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Hydrological Data Banking for Sustainable Development in Nigeria: An Overview

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Abstract - This paper examines the importance of hydrological data banking for sustainable development in Nigeria. Water related projects have failed woefully in Nigeria because they are executed without recourse to or lack of relevant hydrological data. Hydrologists primarily are saddled with the responsibilities of data gathering, processing, storage and retrieval on all components of the hydrological cycle such as precipitation, evaporation, runoff, infiltration, stream flow to mention a few. This however can only be done when hydrologists are adequately trained and efficient hydrological gauging stations with up to date equipment are established. The current situation in Nigeria is that hydrological data banking is lacking which is linked with inadequate and inefficient guaging stations and trained manpower. There is the need to make hydrological data collection, processing, storage/retrieval and banking for sustainable development a must in Nigeria. Government and relevant agencies and institutions need to step up action in this wise.

Keywords: Hydrology, water inventory, river, data banking

Introduction

The greatest challenge facing governments and organizations especially in the developing countries of the world is the problem of failed projects or programmes. This is linked in one way or the other to execution of projects without recourse to relevant data which will make for their effectiveness and sustainability. For sustainable development in water related projects, the issue of hydrological banking, involving data collection, processing, storage /retrieval and management cannot be underrated. In 1984, the university of Loughborough UK in collaboration with the National Water Resources Institute, Kaduna organized a workshop on water resources planning with minimum data, concluded that using minimum data to take decision   would mean minimum accuracy or efficiency, what is commonly described as near enough situation.

In Nigeria, Ononiwu (1994) expressed dismay on the issue of data in all field of management. According to him, the problem with data in every field of management has been and is still an embarrassment. And even when data are available, there is the problem of accuracy, up-to-dateness, completeness, timely, meaningful and commensurate.

Substantiating this claim, Ertuna (1995), Ongley (1997) and USEPA(1994) observed that many developing countries due to institutional, financial and technical reasons are not able to mount stable reliable data gathering stations. Even when they are, data unreliability including intentionally fraudulent data are all too common. In many of these countries, data holding remains only on paper and are unavailable in electronic format, the challenge is how to make the information usable. Acessing knowledge and its use in decision making remain extremely difficult for developing countries. Specific attention needs to be paid to new information technologies that permit user friendly use of knowledge bank or data for decision making, for planning and development. The secret behind the development in most advanced countries of the world is that they commit huge capital to research and development. Africa is generally found to be lagging far behind in this respect especially Nigeria where there is misplacement of priorities.

Role of Hydrologists in Data Banking

As hydrologists and environmentalists *what should we be doing or what are we supposed to be doing?.What do we need to be able to carry out our duties?.Where do we market our products?. How do we manage our products?.What valve is our role in the scheme of affairs of our country's development?.* These are pertinent questions are addressed in this paper.

Hydrology is dynamic earth science that concerns itself almost exclusively with the study of water as environmental resource that has no close substitutes. It is the science of all water on the earth, its occurrence, distribution, and circulation, its physical and chemical properties, its effects on the environment and on all life forms, aquatic and terrestrial(Ward and Robbinson, 1990).It is also extended to include development and management of water resources for various purposes. Hydrologists are primarily concerned with the following:

(i) **Water inventory.** Hydrologists should have a comprehensive knowledge or data on available sources of water that can be harnessed for any meaningful developmental purposes. Example: atmospheric (rainwater harvesting, cloud seeding, traditional rainmaking) surface sources (rivers, streams, lakes, ponds,ocean/sea) underground sources(groundwater, springs).

(ii) **Data collection**. Systematic collection of data on all components of the hydrological cycle is a primary domain of hydrologists. These include data on precipitation, interception, infiltration, run off/streamflow, evaporation, evapotranspiration, groundwater

(iii) **Missing records**. All missing records should be provided for by the way of supplementing or complementing through statistical extrapolation.

(iv) **Data processing.** It is not enough to collect or gather hydrological data but they should be available in the format that is user friendly. This means that all data must be processed or transformed into a useable form such as hydrographs, duration curves, mass curves etc for quick appraisal

(v) **Data storage and management.** Data collection will be a futile exercise if they are not banked and can be accessed when they are needed. This can be stored in electronic data base like computers, internet, GIS (Geographic Information Systems) in soft form and in hard form such as manuals, textbooks, files, archives.

(vi) **Project planning and execution.** All water related projects must incorporate the services of the hydrologists right at the planning stage for professional advice. It is not surprising to note that huge capital projects have failed because of negligence in this regard especially in Nigeria. In the light of the specified traditional role of the hydrologists Nigeria fall short in all regards.

In the first place only few institutions offer hydrology as a course in geography and water engineering departments. Even when they do, issue of qualified manpower and equipment is another thing. At the end of the day it is more of a theoretical exercise. Collection and processing of hydrological data is another uphill task in Nigeria. This is because functional hydrological gauging stations are either lacking or inadequate leading to dearth of hydrological data. This borders on lack of commitment on the part of government on funding of hydrological services.

The good thing that has happened so far in Nigeria is the establishment of the Nigeria Hydrological Services Agency (NHSA).This is in realization of the need for hydrological data banking for planning. Although a welcome development much is still required to perform their function. For now, skeletal hydrological data may accessed in water related agencies and institutions as hydropower stations, river basin development authorities, and meteorological stations. From the foregoing, it is apparent that execution of water related projects stand a very big risk of failure. This perhaps may attributed to the issue of collapsing dams and bridges at events of flooding in Nigeria.

Hydrometeorogical Stations

We need a network of hydrological stations for data generation and collection. A hydrological network is viewed as a set of stations at which observations of hydrologic phenomena are made as a function of time and they are meant to provide information to aid in planning, management and decision making(Dawdy,1979; Ologunorisa, 2009). Hydrological network is established in any country for the collection of data for range of uses. These data can be on rainfall, discharge (rate of flow), streamflow, river stage, groundwater levels, sediment transportation and deposition, water quality, evaporation, evapotranspiration, interception and depression storage, river profile and cross section(Ologunorisa, 2009; Ezenwaji, 2012). For a hydrological station to do this job they must be equipped with necessary relevant and up to date tools (instrumentation)

In Nigeria, the history of hydrological activities started as far back as 1914 when the Inland waterways Department, now National Inland Waterways Authority (NIWA)started to the establishment of hydrological stations on Rivers Niger and Benue. Later on, other agencies such as various Ministries of Agriculture of the former regions started collecting their own hydrological data. The Regional Government of the then Northern Nigeria started collecting data in Sokoto, Kebbi, Zamfara and Katsina axis with high degree of effectiveness up to 1960s. Hydrological data collection received new impetus with the establishment of River Basin Development Authorties. A review of a available data in Nigeria show that a lot of hydrological data are available from 1950's to 1980's before a drastic drop in data collection started. From about 1990 till date, only very few hydrological stations have been functioning such as those operated by PHCN,NIWA, and some RBDA's. This a very serious situation that demands urgent attention (NHSA,2010).

Hydrological Institution Arrangement in Nigeria

The Federal Ministry of Water Resources is, by policy guideline, the umbrella body under which all water resources activities, including hydrological data collection and operation are carried out. This mandate is carried out through the Nigeria Hydrological Services Agency(NISHA). The twelve River Basin Development Authorities (RBDA's), the National Water Resource Institute(NWRI) and other organizations such as State water Boards, State Ministries of water Resources and Agriculture, Agricultural Development Programmes (ADP's) PHCN, NIWA etc are all involved in hydrological activities(NHSA,2010).

The institutional framework as regard the mode of operation can summarized as follows: The apex policy making body is the Federal Ministry of Water Resources (FMWR) operating through the National Council on Water Resources. The Nigeria Hydrological Services Agency(NISHA) is directly charged with the responsibility of supervising hydrological activities in Nigeria. Under the FMWR are the 12 RBDA's and NWRI as parastatals. Operating at the state level are the Ministries of Water resources, utilities, water Boards and other relevant state agencies. NIWA and PHCN operate independently of the FMWR. Some other establishments such as National Fadama Programme, sugar producing companies, etc are involved in one form or the other in hydrological data collection. This disaggregated nature of hydrological data collection call for a concern. There is need for an integrated approach in hydrological data collection and banking for sustainable development (NHSA,2010).

Ideal Hydrological Station Network Density for Nigeria

World Meteorological Organisation(WMO)(1981)prescribed minimum standard network for primary hydrological stations in Nigeria to be four hundred and eighty(482). Presently, one hundred and sixty three (163) primary hydrological stations, out of the prescribed minimum have been established due to financial constraints. It is pertinent to note that of the eight (8) Hydrological Areas(HA's) in the country , none has been fully covered in terms of correct minimum density of stations(NHSA,2010).

Hydrological Stations Instrumentation and Maintenance

Hydrological data generation, collection and processing is capital intensive as such demands commitment on the part of responsible governments and organizations. All hydrological stations must be adequately equipped with appropriate instruments for data collection on say rainfall, streamflow, river discharge, water level both surface and underground, evaporation, evapotranpiration to mention but a few. In the current scheme of affair where are we in Nigeria in term of functional hydrological stations?.

Hydrological Banking Data for Services

Hydrological data are needed in water resources in all related development projects. These include the following: In planning water supply for rural and urban community data on the available and reliable sources of water is needed, be it surface or underground sources. Rural water supply in Nigeria especially exploitation of groundwater through boreholes have suffered series of setback of wells not yielding water for some time causing untold hardships for rural dwellers in need of potable water. They are at times compelled to turn to unsafe sources for drinking with all its health implications.

For engineering designs, such as dams for irrigation and hydro power generation, data or information on the reliability or dependability of river flow or discharge is necessary. For safe engineering design such as dams, flood control spillways, culvert and bridges data on river discharge, river stage, stream flow, river energy, topography is needed. This is the reason why we have cases of dams collapsing, bridges submerged or carried away. For flood control management, data on the river regime or flow characteristics over the years in necessary. For example, the recent flooding of several settlements downstream of Lagdo dam could have been averted if data on the flow characteristics of River Benue were studied and utilized.

Development of river transportation depends very largely on data on river discharge, regime, river stage, current, sediment load. For example the proposed dredging of River Benue for improved inland waterway.

Evaporation and evapotranspiration records are needed in the estimation of water balance of a basin. Data on potential and actual evapotranspiration are needed for agricultural purposes. This is because actual evapotranspiration data are directly related to rainfall amounts which are important for rain-fed agriculture. Again, the length of the growing season is determined by the relationship between rainfall and potential evapotranspiration (Oguntoyinbo, 1983). Interception and depression storage data are important for the quantity of water to be tapped from a basin. Interception can be reduced by thinning or land use land cover change development activities.

Water quality data is essential especially for domestic and industrial water supply developments. Consumption of poor quality or polluted water is linked to sources of most of the water related diseases worldwide. Over 85% of the diseases globally is associated with drinking contaminate water. This is the why World Health Organisation (WHO)set drinking water standard and countries are expected to set their own drinking within the set by the WHO. Hydrological

data is needed on groundwater availability, level, yield, discharge and recharge for development of groundwater for community water supply. This is the reason why we have problems of failed hand dug wells and boreholes.

Training and Retraining for Hydrologists and Water Related Practicisioners

There is a popular saying that whatever count costs. Constant training and retraining of hydrologists and water related practicisioners is a must if we are to make any meaningful progress in various water development endeavours. Training makes for efficiency, acquisition of better skills or techniques in our various endeavours. Attending conferences, workshops, seminars, symposia is of paramount importance for water practicisioners, professionals, and environmentalists to be abreast with current state of affairs in water development sector

Conclusions

For sustainable development in water related projects in Nigeria working with relevant hydrological data is a must. This underscores the need for and urgency of gathering, processing and banking of hydrological data that can be accessible to all users on a continuous basis. The government and relevant bodies need to be proactive in this direction by committing enough resources to this project

References

Nigeria Hydrological Services Agency (2010). Overview of hydrological activities in Nigeria, http://www.nihdydro.gov.ng/Overview.

Dawdy, D.R (1979). The worth of hydrological data. Water Resources Research, 15(6): 60-68.

Ezenwaji, E.E. (2012). Hydrological networks. In: Anyadike, R.N.C and Obeta, M.C (eds). Fundamentals of Hydrology. Chuka Educational Pubishers, Nsukka, Enugu, Lagos.

Ertuna, C. (1995). Water resources development and management in Asia and Pacific: A brief overview in experience in development of small-scale water resources in rural areas, Bangkok and Khon, Thailand. Carl Duisberg Gesellschaft, South East Asia Program Office.

Ologunorisa, T.E. (2009). Content analysis of hydrometeorological network in Lower River Benue Basin, Nigeria. Journal of Applied Science, Environment and Management, 13(2): 32-35.

Oguntoyinbo, J.S. (1983). Climate. In: Oguntoyinbo J.S., Areola, O.O., and Filani, M. (eds), A Geography of Nigerian Development, 2nd edition. Heinemann Educational Books, Ibadan.

Onley, E.D. (1997). Water quality: An emerging global crisis, paper submitted to the United Nations ACC sub-committee on water research on behalf of the GEM/Water collaborating centre. Publication of United Nations of Commission for Sustainable Development, Burlington, Canada.

Ononiwu, N.U. (1994). An appraisal of the role of satellite systems in acquisition of data for monitoring and evaluating global climate changes with respect to reservoir energy generation. In: Umolu, J.C(ed) Global Climate Changem: Impact on Development,165-171,Published by Damtech Nigeria Limited, Lagos.

USEPA. (1994). National water quality inventory, Report to Congress -841-R94-001. Office of Water, Washington.

Ward, R.C. and Robinson, M (1990). Principles of hydrology, 3rd Edition. McGraw-Hall Publishing Company, Berkshire, England.

WMO. (1981). Guide to hydrological practices(1) 4th ed. WMONo.168 Switzerland, Geneva.