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*Research article*

# METHODOLOGY FOR BUILDING AUTOMATED SYSTEMS FOR MONITORING ENGINEERING (LOAD-BEARING) STRUCTURES, AND NATURAL HAZARDS TO ENSURE COMPREHENSIVE SAFETY OF BUILDINGS AND CONSTRUCTIONS

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**Abstract:** The load-bearing structures of buildings and constructions (further on referred to as ‘facilities’) are subject to wear-caused loss of operability. Exploitation of facilities with damaged construction elements may lead to emergencies, which are likely to cause loss of life. The article describes a methodology for automated monitoring of engineering (load-bearing) structures and natural hazards to ensure comprehensive safety of buildings and constructions.

**Keywords:** automated monitoring systems, safety of buildings and constructions, assessment of technical condition of facility load-bearing structures, emergencies.

## 1. Introduction

The load-bearing structures of buildings and constructions (further on referred to as ‘facilities’) are subject to wear-caused loss of operability. Exploitation of facilities with damaged construction elements may lead to emergencies, which are likely to cause loss of life. This is confirmed by unexpected collapses of facility construction elements in Russia, Azerbaijan, Germany, Poland, and other countries, which resulted in extensive casualties (Ginzburg & Khripushin, 2013, Ginzburg, Ryzhkova & Skiba, 2014) (Figure 1).



**Figure 1.** Suddenly Collapsed Building in Baku, 2007.

Various disasters have struck countries around the world in recent decades, with the frequency of such events significantly increasing, having a devastating impact on buildings and infrastructures, killing millions of people, and exposing the environment to growing dangers (Rico, 2019). Given the overall lack of awareness of such threats among the general public, it is required to engage in a variety of initiatives in order to positively improve the situation.

The assumption behind integrated natural disaster management is that people can perceive, identify, and assess a wide range of natural catastrophe risks (Cvetkovic & Martinovic, 2021). The FGBU VNII GOChS (FTs), MGSU and a number of other agencies have jointly designed a unique technology for building an automated structured system for monitoring engineering (load-bearing) structures, and natural hazards (ESMS) to ensure comprehensive safety of buildings and constructions (Kachanov & Nigmatov, 2008, Kachanov, Volkov & Fatyhoj, 2009, Kachanov, Mahutov & Taranov, 2010). The ESMS is designed for: timely automated remote notification of the emergency and dispatching services, management, and on-duty services of the facility under monitoring, on the condition of the facility's load-bearing structures and natural hazards, using the following criteria: 'normal condition', 'higher risk', 'emergency'; monitoring and documenting changes in the condition of the load-bearing structures and natural hazards caused by accumulated exploitation defects, which may lead the building or construction to an extreme condition mandating corresponding repairs or bringing the operation to a halt, throughout the whole facility operation period.

The ESMS is comprised by equipment for monitoring changes in the condition of foundations and engineering structures of buildings and constructions; engineering protection facilities, and also, if there is any corresponding hazard, for monitoring the areas of possible mudflows, mudslides and avalanches in the building or construction operation area (Volkov, Sedov, Chelyshkov & Zinkov, 2010). It includes: ESMS servers, local servers and controllers; ESMS automated workstations (AW); data gathering and transferring network equipment; sensors monitoring changes in the condition of foundations and engineering structures of buildings and constructions; engineering protection facilities, and also areas of possible mudflows, mudslides and avalanches (Kachanov, Batyrev & Volkov, 2011).

See Figure 2 for the ESMS algorithm.

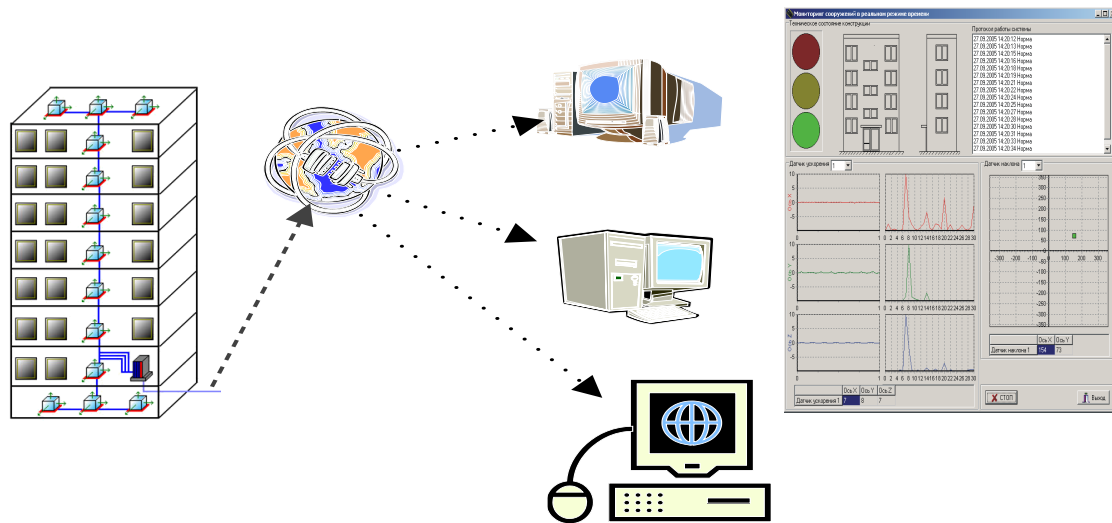


Figure 2. ESMS Algorithm.

The ESMS has the following functional subsystems (Kachanov, Batyrev & Volkov, 2011): 1) the signaling monitoring subsystem, which continuously operates: to monitor the integral characteristics of the facility load-bearing structures in an automated real-time mode; to notify the facility operations control desk and the city emergency service personnel on the critical changes in the condition (deformed condition) of the facility structures in an automated real-time mode; 2) the intermittent monitoring subsystem, which is launched by notifications (incident, accident) coming from the signaling monitoring subsystem or under a regulation. In an automated mode it: assesses the technical condition of the facility load-bearing structures and issues recommendations for reinforcement (reconstruction); controls and adjusts (if necessary) the signaling subsystem.

ESMS installation is advisable for the following types of facilities: facilities constituting nuclear and/or radiation hazard (nuclear power plants, research reactors, fuel cycle facilities, temporary and long-time warehouses for nuclear fuel and radioactive waste), facilities using nuclear energy; for production, use, processing, generation, storage, transportation and disposal of hazardous materials in the volumes exceeding the limits under the Russian Federation Law; for chemical and other hazardous waste disposal and burial; having large warehouses for storage of oil and oil products (over 20,000 tonnes) and isothermal storage facilities for liquefied gases; for production of melts of ferrous and nonferrous materials and alloys based on these melts; for mining, minerals processing, subsoil operations, including companies performing subsoil and open-pit (mining depth over 150 m) extraction and processing of solid minerals; using stationary cableways and funiculars; for production, generation or processing of liquid or solid materials with explosive features or prone to spontaneous decomposition with a possible explosion energy equal to 4.5 tonnes of TNT; power transmission lines and other grid facilities with the voltage of 330 kilovolts or more; space infrastructure facilities; airports and their infrastructure facilities; public railway system facilities; metros; sea ports excluding specialized sea ports for sports and pleasure boats maintenance; thermal power plants with the capacity of 150 megawatts and more; offshore oilfield facilities; mainline gas, oil and product pipelines; gas distribution system facilities using, storing or transporting natural gas or liquefied hydrocarbon gas; waterworks of class 1, 2 and 3; large industrial facilities with more than 10,000 workers; capital construction facilities with the design documentation comprising at

least one of the following features: height over 100 meters; flights over 100 meters; console over 20 meters; with depth of the subsoil part (in full or in part) more than 10 meters below the grade (ground) elevation; with constructions and construction systems, which have unconventional design methods applied to them to consider physical or geometric non-linear features or have specialized design methods developed for them; facilities with maximum design capacity of 500 people and more: entertainment, sports facilities, multifunctional office centers and shopping malls, health facilities, hotels; life-supporting facilities: units, warehouses, storage facilities, waterworks and engineering protection facilities and communications whose destruction (damage to) may disrupt the life of people (stop water, gas, heat, power supply, cause flooding, damage residential communities, cause failure of waste water and sewage water treatment facilities) resulting in an emergency.

ESMS has unique features and thus requires dedicated scientific and technical research. Firstly, the subsystem has to gather long-term, reliable and accurate information on the condition of load-bearing structures. This requirement stems from the fact that construction facilities, especially the unique ones, are designed for a long life totaling dozens and even hundreds of years and the accident-causing events feature very low probability of tenths and even thousandths of a percent.

It is advisable to highlight an important feature of the ESMS design calculations compared to the load-bearing structures design calculations. The design process has to ensure the structures reliability under the statistical uncertainty of the design parameters, which is often offset by establishing safety margins and redundancy of design models. While performing calculations for setting up an ESMS, including experimental research, one has to deal with a real structure and real loads, while the design models have to be adequate for a real construction operation. All the features mentioned require in-depth analysis of the results of theoretical and experimental research to project the behavior of structures in exploitation, which will help design a concept for a monitoring system and its technical implementation, design the parameters and criteria to assess the technical condition of the structures for decision-making concerning further exploitation (Kachanov, Volkov & Fatyhoy, 2009, Kachanov, Batyrev & Volkov, 2011).

The following tasks are to be performed to achieve the goal: a) to create a mathematical model of the load-bearing structures; b) to calibrate the model based on on-site experimental data to ensure its adequacy; c) to perform static calculations under normal construction exploitation conditions (based on standard loads) and extreme conditions (based on design loads) to identify and assess the parameters controlled by monitoring; d) to perform dynamic calculations – modal analysis and vibration-based diagnostics – to project and analyze corresponding experimental data; e) to perform dynamic calculations to identify typical damage scenarios and corresponding changes in the controlled parameters of the structures.

Let's consider a mathematical model for the roof of the Ice Sports Palace on the Khodynskoye Field in Moscow as an example for developing a mathematical model for load-bearing structures (Kachanov, Volkov & Fatyhoy, 2009, Kachanov, Batyrev & Volkov, 2011). The load-bearing structure of the roof of the Ice Sports Palace on Khodynskoye Field is a one-layer, reticle, guy shell made of 48 radial flexural-hard I-section threads delineated on the 198 m radius, ring cells consisting of I-section beams and tubular connections filling virtually all the roof cells. In fact, this is an inverted Shvedler Cupola, which is a discreet analogue of a guy shell with the elements resisting tension, compression, bending, and shear in three dimensions.

The roof shell has a circular outline with the external diameter of around 110 m. The sag is 7.9 m, or 1/14 of the flight. The shell has a doubly connected contour comprised by an external composite ring with rectangular 1,200x1,600 mm cross-section, and an I-section central

internal ring with 20 m diameter and 1,200 mm height. The external bearing ring rests on a ferroconcrete slab crowning the load-bearing structures of the stalls. The main supports of the shell are 'floating' to prevent the thrust transfer from the shell to the stalls. The three supports on the major diameters of the roof prevent it from the horizontal shift.

The load-bearing element of the roof is roofing profile put in a circular fashion on the load-bearing threads and attached to them by tapping screws. The roofing profile makes an orthotropic shell working jointly with the major reticle shell. The mathematical model has been designed on the Nastran calculation suite and includes a three-dimensional geometric layout of the structures, databases on the physical features of the construction materials and geometrical features of the cross-sections of the construction elements, databases on the loads and their design combinations. The three-dimensional geometric layout was built on the AutoCAD design suite and exported to the Nastran's Femap preprocessor in the DXF format. All the construction elements of the roof mesh (rings, hard threads and bracings) were modelled by lines, and the plate elements framing the internal ring were modelled by flat surfaces.

The end element mesh was superimposed on the geometric layout: the BEAM type rod end elements were used for the lines, and the PLATE type elements were used for the surfaces. The database on the physical features of the construction materials was generated based on the following data.

For steel:

- $E = 2.1 \cdot 10^6 \text{ kgf/cm}^2$  – modulus of elasticity,
- $\nu = .3$  – Poisson ratio,
- $\rho = C\gamma/g = 1.2 \cdot 7.85 \cdot 10^{-3}/981 = 9.6 \cdot 10^{-6} \text{ kgf}\cdot\text{sec}^2/\text{cm}^4$  – density,

where  $C = 1.2$  – construction coefficient,  $\gamma = 7.85 \cdot 10^{-3} \text{ kgf/cm}^3$  – bulk weight of steel,  $g = 981 \text{ cm/sec}^2$  – free fall acceleration.

For concrete:

- $E = 3 \cdot 10^5 \text{ kgf/cm}^2$  – modulus of elasticity,
- $\nu = .3$  – Poisson ratio,
- $\rho = C\gamma/g = 1.1 \cdot 2.5 \cdot 10^{-3}/981 = 2.8 \cdot 10^{-6} \text{ kgf}\cdot\text{sec}^2/\text{cm}^4$  – density.

A specialized component unit of the Nastran suite was used for designing the geometric features of the cross-sections of the construction elements.

The geometric layout and the end-element layout of the roof load-bearing structures were respectively imported and designed under the protocol in Table 1. The titles of the construction elements correspond with the titles of dxf-files.

The lines and end elements with geometric features are represented by corresponding groups of numbers, which are in their turn arranged by layers. A structure like that when used for designing a roof mathematical model ensures convenient application of large databases in the future.

**Table 1.** Protocol for Designing End-Element Layout of the Roof

Title of construction elements	Average length of end-element (cm)	Line numbers	End-element numbers	Geometric features numbers	Layer numbers	
Outer ring, ferro-concrete filling	42	1 - 144	1 - 816	Prop. 1	Layer 5 Koltso beton	
Outer ring, steel form	42	1 - 144	817 - 1632	Prop. 2	Layer 6 Koltso steel	
Outer ring supports with gaps	105	145 - 240	1633 - 1728	Prop. 3	Layer 3 GAP	
Hard threads 1	61	241 - 432	1729 - 2688	Prop. 4	Layer 2 Pokrytie	
Hard threads 2	61	433 - 576	2689 - 3456	Prop. 5		
Hard threads 3	61	577 - 720	3457 - 4224	Prop. 6		
Hard threads 4	61	721 - 912	4225 - 5232	Prop. 7		
Ring elements 1	90	913 - 960	5233 - 5568	Prop. 8		
Ring elements 2	90	961 - 1008	5569 - 5856	Prop. 9		
Ring elements 3	90	1009 - 1104	5857 - 6384	Prop. 10		
Ring elements 4	80	1105 - 1200	6385 - 6816	Prop. 11		
Ring elements 5	48	1201 - 1296	6817 - 7248	Prop. 12		
Ring elements 56	40	1297 - 1344	7249 - 7440	Prop. 13		
Bracings $\alpha$	110	1345 - 1392	7441 - 7824	Prop. 14		
Bracings $\beta$	91	1393 - 1632	7825 - 9504	Prop. 15		
Bracings $\theta$	80	1633 - 1728	9505 - 10320	Prop. 16		
Bracings $\varepsilon$	75	1729 - 1776	10321 - 10512	Prop. 17		
Inner ring	33	1777 - 1824	10513 - 10704	Prop. 18		
Chords	62	1825 - 1936	10705 - 11088	Prop. 19		
Diagonal rods	41	1937 - 2032	11089 - 11472	Prop. 20		
Inner ring reinforcement plates			11473 - 12240	Prop. 21		Layer 4 Plate
Rigid Inserts Rigid			12241 - 12272			Layer 2 Pokrytie

To ensure the roof survivability if the outer ring fails (is damaged), 96 extra horizontal bearings are to be employed if the ring moves inside about 20 mm. In the mathematical model, the elements are represented by the dedicated GAP type end elements with the gap of 20 mm and compressive stiffness of  $C_e = 2 \cdot 10^6$  and tension stiffness of  $C_t = 1 \cdot 10^{-4}$ . The Nastran design software was used to calculate the gravity load of the roof load-bearing structures, including the roofing profile shell, based on the geometric and physical features of the construction materials.

The test loads modeling the gravity load of the roof, the snow and technological load are calculated and applied to the roof bearing mesh as lumped masses at the ring and radial element intersection nodes. The dedicated MASS end-element type is used for this purpose (Fig.3).

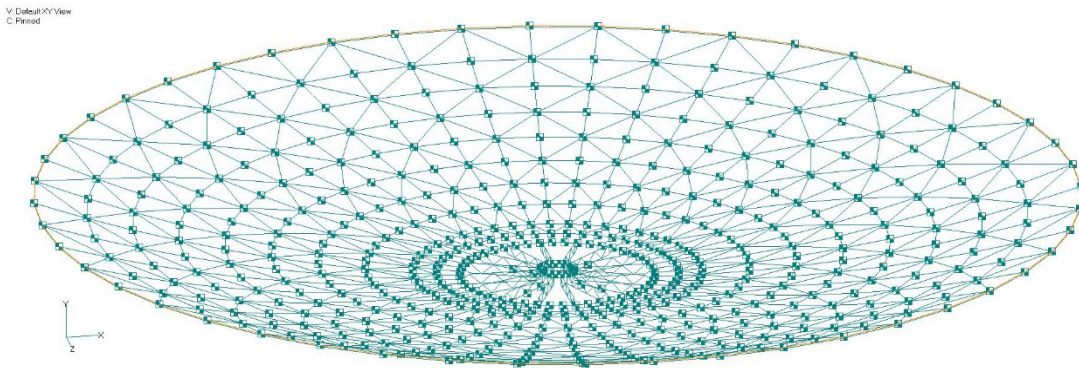


Figure 3. MASS-Type End-Element Layout

See Table 2 for the roof load intensity.

Table 2. Intensity of Loads on the Roof

Load Type	Design Load $g^n$ (kgf/m <sup>2</sup> )	Load Effect Factor $\gamma_f$	Design Load $g$ (kgf/m <sup>2</sup> )
Insulating roof layers	65	1.1	72
Technological	10	1.1	11
Subtotal load	75	1.1	83
Snow load	140	1.43	200
Total, snow included	215	1.316	283

The data in the table is based on the design materials specified according to the results of an on-site survey. Considering the roof symmetry, it is enough to calculate the values of node masses located on one radial hard thread. Figure 4 shows the sizes of load areas  $A(m^2)$  related to corresponding nodes, where Num shows the numbers of the nodes on the hard thread, starting with the outer ring and going to the center, while Table 3 shows standard and design values of node masses.

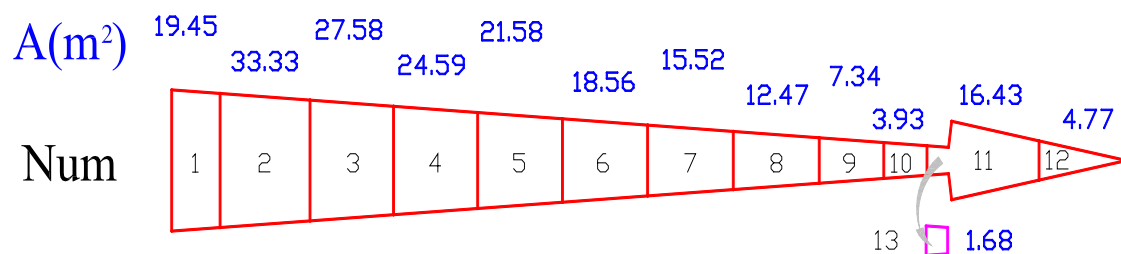


Figure 4. Load Areas for Calculating Masses.

Table 3. Standard ( $m^n$ ) and Design ( $m$ ) Values of Node Masses ( $kgf \cdot sec^2/cm^4$ )

# of node (load area)	PROP	Load area $A_i (M^2)$	Summer (no snow)		Winter (with snow)	
			$m^n = A_i \cdot 75/981$	$m = A_i \cdot 83/981$	$m^n = A_i \cdot 215/981$	$m = A_i \cdot 283/981$
1	2	9.45	1.487	1.646	4.263	5.611
2	3	33.33	2.548	2.820	7.300	9.615
3	4	27.58	2.109	2.333	6.045	7.956
4	5	24.59	1.880	2.080	5.389	7.094
5	6	21.58	1.650	1.826	4.730	6.225
6	7	18.56	1.419	1.570	4.068	5.354
7	8	15.52	1.187	1.313	3.401	4.477
8	9	12.47	0.953	1.055	2.733	3.597
9	0	7.34	0.561	0.621	1.609	2.117
10	1	3.93	0.300	0.333	0.861	1.134
11	2	16.43	1.256	1.390	3.600	4.740
12	3	4.77	0.365	0.404	1.045	1.376
13	34	1.68	0.128	0.142	0.368	0.485
14	5	Technological platform with the weight of 8 tf. $m = 8\ 000/4/981 = 2.0387\ kgf \cdot sec^2/cm^4$ .				
15	6	Mediacube with the weight of 10 tf. $m = 10\ 000/4/981 = 2.548\ kgf \cdot sec^2/cm^4$ . (only for the Y axis)				

See Tables 4 and 5 below for the results of statistic calculations determining the thresholds for normal, pre-fault and unacceptable exploitation in summer and winter, based on the accepted mathematical model for the behaviour of the ISP roof.

**Table 4.** Criteria for Technical Condition of the Roof Depending on the Controlled Rings Rotation Angles in the 'Summer' Exploitation Period.

Roof Ring Number	Normal exploitation threshold (Normal mode)		Pre-fault exploitation threshold (Caution mode)		Unacceptable exploitation threshold (Danger mode)	
	Movements (mm)	Rotation An- gle (radian)	Movements (mm)	Rotation An- gle (radian)	Movements (mm)	Rotation An- gle (radian)
1	0	0.00391	0	0.00407	0	0.00423
2	34	0.0018	35.7	0.00191	37.4	0.00202
3	44.3	0.00025	46.4	0.00034	48.5	0.00041
4	53.9	0.00025	54.7	0.00032	55.5	0.00039

The calculations shown in the table above are based on the standard gravity loads generated by the roof load-bearing and enclosure structures, technological loads from engineering networks, flying bridges, the central technological platform and the mediacube.

**Table 5.** Criteria for Technical Condition of the Roof Depending on the Controlled Rings Rotation Angles in the ‘Winter’ Exploitation Period (with Snow Load)

Roof Ring Number	Normal exploitation threshold (Normal mode)		Pre-fault exploitation threshold (Caution mode)		Unacceptable exploitation threshold (Danger mode)	
	Movements (mm)	Rotation Angle (radian)	Movements (mm)	Rotation Angle (radian)	Movements (mm)	Rotation Angle (radian)
1	0	0.00563	0	0.00709	0	0.00855
2	54.1	0.00331	70.8	0.00454	87.5	0.00577
3	75.2	0.00059	100.6	0.00074	126	0.00089
4	75.8	0.00053	93.9	0.00122	112	0.00191

The figures in Table 5 are based on the design values of the permanent loads mentioned above, as well as the design snow load (200 kgf/m<sup>2</sup>) applied to half of the roof and all the surface inside the inner ring. A similar distribution of snow on the roof was observed in winter 2007. The snow redistribution on the roof was caused by its gradual slide from the peripheral area to the center. It is obvious that the distribution of snow on the roof like that is not strictly justified and is used here with a certain safety margin given the lack of more precise data.

The ESMS software suite registers changes based on the criteria calculated in the tables above. The technical condition criteria for the ISP roof load-bearing structures can be developed on the aforementioned basics to establish a conclusion-drawing procedure for a monitoring stage of the technical condition of the facility engineering structures and determine a decision-making procedure to ensure a safe technical condition for the facility engineering structures.

The ‘traffic lights’ may be used as danger indicators and the integral characteristics like movements, shapes and oscillation frequencies of the construction may be considered to ‘switch on’: a) the green light, when the values monitored for these characteristics are within the standard impact scope. This is a normal exploitation condition for the construction; b) the red light, when the monitored values reach or exceed the limits for design impact. This condition bans further construction exploitation; c) the yellow light, when the monitored values are between the abovementioned ones. This condition warns about a significant danger forthcoming. It is expedient to discover the reason quickly, eliminate it if possible, or take preemptive measures.

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*Research article*

# BUILDING RESILIENCE THROUGH LOCAL AND INTERNATIONAL PARTNERSHIPS, NIGERIA EXPERIENCES

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**Abstract:** Current human development pathways tend to increase disaster impacts, and many disaster impacts are likely to increase due to anthropogenic activities that catalyse epidemiological virus mutation impact series, global warming, and climate change. No specific federal agency is exclusively responsible for disaster management as all the required scientific skills and fiscal resources are not in situ. It is also a fact that global pandemic like COVID-19 has local implications, and that local management of the disease has international implications, as revealed in this study. The study actually examined Nigeria's experience in building national resilience through local and international coalition amidst disaster diplomacy among strong nations. The study also assessed the country's National Emergency Management Agency's programmes and other international donor agencies like UNDP, EU and NGOs' pilot projects surveys. It is revealed that the idea of the global village is fully exemplified as COVID-19 impacts is every one's business and that Nigeria, as a major beacon in Sub-Sahara countries, is a laboratory for disaster diplomacy testing in understanding how donor competition shapes recipients' policy and support. Therefore, a symbiosis relationship among nations and agencies is recommended to enhance the DRR issue.

**Keywords:** COVID-19, Coronavirus, DRR, Disaster Diplomacy, Disaster Resilience, Foreign Aids, Disaster vulnerability, Global pandemic, Inclusive policy, International coalition, Political Synergy, Sub-Sahara countries.

## 1. Introduction

That disasters will continue to occur is as certain as saying the sun will rise or set especially with the new discoveries in coronavirus mutations, but actions that move a nation, region or community from reactive to a more proactive activity that enhance resilience will reduce

many of the broad societal and economic burdens that disasters often cause. The pattern and levels of cities development shapes disaster risk, and disaster risk also shapes development possibilities since human life itself is risk as they are causers of risk and recipients of risk It has been generally asserted that no nation or community is immune from disasters or disaster-related losses. Challenging issues that are anthropogenic related like; Earthquake, Tsunami, Wildfire, Drought, Flooding, Heat wave, Epidemic outbreaks, and Terrorism can all lead to large-scale consequences for the nation and its communities. Communities and the nation thus face difficult fiscal, social, cultural, and environmental choices about the best ways to ensure basic security and quality of life against hazards, deliberate attacks, and disasters. Beyond the unquantifiable costs of injury and loss of life from disasters, statistics for 2011 alone indicate economic damages from natural disasters in the United States exceeded \$55 billion, with 14 events costing more than a billion dollars in damages each, (NRC, 2012).

One way to reduce the impacts of disasters on the nation and its communities is to invest in enhancing resilience, (UNDP, 2004). Resilience by way of defined is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. Enhanced resilience allows better anticipation of disasters and better planning to reduce disaster losses—rather than waiting for an event to occur and paying for it afterward. Although, building the culture and practice of disaster resilience is not inexpensive or complex. Decisions about how and when to invest in increasing resilience involve short- and long-term planning and investments of time and resources prior to an event. Although the resilience of individuals and communities may be readily recognized after a disaster, resilience is currently rarely acknowledged before a disaster takes place, making the “payoff” for resilience investments challenging for individuals, communities, the private sector, and all levels of government to demonstrate. An important responsibility for increasing national resilience lies with residents and their communities. Input, guidance, and commitment from all levels of government and from the private sector, academia, and community-based and nongovernmental organizations are needed throughout the entire process of building more resilient communities.

In fulfilment of the adage that says ‘A friend in need, is a friend in deed’ create a test bed for international donor competition in countries like Nigeria as a major market dumping site for global economic powers like US and China. For instance, according to Chung et al (2020) making reference to Wilson Center, China gave \$129,966,634.2 more than the U.S. (China’s total assistance of \$297,895,104.4 vs. U.S.’s assistance of \$167,928,470.2) in total aid more to Latin American nations during the COVID-19 pandemic in March-August 2020 This paper, therefore, examine the pattern of foreign aids to Nigeria before and during the pandemic as a way of wooing the country and the same time strengthening national resilient while preventing spill-over effects of disaster mismanagement globally.

## **2. Review of literature**

In building resilience to disasters, there is the need to fully understand, manage, and disseminate foundation on disaster risks reduction. The leadership should establish a national “culture of resilience,” a full and clear commitment to disaster resilience by the federal government is essential (NAP, 2012). Risk management therefore is a continuous process that identifies the hazard(s) facing a community, assesses the risk from these hazards, develops and implements risk management strategies, re-evaluates and reviews these strategies and policies. Risk management strategies requires regular re-evaluation in the context of new data and best practices on the hazards and risk facing a community, and changes in the socioeconomic and demographic characteristics of a community, as well as the community’s

goals. Although some residual risk will always be present, risk management strategies can help build capacity for communities to become more resilient to disasters.

Historical patterns of disaster losses provide some sense of the magnitude of the need to become more disaster resilient. The geographic patterns of disaster losses—e.g., human fatalities, property losses, and crop losses—illustrate where the impacts are the greatest, what challenges exist in responding to and recovering from disasters, and what factors drive exposure and vulnerability to hazards and disasters. Although, most countries lack a national repository for all hazard and loss data, causes the compromising the ability of communities to make informed decisions about where and how to prioritize their resilience investments.

International collaborations on disaster management and resilience building have been in the front burner of UN bodies and NGOs. Most developing countries depend on developed countries for aids when it comes to disaster event. Although from the definition of disaster, an event is termed disaster when their occurrences overwhelm the affected community or nation, and so if nations depend on others for intervention is not out of place. In comparison, a pandemic is defined as an event where there is a sudden increase in cases that spread across several countries and affects a large number of people” (Centers for Disease Control and Prevention, 2020). While the WHO specified that to reach pandemic status, a disease must have caused significant outbreaks in at least two countries within a region, and one country outside of the region.

Foreign aids, however, have a lot of connotation as observed by Chung et al (2020), and Ferry and Cleo (2020). They both see disaster assistance having political consequences for donors, recipients, and the relationship between the two. The politics of emergency health assistance follow many of the same patterns as general humanitarian disaster aid. Chung et al (2020) referred to Morgenthau (1962) to have described aid as little more than a bribe, and that recent studies show that the instrumental benefits derived from providing aid far exceed its humanitarian value. This is very obvious where donor governments use aid as a foreign policy instrument to influence recipient states’ policy choices, (Spaniel 2020). Studies on aid in the context of the UN politics have revealed “vote-buying” patterns to foreign aid as a motivated tool to reward or induce recipient countries.

## 2.1. International Conventions on DRR

Disaster risk and resilience seem not to receive sufficient emphasis in the original Millennium Development Goal agenda, even though there is a great relationship between disasters and development. Although it is universally accepted that disasters do erode and destroy development gains, there is limited recognition of the role that different approaches to development play in creating or increasing vulnerability. Building the Resilience of Nations and Communities to Disasters was therefore adopted at the World Conference on Disaster Reduction in Kobe, Hyogo, Japan in 2005.

The Framework (The Hyogo Framework for Action 2005-2015) serves as the guiding instrument for international cooperation, disaster risk reduction and resilience building. The multi-stakeholder and multi-sector nature of the Hyogo Framework for Action provides guidance on how disaster risk reduction contributes to sustainable development.

Following on the outcome of the 2010 High-level Plenary Meeting of the General Assembly on the Millennium Development Goals, the United Nations Secretary-General established the UN System Task Team in September 2011 to support UN system-wide preparations for the post-2015 UN development agenda, in consultation with all stakeholders. From the ‘preparedness saves lives’ approach came the insight that economics played a significant

role and a recognition that a longer-term approach was required to reduce disaster risk and build resilience.

The Hyogo Framework for Action (HFA) on disaster – focused on disaster losses and the Sendai Framework concentrates on disaster risk reduction that charts the global course on DRR matters over the next 15 years, (Sendai Framework 2015-2030). One of the framework's core concerns is that more dedicated action needs to be focused on tackling underlying disaster risk drivers and strengthening good governance in DRR strategies at all levels and across sectors and institutions. Also, because disasters such as floods know no borders, effective response requires transboundary or regional coordination and cooperation, the UNECE supports the implementation the Sendai Framework for Disaster Risk Reduction 2015-2030 (SF-DRR), was adopted at the Third UN World Conference in Sendai, Japan, on March 18, 2015

As a follow up, the national or community targets are recognized as best practice for effective implementation, while some specific examples of national level goals or indicators can be seen in Bangladesh (Sixth Five-Year Plan 2011-15), Mozambique (Five Year Government Plan 2010-14 and Master Plan for Disaster Prevention and Mitigation 2006), Peru (State Policy 32) and Philippines (Philippine Development Plan 2010-14). In the same vein, the Tunisia African/Arab platform of 2018 focused on disaster risk Informed and inclusive sustainable development that is geared toward actualizing the Sendai Framework in Africa.

## 2.2 Inclusiveness in building national Resilience

Disaster resilience has been defined from different perspectives depending on the definers background, as a process (Norris et al., 2008; Sherrieb et al., 2010), as an outcome (Kahan et al., 2009), or both (Cutter et al., 2008), and as a term that can embrace inputs from engineering and the physical, social, and economic sciences (Colten et al., 2008). According to UNISDR (2011), it is the ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events. A natural or technological hazard can have different short or long-term impacts on various groups within society. For instance, a person's gender, age, physical abilities, ethnicity and sexuality, for instance, can lead to a higher risk of death or injury, longer recovery times, or greater risk of mental or physical trauma. Equally, different groups may bring unique skills, resources and knowledge to reduce risk and overcome the aftermath of a disaster, (Cutter et al, 2010). The strengths and challenges of each group should be recognized at an early stage of preparing the assessment. In building a formidable community resilient along the Sendai Framework, some universal steps that aid local communities in making progress in their resilience include the following:

- I) Engaging the whole community in disaster policymaking and planning;
- II) Linking public and private infrastructure performance and interests to resilience goals;
- III) Improving public and private infrastructure and essential services (such as health and education);
- IV) Communicating risks, connecting community networks, and promoting a culture of resilience;
- V) Organizing communities, neighborhoods, and families to prepare for disasters;
- VI) Adopting sound land-use planning practices; and
- VII) Adopting and enforcing building codes and standards appropriate to existing hazards.

While the characteristics of a resilient nation in the year 2030 according to NAS (2012) is as follows:

I) Every individual and community in the nation has access to the risk and vulnerability information they need to make their communities more resilient.

II) All levels of government, communities, and the private sector have designed resilience strategies and operation plans based on this information.

III) Proactive investments and policy decisions have reduced loss of lives, costs, and socio-economic impacts of future disasters.

IV) Community coalitions are widely organized, recognized, and supported to provide essential services before and after disasters occur.

V) Recovery after disasters is rapid and the per capita federal cost of responding to disasters has been declining for a decade.

VI) Nationwide, the public is universally safer, healthier, and better educated.

### 2.3 Impacts of exclusion in building national resilience

Exclusion generally erodes community resilience and the current physical planning approaches tend to be reinforcing spatial segregation and creating spaces of exclusion. Insecure tenure impedes infrastructure and services, thus further reinforcing marginality and poverty. Eviction and tenure insecurity destroys social networks and capital and encourages corruption and criminal networks. Territorialisation and isolation of communities creates tensions, especially in cities of diversity, less interaction of people in urban society negatively affects a shared sense of urban citizenship. For many, life is characterised by tenuous connections –to jobs, land, housing and even the ‘right’ to stay in the city. There is a cost for individuals, households and cities in marginalisation and exclusion which include Illegal housing (slums, informal settlements) are rarely included in urban planning and governance which often provide impediments to physical planning.

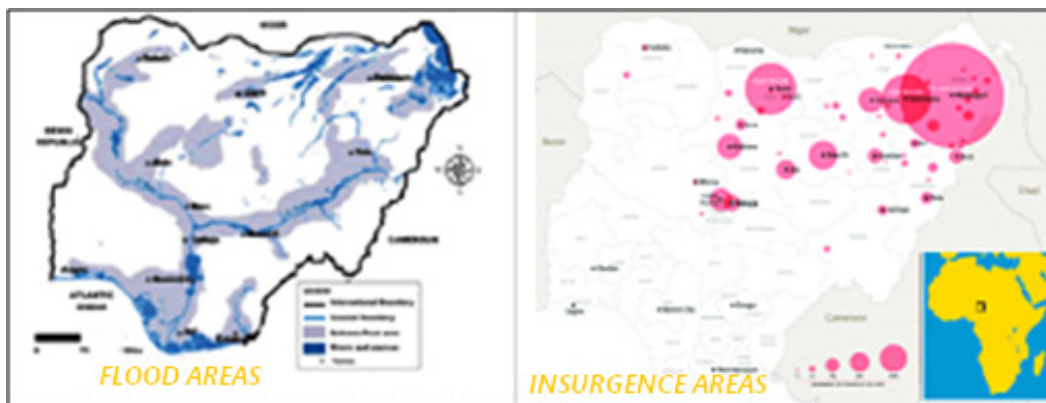
## 3. Nature of disaster in Nigeria

Nationwide natural disaster is not very prevalent in Nigeria comparatively not until the 2012 flood episode. Present, the most devastating prevalent disaster in the country is the seasonal flood and insurgences. Flash floods are common occurrences in Nigeria during the rainy season (May-October), but the flood events of the year 2012 have been described as the worst in over 40 years; and this is attributed to the Ladgo Dam water release Flood and the Niger River Flood. The release of waters from Ladgo dam in Cameroon into the Benue River flood plain, coupled with the effect of global warming were largely responsible for the 2012 flooding in Nigeria. These events forces most of the country’s rivers to overflow their banks thereby submerging series of urban and rural settlements including their farm lands. The significance of the year 2012 flood disasters in Nigeria lies in the fact that they were unprecedented in the past forty years as revealed in figure. 1. However, the ability to measure vulnerability is increasingly being seen as a key step towards effective risk reduction and promotion of disaster resilience culture (Birkmann, 2006).



**Figure 1.** 2012 flood episode in Nigeria.

The insurgencies perpetrated by the Islamic sect ‘Boko-haram’ that was incubated in Borno State around 2010 has become a nightmare in the country and eating deep into the economy of the nation with continuous increase in the number of Internally Displaced persons (IDP) camps all over the country. The impact of flash floods and insurgencies is wide spread and devastating across the country as displayed in Fig 2.



**Figure2.** Spatial distribution of floods and insurgencies in Nigeria.

Strong governance at all levels is a key element of resilience and it includes the making of consistent and complementary local, state, and federal policies. Although resilience at its core has to be carried forward by communities, communities do not exist under a single authority in Nigeria, but rather function under a mix of policies and practices implemented and enforced by different levels of government. Policies that make the nation more resilient are important in every aspect of Nigerian life and economy, (Rose, A. 2009, 2010) , and not just during times of stress or trauma. A key role of policies designed to improve national resilience is to take the long-term view of community resilience and to help avoid short-term expediencies that can diminish resilience.

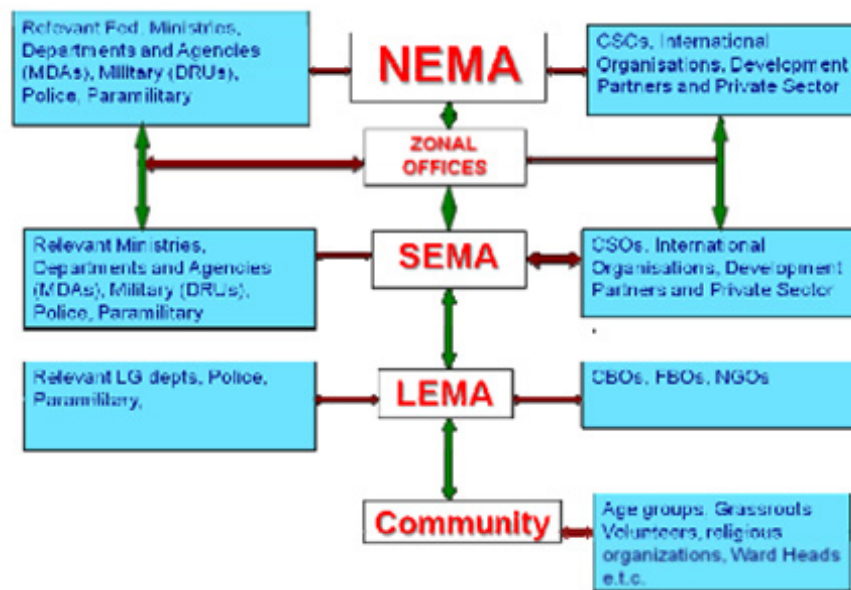
Certain policies of the legislative bodies, including Presidential Executive Directives with political undertone and policies initiated by federal agencies can and do function to help strengthen resilience. Many of the critical policies and actions required for improved national resilience are also enacted and implemented at the state and local levels, (CARRI, 2011). Policies at all levels of governance do exist to enhance resilience; however, some government policies and practices can also have unintended consequences that negatively affect resilience.

#### 4.1 Disaster Management in Nigeria

For the first time in 1976, the Federal Government of Nigeria established the National Emergency Relief Agency (NERA) to coordinate national disaster response activities that is purely a relief outfit, focussing only on post disaster management. The continuous increase in deaths from natural and man-made disasters makes mitigation and prevention of disasters an urgent priority. Consequently in 1999, the National Emergency Management Agency (NEMA) was established in place of NERA to manage disasters in the country holistically. The operational system of the agency is as revealed in figure 3 across the country. In an effort to fulfil its mandate, the agency facilitated the establishment of the National Platform for DRR to advocate and coordinate national level DRR and provide policy direction on DRR priority issues and action areas through a coordinated and participatory process.

The National Disaster Management Framework (NDMF) provides a mechanism that serves as a regulatory guideline for effective and efficient disaster management in Nigeria. Some of the framework’s objectives are:

- a) Establish functional disaster management institutions at all levels of governance to prepare for, prevent, mitigate, respond to and recover from disaster events in Nigeria.
- b) Develop capacity of relevant institutions and stakeholders for effective and efficient disaster management in Nigeria.



**Figure 3.** Horizontal and Vertical Coordination of Disaster Management in Nigeria

The thematic area mandates the establishment of Disaster Management structures at all levels of governance (federal, states and local) in Nigeria. It centres on the principles of shared responsibility and the need to ensure proper integration and collaboration among stakeholders. There is the National Emergency Management Agency (NEMA) at the Federal level, State Emergency Management Agency (SEMA) at the state level, and Local Emergency Management Authority (LEMA) at the local government level. This to a large extent shall strengthen the capabilities of Federal, State and Local Governments to reduce the likelihood and severity of disasters. At the state level, there are state operations offices of NEMA across the 36 states and Abuja that report directly to the national headquarter in addition to the regional warehouses for emergency relief in all the geopolitical zones of the country. For the human capacity development, Apart from the international trainees that the officer are

exposed to, NEMA also established six training centers in each of the geopolitical zones to carryout human capacity development at postgraduate level and research activities in DRR that has direct bearing on the local communities within some selected Universities across the country.

## 4.2 International Collaborating bodies

The Federal government of Nigeria has been and will continue to collaborate with international bodies and government on DRR for effective governance. For example, the federal government and the European Commission entered into cooperation for the period 2014-2020 for a National Indicative Programme in favour of the Federal Republic of Nigeria in tune of €512 million. The A-allocation of the programme is destined to cover macroeconomic support, sectoral policies, programmes and projects, while the B-allocation is destined to cover unforeseen needs such as humanitarian, emergency and post emergency assistance, where such support cannot be financed from the EU budget

Haas and Prabin (2020) however emphasis the fact that there is a dearth of empirical evidence on how disasters impact international collaboration especially in peacekeepers' ability to contain local-level violence even though there is an overwhelming consensus on the ability of international collaborating bodies in sustainable development and peacekeepers to prevent civil war recurrence. The resent COVID-19 pandemic has significantly impacted negatively on project implementation in recipient countries. For instance, An African Union Peacekeeping Mission in Somalia AMISOM report states that the pandemic had resulted in \ reduced information/intelligence flow on Al-Shabaab due to limited interaction of the troops with the local communities and individual Somali nationals" (AMISOM, 2020).

4.2.1 The GFDRR - the Global Facility for Disaster Reduction and Recovery (GFDRR) that is supported by 37 countries and 11 international organizations and hosted at the World Bank, is a global partnership established in 2006 to support developing countries to understand, manage, and ultimately reduce their risk from natural hazards and climate change; has been granting series of award on environmental issue since 2007 in Nigeria. Some of those specific programmes are listed below:

I) Enhancing Country Capacity to Develop, Implement and Trigger a CERC in an Emergency \$271,136 07/2017 - 11/2017

II) Improving Resilience and Resilience Impact of National Land and Geospatial Systems \$500,000 09/2017 - 07/2019

III) Disaster risk management in Africa: operational support, capacity development. \$800,000 02/2018 - 02/2020

IV) Strengthening Disaster Risk Management Capacity in Ibadan, Nigeria. \$200,000 03/2018 - 09/2019

V) World Reconstruction Conference 3 - Knowledge and Lessons Learned from ACP Countries. \$344,465 03/2017 - 04/2018

VI) Just-in-Time Capacity Building and Advice for Climate Resilience. \$3,100,000 01/2015 - 12/2018

VII) City Coastal Resilience Africa (CityCORE). \$980,000 02/2018 - 08/2019

VIII) Strengthening Global Hydromet System - Investment Support. \$1,400,000 08/2015 - 07/2019

IX) Strengthening DRR Coordination, Planning and Policy Advisory Capacity of ECOW-AS, \$1,977,500 06/2015 - 12/2019

X) Strengthening DRR Coordination, Planning and Policy Advisory Capacity of ECOWAS. \$1,285,000 10/2016 - 06/2019

4.2.2 *The UNDP* – The United Nations Development Programme (UNDP) that operates in 177 countries and territories of the world, is the UN’s global development network that partners with people at all levels of society to help build nations that can withstand crisis, and sustain the kind of growth that improves the quality of life for everyone. In Nigeria of recent, UNDP and Japan supports IDPs in North East of Nigeria. With funding from the Government of Japan, UNDP and its implementing partners continues to provide support to people affected by the ongoing military insurgency in North East region of Nigeria. This support is being channelled through two projects; one focusing on Livelihood and Social Cohesion, while the other on De-radicalization, Counter-Terrorism and Migration.

Also, the pupils of Ngwom Primary School in the North East Nigeria were glad to be back after their school were destroyed in 2016 crisis. Collective learning in classrooms environment were restored through the assistance of the Japan Government, the EU government, Swiss government and the Borno State Government that rebuilt and furnished 12 classrooms, offices, stores, and toilets.

In the areas of capacity development, UNDP has been supporting NEMA in series of national programmes on DRR like the Risk Identification, Monitoring and Assessment (**RIMA, 2018-2020**). NEMA needs to develop appropriate capacity for undertaking risk identification, monitoring and assessment so as to provide logical steps and actions required for an efficient and effective disaster risk management at different levels in the country. Specifically, RIMA products for stakeholders’ consumption are:

- a) transformation and strengthening of the GIS Unit of NEMA
- b) development of a national training programme in RIMA for SEMAs, MDAs and other stakeholders;
- c) identification of support roles for CSDDRR: (i) training and partnering SEMAs to undertake their programmes; (ii) undertaking RIMA activities as consultancies.

#### **4. COVID-19 and Territorial Influence Diplomacy on Nigeria**

Sequel to the outbreak of COVID-19 pandemic in mainland China and other countries worldwide, the Federal Government of Nigeria on 31 January set up a Coronavirus Preparedness Group so as to mitigate the impact of the virus if it eventually spreads to the country (Ifijeh 2020, MSN, 2020). Coincidentally, the World Health Organization (WHO) on the same day, listed Nigeria among other 13 African countries identified as high-risk for the spread of the virus (Ezigbo and Ifijeh, 2020). The first index case was confirmed in the country on 27 February and was transferred to Lagos State biosecurity facilities for isolation and testing, (Gesinde 2020), Ugbo 2020). Consequently, as of August, 2020, 48,116 cases have been confirmed, 34,309 cases have been treated and discharged, while 966 deaths have been recorded in 36 states and the Federal Capital Territory, (NCDC, 2020)

The Bill for an Act to establish Nigeria Centre for Disease Control (NCDC) was signed into law in November 2018, by President Muhammadu Buhari. The mission for the NCDC (2017-2021) is ‘To protect the health of Nigerians through evidence-based prevention, integrated disease surveillance and response activities, using a one health approach, guided by research and led by a skilled workforce’ The post economic impact of COVID-19 is expected to be severe because, even before the pandemic outbreak, Nigeria’s economy was already

nose-diving following the falling of per capita GDP levels and the sharp fall in oil prices which magnified the vulnerabilities level and historic decline in growth and large financing needs. These shocks have created large external and financing needs for 2020. Additional declines in oil prices and more protracted containment measures would seriously affect the real and financial sectors and strain the country's financing.

The concept of collective responsibility in fighting COVID-19 advocated by WHO has played out for a country like Nigeria who hitherto lack the required manpower, health infrastructure, and political will ion curtailing the adverse impact of the pandemic as envisaged. Zhang and Dolan (2020) in their work on China-US COVID-19 disaster diplomacy quoting Lee and Smith (2011) define global health diplomacy as "policy shaping processes through which state, non-state and other institutional actors negotiate responses to health challenges, or utilize health concepts or mechanisms in policy-shaping and negotiation strategies, to achieve other political, economic or social objectives." The two contesting economic world power (China and US) have been playing superior donor 'fatherism' to developing countries most especially on Nigeria because of their market economy. In fact, while countries like US are talking of when and how to sell the COVID-19 vaccine developing countries like Nigeria, China has promised to assist Nigeria with the same vaccine soonest.

Academia's like Colglazier (2020) and Qingguo (2020) has argued that despite America's strong links between science, policy and society, they has failed to capitalize on this knowledge when it is most needed. While: China's diplomacy is fending off Western attacks and endorsing international efforts to fight the pandemic. .Table 1 shows the external aids given to the country in combating the pandemic, and this has drastically reduced the death rate to about 966 as of august, 2020 in a country of over 200 million population with high poverty rate.

**Table 1.** Foreign Aids to Nigeria on COVID-19

S/N	Country/Organization	Amount (\$)
1	IMF	3.4billion
2	USA (USAID)	32.8 million
3	China	48 million
4	UKAid	£661,000
5	Africa Dev. Bank	\$288.5 million

Generally, Nigeria as a nation has benefited from international collaboration with government agencies and NGOs in building her disaster resilience to the community levels Nigeria is a major market for manufactured goods across the world, hence the rate of grants, loans and aids to the country.

## 5.1 Discussion - Foreign aid and International Coalition for Disaster Management

Foreign aid in the works of Chung et al (2020) citing authors like (Bueno de Mesquita and Smith, 2009; Kuziemko and Werker, 2006; and Woo and Chung, 2018) is a tool with which donors manoeuvre policies and opinions of its recipients UN General Assemblies or winkle out policy concessions from recipients. Awareness of donor competition often boost support for aid where donors seeks for national pride, humanitarian value, and instrumental value of foreign aid. Although the global pandemic has local implications, yet local mismanage-

ment of the disease has colossal international implications as can be inferred from Wuhan in China. This has necessitated the scholarly comparison of countries' geo-administration, different policy levels updates, and public health outcomes over time and cross nationally. Professionals in sociology have seen disaster (especially COVID-19) as laboratory for the study of sociology of disaster as it serve as avenue to test many hypothesis like the theory of Disaster Diplomacy. Developing countries like Nigeria have benefited immensely in both cash and kind from the global pandemic through international collaboration coupled with humanitarian pride that promotes willingness to aid out-groups due to the fact that collective pride is generally a positive emotion as is being demonstrated by China in the management of COVID-19.

In disaster information disseminations, the reception and interpretation of the information content is a function of the existing levels of socioeconomic inequality. The flow of information to and from citizens and policy makers coated with emotional words convey meanings outside cultural and textual context and can serve as an important measure of emotional effects of natural or human-induced disasters, that is critical to successful management and preservation of public health. Foreign aids without direct citizen welfare distort information flow and assimilation and this is the bane of the poor disaster resilient level in most African countries.

## **Conclusion**

Disasters occurrences globally seem to be on the increase due the growth in the reporting system that is space and information technology based (CNN, Aljazeera, VOA, etc). This paper examines the role of collaboration and foreign aids in managing natural disasters and in particular the global pandemic COVID-19, the management of natural disaster and the COVID-19 by Nigeria government with the intervention of international donor agencies of which researchers like Chung et al (2020), and Ferry and Cleo (2020) admitted to have some political undertone and territorial influences. It also addresses the issue of China-US competition in global economic power struggle as it affect aids to developing countries like Nigeria. All hese then serve as laboratory for both sociologist and researchers in international relations in the analysis of disaster aid diplomacy as already observed by Ferry and Cleo (2020) and DHS (2009). The pattern and levels of cities development shapes disaster risk, and disaster risk also shapes development possibilities since human life itself is risk as they are causers of risk and recipients of risk.

Since disaster is not territorial boundary bound, there should be vertical and horizontal cooperation between and within nations of the world in the area of community awareness, prevention, preparedness, and mitigation of disaster. Risk pulling is one of the best practices that should be imbibed by every nation and communities. Going by the official definition of disaster or catastrophe, the challenging phenomena or episode must be beyond the coping capacity of the affected nation, region or community, thereby requiring external intervention. Countries therefore needs symbiotic partnership through international treaties in build a formidable resilient nation.

## Recommendations

Disaster has been generally accepted as every man's business and the world as a global village in which local mismanagement of environmental disaster often boomeranged to the global level (Wuham-China) calls for the following recommendations:

I) Nations and regions having the same environmental challenges establish more treaties that are not based on tokenism. This is very apparent in the way banditry and Boko-Haram is being handled between Nigeria and the neighbouring countries.

II) International bodies though having different aim and objectives should harmonize their responses in affected communities to avoid unintended humanitarian environmental impacts.

III) International organizations and NGOs should direct more of their assistance toward building early warning systems and human capacity in the developing countries. These will help to reduce the colossal amount of dollars wasted in relief packages that is never enough.

IV) The international court of justice should be more proactive in intervening in governments that perpetrates injustice before it degenerated into genocide as in Somali, Rwanda-Burundi.

V) Federal government agencies should incorporate national resilience as a guiding principle to inform the mission and actions of the federal government and the programs it supports at all levels.

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*Research article*

## PHARMACY RESPONSE TO NATURAL DISASTERS

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**Abstract:** Pharmacy institutions are one of the key elements in modern health-care systems throughout the world. Pharmacies can be a part of the public health-care system at primary, or secondary and tertiary levels. Also, pharmacies can be founded as a private institution, having the same roles and amount of responsibility compared to public ones. The aim of this paper was to examine the role of pharmacies in emergency and catastrophic events. The crucial role of pharmacies is especially emphasized in emergency and catastrophic events when the majority of other healthcare institutions are mobilized in providing more important healthcare activities and services. In those instances, pharmacies represent a primary connection between the patients and community in general and the healthcare system. Proper fulfillment of necessary requirements for registration of pharmacy institutions is essential for its successful operation, but continuous education of pharmacy staff plays an equally important role. The most recent events, such as the COVID-19 pandemic, are one additional evidence confirming that pharmacy institutions are an irreplaceable link in the healthcare system chain continuously serving as a first-line connection with all individuals in a community.

**Keywords:** pharmacy, natural disasters, emergency, response

### 1. Introduction

The role of pharmacists in disaster risk management is undoubtedly enormous. During and after disasters or other emergencies, it is especially important to continuously supply pharmaceutical products and medical supplies in order to provide an effective response to these specific circumstances, to alleviate the difficulties that accompany emergency situations, and to reduce damage as much as possible. To this end, the importance of locally available pharmacy staff, both licensed pharmacists and unlicensed support staff in carrying out activities during emergencies is emphasized.

Emergencies and disasters represent two major threats to the healthcare systems of any country, and at the same time, together, they are a global threat. Pharmacists have a major impact on disaster preparedness and response because they are involved in both clinical and non-clinical roles (Aburas & Thamir, 2020).

In modern approaches to disaster management, disasters are spatial-related; the distribution, severity, type and population affected by the disasters are taken into account (Ocal *et al.*, 2021).

The article is structured as follows. The first section presents a look at pharmacy institutions in the Republic of Serbia. The second section presents the role and significance of pharmacy institutions in emergency situations. The last section includes the conclusions.

## 2. A look at pharmacy institutions in the Republic of Serbia

Organizing and performing pharmacy activities in the Republic of Serbia is performed in accordance with the law governing health insurance, the law governing drugs, and the law governing medical devices, as well as the Guidelines of Good Pharmacy Practice, issued by the Pharmaceutical Chamber of Serbia (hereinafter: the Pharmaceutical Chamber), with the consent of the Minister of health (Law on Health Care, Article 221, “Official Gazette of the Republic of Serbia”, No. 25/2019)

Pharmacy activity is a healthcare activity that provides pharmaceutical health care to citizens, and which is implemented through the healthcare system and performed at the primary, secondary, and tertiary levels of health care and in private practice (Law on Health Care, Article 201, “Official Gazette of the Republic of Serbia”, No. 25/2019).

The Law on Health Care, among other things, prescribes what is and what is included in the pharmacy activity, as well as what are the forms of organization in which the pharmacy activity is performed. A pharmacy can take the form of a healthcare institution and a private practice institution. The choice between these two forms will depend on the staff, space, and equipment, and what is also important to keep in mind is that private practice takes the form of entrepreneurial activity. Pursuant to the mentioned law, the pharmacy activity is performed by:

- pharmacy institution;
- pharmacy of the community healthcare center or as an organizational part of another healthcare institution at the primary level of health care;
- pharmacy as an organizational part of a health institution at the secondary or tertiary level of health care, or a healthcare institution that performs activities at several levels of health care (hospital pharmacy);
- private practice pharmacy.

The pharmacy institution, as well as all other privately owned healthcare institutions, pursuant to the law, is established by a legal entity or an individual, under the conditions prescribed by the Law and bylaws adopted for the implementation of the Law (Rule book on detailed conditions for performing healthcare activities in healthcare institutions and other forms of healthcare service). Therefore, for the establishment of a pharmacy institution (founder – a legal entity or an individual), the professional or other personal qualifications of the founder are not important, but it is necessary for the founder, in addition to submitting the founding act, to provide conditions prescribed in terms of staff, premises, equipment, and medicines.

Any of the types of health care institutions determined by the Law, as well as any form of private practice, may be established and may perform healthcare activities if it meets the conditions prescribed by the Law and the Rule book on detailed conditions for performing healthcare activities in healthcare institutions and other forms of healthcare service, concerning staff, equipment, space, and medicinal products.

At the request of the founder, the fulfillment of the prescribed conditions is assessed by the health inspector of the Ministry of Health, by a decision, in accordance with the Law on Healthcare and the Law on General Administrative Procedure, on the basis of which the pharmacy institution is entered in the register of the Business Registers Agency, when it acquires the right to operate.

The resilience of small and medium-sized enterprises (SMEs) is considered a prerequisite for sustainable development at both local and national levels, but they are also the most vulnerable as a result of financial, technological, and administrative constraints, with most SMEs lacking even basic knowledge of disaster preparedness and techniques of responses (Mavrodieva *et al.*, 2019).

### **3. Role and significance of pharmacy institutions in emergency situations**

Pharmacists and their counterparts generally receive limited training in disaster medicine and emergency preparedness as part of their initial qualifications, even in countries with well-developed vocational education programs. In this context, Alkhalili *et al.* (2017) point out that pharmacy efforts have also traditionally focused on medical supply activities, rather than on general emergency preparedness. In order for pharmacists to be able to adequately respond to disasters, which is essential for ensuring the continued health and well-being of the local population, pharmacists need to be prepared for disasters in order to successfully implement pharmacy services (McCourt, *et al.*, 2020). The pharmacist's readiness depends, among other factors, on the vocational education program and general emergency preparedness.

The past decade has seen rapid changes in the climate system with an increased risk of extreme weather events, which has encouraged the wider community to properly recognize the important role of primary health care. In this context, there is no doubt that pharmacists have a special place in the implementation of activities during natural disasters, and in this regard, they need to be fully involved in the process of disaster management planning, to minimize the risk of their consequences (Mak & Singleton, 2016).

Breakdown of healthcare systems is a common outcome of natural disasters, which include tropical cyclones. In such circumstances, pharmacists have direct communication with the population that may be at risk of disasters and there is no need to make an appointment. It is therefore important that pharmacists develop trust with the community, and it is undeniable that they can play a key role in providing health care in the communities they serve during disasters (Vhiriri *et al.*, 2021). In the circumstances of a natural disaster and pandemic, the need for cohesive departmental communication, staff flexibility, prioritization of teamwork, and external collaboration are crucial (Zuckerman *et al.*, 2020).

Pharmacists play a very important role in the accurate identification, provision, and use of medicines that are of particular importance in terms of the medical care used by disaster victims. During disasters, it is important to focus on accomplishing tasks by defining employee roles, establishing chains of communication, delegating authority to competent persons, re-

stricting decision-making by non-commanders, and defining pharmacy participation limits in disasters (Moore, 1979).

There are also specific issues that need to be considered according to the types of disasters. For example, during the events of Hurricane “Florence”, suboptimal functionality of the pharmacy for coastal areas was discovered during the period of disaster response (Sharpe & Clennon, 2020). In order to prevent such situations from recurring, hurricane preparedness and infrastructure strengthening plans need to be specifically dimensioned for local pharmacies in hurricane-prone areas. Furthermore, floods are one of the most common and extreme threats today, so it is necessary to evaluate the vulnerability of relevant organizations to the danger of floods (Aktar *et al.*, 2021). Perić & Cetković (2019) state that, having in mind that floods are very common in the Republic of Serbia, as well as that they directly endanger people’s lives and health, their property, and the environment, it is necessary to consider how an individual perceives risk from natural disasters caused by floods. In addition, Cvetković (2019) emphasizes the importance of building fire risk perception.

Pharmacists are in a unique position in the community to help disaster-stricken patients. However, what is specific to them is that their roles in disasters have been identified based on their own experiences and networks (Watson *et al.*, 2019). Adopting the role of pharmacists in non-pharmaceutical supply may present a problem of accepting paradigm shift in non-traditional roles. Possible staff shortages in future disasters may change pharmacists’ approach to disaster management (Ford *et al.*, 2013). The role of pharmacists in disasters has not changed significantly since the 1960s. Pharmaceutical procurement remains their desirable role, while patient management and response integration roles are diminishing in the context of common, geographically widespread disasters (Raza *et al.*, 2021).

COVID-19 pandemic as a public health emergency evolved fast and put pharmacies at the front lines. The fact that further intensifies this emergency situation is it’s a potential connection with ecology disasters question (Nikolovski, 2021a; Murányi & Varga, 2021), and new COVID-19 variants of concern which can significantly vary leaving not enough time for the population to adapt (Nikolovski, 2021b).

The question is often asked: what are the roles and added value of intensive care pharmacists during the COVID-19 pandemic period? Their missions have evolved although they have remained focused on providing health care to patients (Lemtiri *et al.*, 2020). It is interesting to see the perception of different groups of employees (according to professions) in Serbia on Public trust when it comes to the COVID-19 pandemic (Markovic *et al.*, 2020). It is out of paramount importance for disaster preparedness as well, since the central point of public trust is a government which is also a central point in coordinating disaster response measures.

## Conclusion

The pharmacy profession has a significant role in the efficient management of activities during and after the disaster event, and in the event of other emergencies. Therefore, pharmacists are especially expected to provide an effective response to emergencies. In addition, there is a need for effective communication and cooperation in general between the members of the pharmacy team in situations that can be described as “catastrophic”.

All stages of development of pharmacy institutions, starting from fulfilling the requirements needed to the initiation of business and including continuing education of staff and adaptation according to the population needs are essential for the existence and accomplishing the unique

role those institutions have. Public health emergencies are certainly the most representative examples of emergency situations in which pharmacies have a specific role and when those institutions are pushed to the front line, serving as an always-available primary contact to patients and other community members and linking them to the healthcare system.

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