FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI, NIGERIA
INSTITUTE OF EROSION STUDIES (IES)

PROCEEDINGS

1ST OF THE INTERNATIONAL TRAINING WORKSHOP

ON

EFFECTIVE WATERSHED MANAGEMENT FOR ENVIRONMENTAL HAZARD CONTROL/ MITIGATION IN NIGERIA

DATE: 8TH-10TH FEBRUARY, 2016

EDITORS:
PROF. C. A. Ahiarakwem
ENGR. E. U. Uja
ENGR. P. C. Nwachukwu
Dr. J. E. Umunakwe
Mr E. C. Nwaihu
Mrs Amadi Chinyere
Mr Henry Echetama
Mr J. O. Popoola

Nigeria hydrological services agency(NIHSA) application of hydrological data in erosion and flood mitigation By Beckley, M. O. is licensed under a Creative Commons Attribution-Noncommercial-Noderivatives 4.0 International License.

NIGERIA HYDROLOGICAL SERVICES AGENCY(NIHSA) APPLICATION OF HYDROLOGICAL DATA IN EROSION AND FLOOD MITIGATION

PAPER PRESENTED AT THE
INTERNATIONAL TRAINING WORKSHOP ON EFFECTIVE WATERSHED MANAGEMENT FOR ENVIRONMENTAL HAZARD CONTROL/MITIGATION IN NIGERIA, FUTO, OWERRI, NIGERIA

BY
MR. MOSES O. BECKLEY
DIRECTOR GENERAL (NIHSA)
ABUJA.

1.0 Introduction

Water is fundamental to every aspect of our daily lives. We use it for various domestic, industrial and recreation purposes. It is a driver for economic development, supporting industries in manufacturing, agriculture, mining and tourism. Water is also vital to the health and protection of the environment. While Nigeria is generally blessed with regular and reliable rainfall, extreme events such as floods, erosion and drought are common, while there is the prediction that the frequency of these hydrological extremes will increase with climate change.

The finite nature and the fragility of this vital resource is too often taken for granted. It is generally only when something happens to our water supply – such as lack of water during droughts, or through overuse, when water quality becomes unsuitable for intended uses or when our crops and infrastructure are destroyed by unpredictable floods and erosion – that we notice.

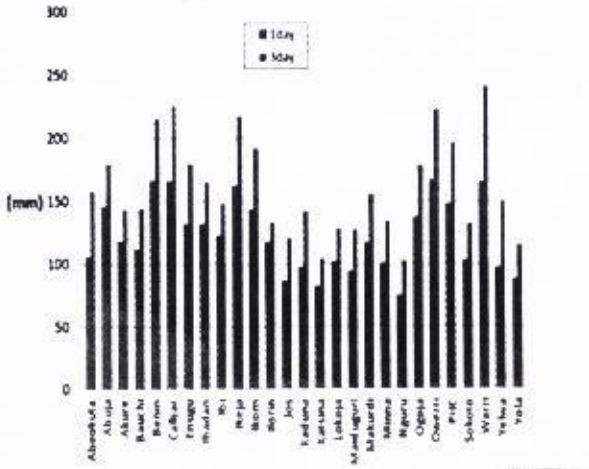
It is not always possible to predict the severity of floods and droughts, but we can do a lot to improve our understanding of our water resources. This will allow us to reduce our exposure to these extreme events and provide data that will help us design better infrastructure, devise more accurate and responsive early warning systems, and plan sustainable developments with both economic and environmental benefits.

Nigeria: Relief

Nigeria: Drainage System

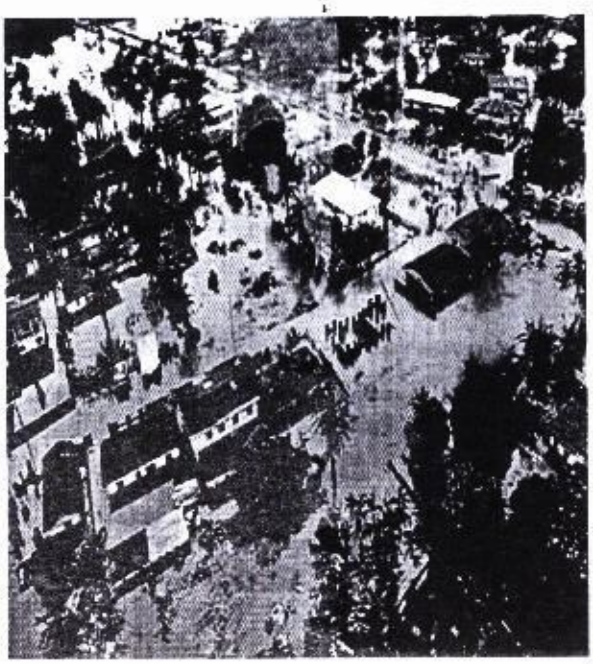
Nigeria: Principal Rivers – Niger and Benue

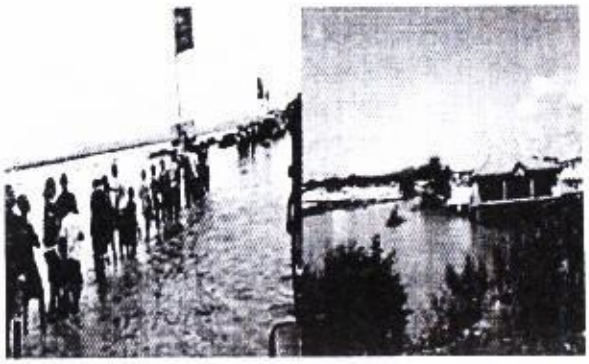
Probable Rainfall for 10 years Return Period in NIMET stations – Principal input to Hydrological Cycle



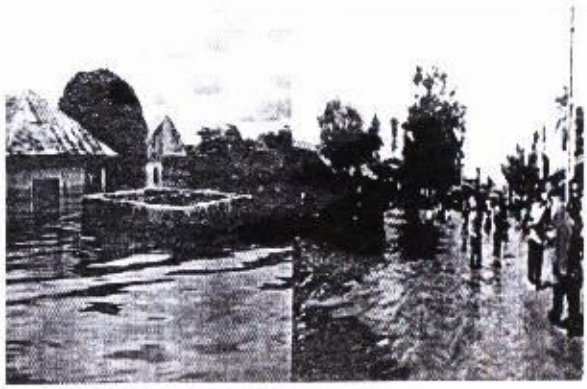
1.1 Impact of Flood

Floods continue to cause tremendous damage to communities. People's lives and livelihoods are regularly lost. Damage to infrastructure and crops, reduced productivity, impacts to schools and hospitals, all have an enormous cost on communities and can setback a nation's economic development. Similarly droughts, while slower to develop, can place enormous burdens on families and communities.





Lokoja (Kogi State), 2012.



Makurdi (Benue State), 2012

Past major Flood Disasters in Nigeria

S/N	Year/Month	State (City)/River	Description, Cause and Damage
1	1980	Oyo (Ibadan) / Ogunpa River	274.1mm rainfall in 12 hours, 100 people died and 50,000 homeless
2	1988 August	Kano	Bagauda dam failure, destroying 18,000 houses and leaving 200,000 homeless and 23 people dead
3	1999 September	Kaduna / Kaduna and Niger River	Killed 39 people, submerged hundreds villages, affected 300,000 people.
4	2010 September	Sokoto, Kebbi / Sokoto and Rima River	Heavy rainfall and Goronyo dam release
5	2011 August	Oyo (Ibadan)	120 people killed due to flash flood from Eleyele Dam failure
6	2011 July	Lagos, Ogun, Oyo	25 people killed due to Heavy rainfall
7	2012 August – October	33 States, especially Kogi, Benue, Taraba, Adamawa, Edo, Delta and Anambra / Benue, Niger R.	363 people dead, 2.2 million people were displaced, damaged several thousand hectares of cropland and destroyed houses and properties.
8	2015 October	Kaduna / Kaduna River	Several people were rendered homeless, properties were destroyed

Flood Affected States between 2000 and 2015				
Year	No of States	(%) States affected	List of states	No of lives lost
2000	1	2.8	Lagos	1
2001	4	11.1	Lagos, Kano, Edo, Imo	40
2002	3	8.3	Kebbi, Lagos, Edo	Nil
2003	8	22.2	Kano, Kaduna, Jigawa, Katsina, Gombe, Yobe, Zamfara, Bauchi.	1
2004	9	25	Lagos, Abuja, Benin, Katsina, Sokoto, Delta, Gombe, Kano, Plateau.	2
2005	2	5.6	Abia, Lagos	1
2006	1	2.8	Nasarawa	4
2007	3	8.3	Ogun, Lagos, Akwa Ibom	Nil
2008	5	13.9	Bauchi, Lagos, Oyo, Katsina, Abuja	Nil
2009	8	22.2	Anambra, Bayelsa, Cross River, Edo, Ekiti, Lagos, Ondo, Rivers.	Nil
2010	8	22.2	Bauchi, Sokoto, Oyo, Lagos, Delta, Osun, Bayelsa, Jigawa.	2
2011	9	25	Oyo, Katsina, Lagos, Borno, Bauchi, Cross River, Kebbi, Delta, Anambra.	143
2012	33	92	Plateau, Nasarawa, Edo, Cross River, Lagos, Ogun, Katsina, Gombe, Enugu, Niger, Kwara, Rivers, Abia, Imo, Anambra, Akwa Ibom, Ebonyi, Delta, Benue, Kogi, Abuja, Oyo, Ekiti, Kano, Kaduna, Bauchi	363
2013	22	61	Katsina, Bauchi, Cross River, Abia, Benin, Delta, Kano, Anambra, Enugu, Ebonyi, Benue, Kaduna, Niger, Bayelsa, Rivers, Kogi, Imo, Lagos, Ogun, Kwara, Taraba & Sokoto.	1
2014	20	55.5	Kwara, Cross River, Oyo, Ogun, Delta, Ondo, Kebbi, Benue, Abuja, Gombe, Osun, Anambra, Edo, Lagos, Ebonyi, Katsina, Akwa Ibom, Rivers, Sokoto & Abia	20
2015	18	50	Rivers, Kano, Lagos, Delta, Ogun, Ekiti, Beyalsa, Akwa Ibom, Abuja, Sokoto, Anambra, Adamawa, Ondo, Enugu, Abia, Benue, Niger, Bauchi	3
Note: The sources of these data include reportage in Nigeria Dailies, NEMA and other print and electronic media.				

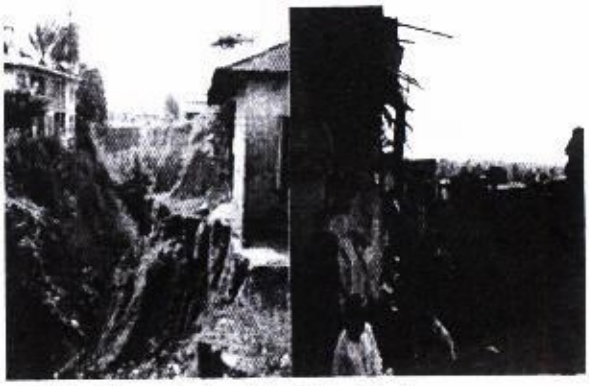
Nigeria faces severe problem of soil erosion – especially gully erosion – due to both natural and human causes.

Over 6000km^2 under erosion and about 3400km^2 are highly exposed.

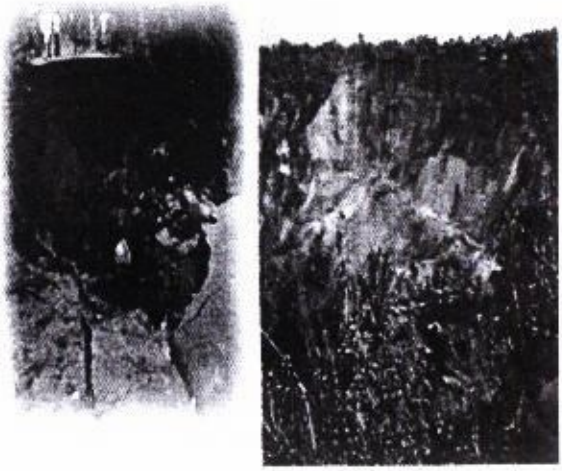
Erosion has a devastating effect on many peoples' lives and destroys essential infrastructure for economic development and poverty alleviation.

Gully erosion contributes to environmental problems and damage estimated at over $100 million annually (mostly in South-Eastern Nigeria). This undermines economic growth and a threat to vision 20-2020.

Many activities done earlier – but were adhoc and not integrated.



Gully Sites in Auchi, Edo State



Gully Sites in Anambra State

2.0 NIHSA Background

The Bill for the creation of the Agency was signed by Mr. President on 27th August 2010. The ACT was published in the FGN Official Gazette No. 100, Vol. 97 of 31st August, 2010.

2.1 MANDATE

To carry out hydrological activities and related services for assessment of the nation's surface and groundwater resources in terms of quantity, quality, distribution and availability in time and space; for efficient and sustainable management of water resources.

Surface WR Potential – 332.0 x 10 cumecs

Ground WR Potential – 42.0 x 10 cumecs

By these activities and services, the Agency operates and maintains hydrological stations

nationwide for surface water resources assessment, groundwater monitoring using various scientific techniques. In this way, Hydrological and hydrogeological data needed for planning, design, execution and management of water resources and allied projects are thereby generated.

2.2 NIHSA Functions

Assessment of the nation's vast water resources,

Providing data and information for planning, design and operation of water projects and other facilities or non-water projects consuming water,

Monitoring the impact of non-water sector activities on water resources,

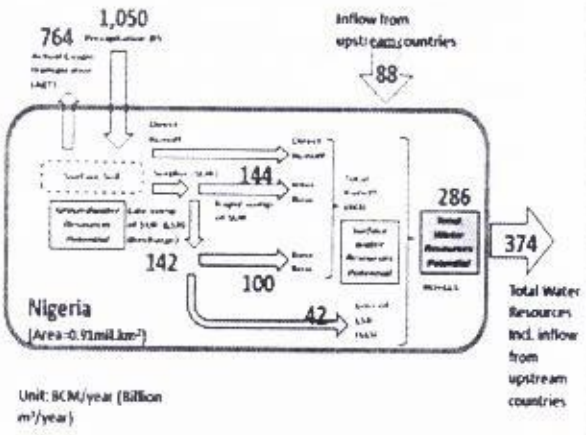
Providing security for life and property against water related hazards such as floods (and erosion) and drought, through forecasting and related activities,

Providing information and management of trans-boundary water bodies,

Operation and maintenance of hydrological stations nation-wide for gauging of surface water points.

Groundwater monitoring.

Nigeria: Water Resources Potential



Eight Hydrological Areas

Hydrological Areas and Location of NIHSA Field Offices

HYDROLOGICAL AREA	AREA OFFICE	FIELD OFFICE
Hydrological Area 1 Niger - North	Sokoto	(i) Katsina (ii) Birnin Kebbi
Hydrological Area 2 (Niger Central)	Kaduna	(i) Ilorin (ii) Minna
Hydrological Area 3 (Upper Benue)	Yola	(i) Bauchi (ii) Gombe
Hydrological Area 4 (Lower Benue)	Makurdi	(i) Lafia (ii) Wukari
Hydrological Area 5 (Niger – South)	PortHarcourt	(i) Lokoja (ii) Asaba
Hydrological Area 6 (West Littoral)	Ibadan	(i) Benin (ii) Akure
Hydrological Area 7 (East Littoral)	Enugu	(i) Calabar (ii) Owerri
Hydrological Area 8 (Basin Chad)	Maiduguri	(i) Kano (ii) Damaturu

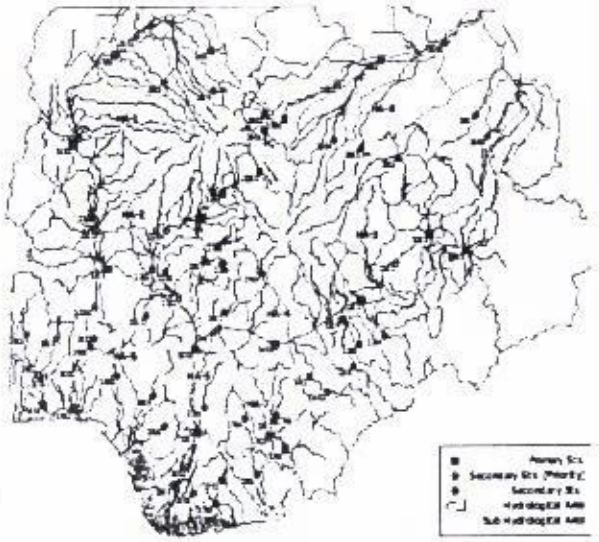
3.0 What is Hydrological Data?

Hydrological data (rainfall, stage height/water level, discharge, sediment yield, water quality, etc.) are random in nature depending on their magnitude and time of occurrence. When the data are arranged in the order of magnitude, a series of data which can be subjected to mathematical and statistical analysis is formed. Normally, the distribution of hydrological data

possesses a definite pattern which may be derived by mathematical theories and verified by observed data.

Nigeria Hydrological Services Agency (NIHSA) operates and maintains hydrological stations on major rivers with good spread across the country for the collection of hydrological data for water resources assessment, planning purposes and river basin management.

Hydrological Stations – For collecting hydrological data



3.1 Need for Hydrological Data: "you can't manage what you don't measure"

Accurate information on the condition and trends of a country's water resource - surface and groundwater; quantity and quality - is required as a basis for economic and social development, and for maintenance of environmental quality through a proper perception of the physical processes controlling the hydrological cycle in time and space.... almost every sector of a nation's economy has some requirement for water information, for planning, development, or operational purposes."

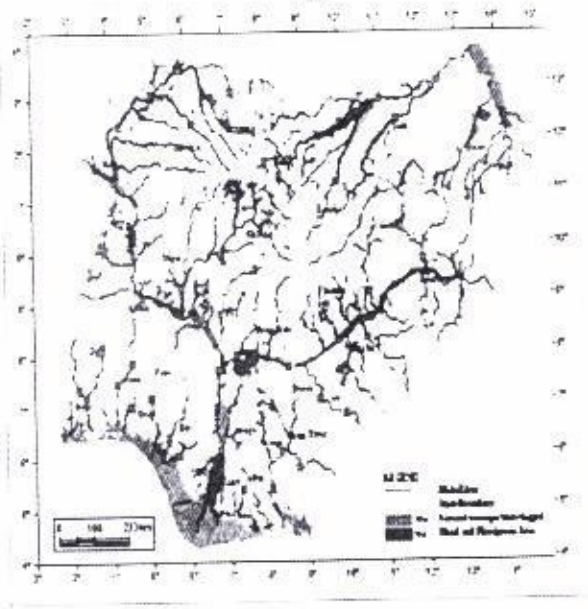
--WMO/UNESCO Report on Water Resources Assessment, p. 16.

- Hydrological data can help us prepare and plan for extreme events by identifying where the risks are highest. Day to day hydrological data is used to better manage our water resources in ways which suit our economic and environmental needs by providing information on the availability and quality of water for all uses.
- Access to accurate and reliable hydrological data allows us to better appreciate hydrological trends and our own water needs and that of the environment, so that options and strategies can be developed which are better placed to benefit all.

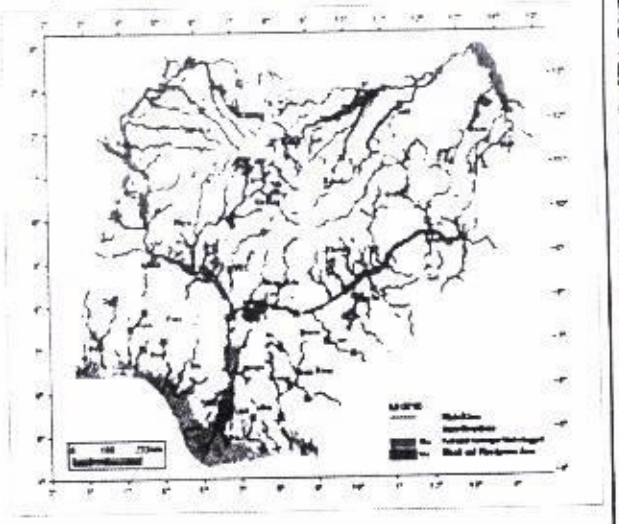
3.2 Hydrological Data: for Flood Control

- Rainfall monitoring
- Water level / River Discharge Measurement
- Rainfall – Runoff Analysis
- Flood information – Inundation depths, flood duration time, peak time and flow direction
- Flood Early Warning:
- Flood information dissemination: Publication of Annual Flood Outlook (AFO), Advocacy and sensitization in both prints and electronic media.
- Hydrological Modelling
- River Cross-sectional survey
- Establishment of flood beacons
- River dredging –channelization and desiltation
- Flood vulnerability/hazard mapping.

Hydrological Monitoring Stations and Flood Plains



Proposed Flood plains to be designated



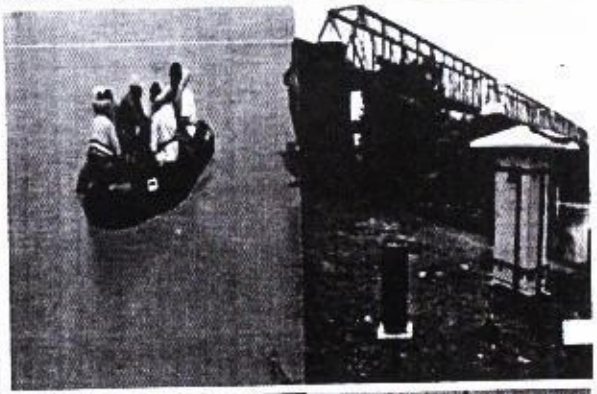
3.3 Hydrological Data: for Erosion Control

Preservation of water quality and the minimization of erosion is important component of drainage design. The flow of water over and adjacent to roadways can result in erosion of soils, which is detrimental both to the roadway's structure and to the surrounding environment. The drainage design should also minimize the potential for the negative impacts of erosion.

Hydrological data for the design of erosion control structures are:

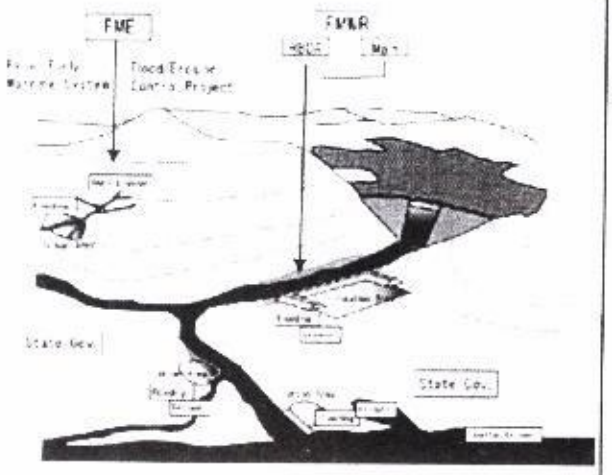
- Selection of the design flood (storm) frequency (2, 5, 10, 50 and 100-year storm frequencies)
- Selection of appropriate hydrologic method
- Determination of the peak design discharge,
- Determination of the flood hydrograph and runoff volume.

Hydrological Data Measurement Equipment



Groundwater monitoring wells – using data logger

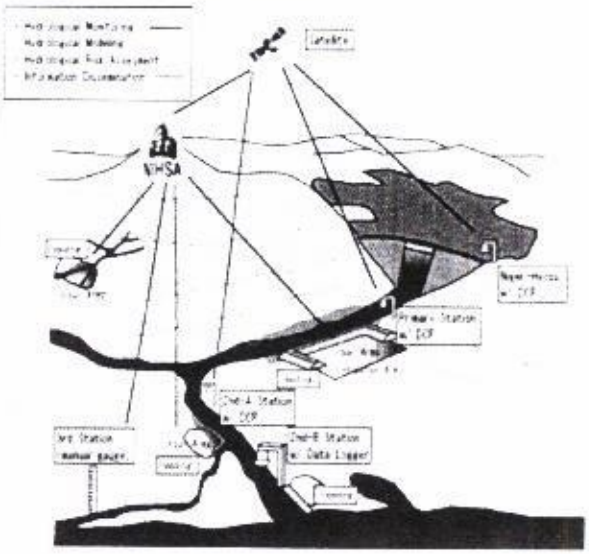
Present Institutional Arrangement for Flood and Erosion Control



4.0 Hydrological Monitoring and information dissemination for Flood and Erosion Control

- The rapid growth of data communication networks in recent years, now makes it possible to quickly disseminate hydrological data to a wider audience. The availability of mobile communications, and technology advances, provides the potential to share information about a rapidly rising river, or the likelihood of reduced rainfall in coming months to the community and decision makers in a more timely manner.
- Hydrological models are now used to determine the extent and timing of floods and to predict the likelihood of drought in coming seasons. This provides forewarning to authorities and communities alike allowing them to together take timely and appropriate actions to reduce the impacts. The more accurate and comprehensive our hydrological data is, the better our predictions.

4.1 Hydrological Monitoring and Risk Assessment and Dissemination



5.0 Recommendation

- Integrated approach to flood management on a catchment basis.
- Establishment and operation of adequate number of hydrological monitoring stations on our river systems.
- Incorporation of climate change adaptation in the design and operation of water resources structures.
- Effective river training and channelization.
- Periodic de-silting of dams and dredging of rivers.
- Improved advocacy on flood prevention and activities
- Construction of more dams and reservoirs to ameliorate flooding.
- Capacity building in the area of flood forecasting and management.
- Adequate and sustained funding for flood management.

5.1 Conclusion

Accurate, reliable, and accessible hydrological data can not necessarily stop floods, erosion and drought from occurring, it can however provide timely warnings, and be used to reduce the impacts. Early warning systems, flood

modelling, and drought prediction, can help us to prepare for these events and reduce our exposure to risk. Hydrological information can also be used to identify alternate water sources for use during critical times.

Despite this, hydrological network within the country are few nor is there sufficient annual financial support to maintain even basic hydrological services and their data collection. Without the recognition and financial support for this important service, national hydrological will continue to struggle, putting lives and infrastructure at risk and limiting the potential for better decisions and sustainable developments for the future.

ISBN 978 - 978 - 54526 - 6 - 2

Printed by: **R. Atlas Ent.**
School by Zander Street, Owerri
08036663640

Application of hydrological data in erosion and flood mitigation By Beckley, M. O. is licensed under a Creative Commons Attribution-Noncommercial-Noderivatives 4.0 International License.