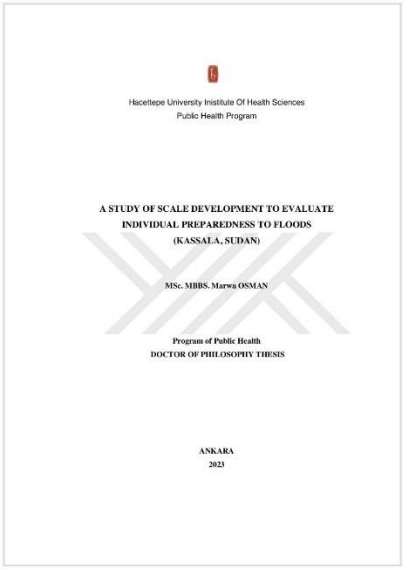
turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Marwa Mustafa Mohamed OSMAN
Assignment title:	A STUDY OF SCALE DEVELOPMENT TO EVALUATE INDIVIDUAL...
Submission title:	Marwa Osman Full Thesis
File name:	Marwa_thesis_22.01.2024HA_R_27.12.2023.docx
File size:	4.86M
Page count:	183
Word count:	43,892
Character count:	241,950
Submission date:	22-Jan-2024 03:16PM (UTC+0300)
Submission ID:	2275830467



Hacettepe University Institute Of Health Sciences
Public Health Program

A STUDY OF SCALE DEVELOPMENT TO EVALUATE
INDIVIDUAL PREPAREDNESS TO FLOODS
(KASSALA, SUDAN)

MSc. MBBS. Marwa OSMAN

Program of Public Health
DOCTOR OF PHILOSOPHY THESIS

ANKARA
2023

Annex 5: Educational Material Prepared By Sudan Mininstry of Health and World Health Organization

Annex 6: Curriculum Vitae

Name: *Marwa Mustafa Mohammed Osman (Marve Osman)*
Date Of Birth: *03/11/1986*- Sudan
Address: *Hacettepe University, Ankara, Turkey*
E- Mail: *marwamustafa135@gmail.com*
Google Scholar: https://scholar.google.com/citations?user=swb-CKUAAAAJ&hl=en&oi=sra
Orcid: https://orcid.org/0000-0003-4196-8141

Education and Qualifications

2016 – 2023	**PhD Health sciences *institute,*** *Hacettepe University, Ankara, Turkey* *With accreditation by the European Doctoral Organization in Biomedicine and Health Sciences (ORPHEUS).*
2013- 2015	***MSc*** *of community medicine (Public health), University of Khartoum, Sudan*
2003- 2010	***MBBS*** *Faculty of medicine, University of Khartoum, Sudan*
	Alnil Secondary school, Khartoum, Sudan
2000-2003	*I scored (92.2%) which placed me among the highest 150 mark in Sudan.*
	Primary school, Khartoum
1992-2000	*I scored the highest mark (249 out of 250) in Khartoum state the Capital of Sudan.*

Work Experience

2016 -2023	**lecturer** *in department of community medicine (public health) in faculty of medicine, University of Khartoum*
2012 -2016	**Teaching Assistant**
2010-2012	- **General medical practitioner** - **Permanent registered *medical practitioner,*** Sudan medical council, Sudan - **Registrated doctor**, *Sudan medical council, Sudan* - ***House officer*** *(intern doctor), Khartoum state hospitals, Sudan*

Courses I have teached

1. Biostatistics
2. Epidemiology
3. Research methodology

4. Community health (general concepts of health definitions, health determinants and indicators)
5. Primary health care
6. Environmental health

Course &training

Medical education

1. Intensive Research methodology course, department of community medicine University of Khartoum,2013
2. Problem-Based Learning (PBL) course, Educational development centre (EDC), faculty of medicine, university of Khartoum, 2012
3. Teaching & learning course, Educational development centre (EDC), faculty of medicine, university of Khartoum, 2013
4. Students' assessment & evaluation course, Educational development centre (EDC), faculty of medicine, university of Khartoum, 2013
5. Principle & Techniques of Course Design, Educational development centre (EDC), faculty of medicine, university of Khartoum, 2013
6. Academic Advising, University of Khartoum Advanced Training Centre, Sudan, 2022
7. Continuing professional development, international medical education scholarship (a workshop held in Sudan in collaboration with association for medical education in Europe (AMEE), 2014

Public Health Training

8. "Surveillance, outbreak investigation and response" training course, the federal ministry of health in collaboration with EMPHNET {Eastern Mediterranean Public Health Network"
9. Training courses in general management, Projects & organizations management, communication skills & training of trainers in Health Education about risks of drugs & AIDS prevention.
10. Qualitative Research Methods for Mental Health in War and Conflict,44HC-MENA (King's College London, Birzeit University and Hacettepe University), Ankara, Turkey, 2019

Publications

1. Osman, M., & Altıntaş, K. (2023). Domains and Psychometric Properties of Scales Measuring Disaster Preparedness among General Population: A Systematic Literature Review. Prehospital and Disaster Medicine, 38(5), 636-644. doi:10.1017/S1049023X23006386 **(Q2)**
2. Cavusoglu R, Aktuna G, Koc E, Aslan D, Osman M. Global overview of refugees: comparison of 2005 and 2015 data for the 10 most affected countries. Eastern Mediterranean Health Journal, World Health Organization, 2019;25 (6): 435-40. **(Q3)**
3. Osman M, Shigidi M, Ahmed H, Abdelrahman I, Karrar W, Elhassan E, Shwaib H, Ibrahim R, Abdalla M. Pattern and outcome of acute kidney injury among Sudanese adults admitted to a tertiary level hospital: a retrospective cohort study. Pan African Medical Journal. 2017;28(1):165. **(Q3)**
4. Osman,M et al (Under review). Development of Flood Preparedness Practice Scale: A Methodological Validity and Reliability Study. Prehospital and Disaster Medicine (Q2)
5. Osman,M et al (Under review). Development of Flood Preparedness Knowledge Scale: A Methodological Validity and Reliability Study. BMC public Health **(Q1)**

Languages

Arabic – mother tongue
English – fluent; (IELTS exam band 7 in July 2014)
Turkish – fluent (C1 certificate from Hacettepe university in June 2016)
French – basic

Computer skills

Familiar with using the internet, Microsoft office programs, SPSS, Zoom, webex meet

References: available upon request
Certificates: available upon request.