Integrated Water Resources

Engineering Development and Management in Akwa Ibom State, Nigeria

By

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Abstract:

Historical background of water resources engineering development has been discussed. Contributors and key persons who played significant roles in the development of water resources engineering have been given. Modern trends and the advent and continued development of high speed digital computers in both a practical and an economic sense with attendant soft wares to cope with challenges have been highlighted. However, milestones in integrated water resources development in Akwa Ibom State have been discussed in detail. Pragmatic steps and further essential development in engineering construction that need to be executed in order to give facelift to the specialty have been stated. Measures that need to be taken so that the already established institutions responsible inter alia for the development of water resources infrastructure are outlined.

Key words: Computer, Construction, Environment, Integrated, Milestones in Water Resources Development

1. Introduction

Water Resources Engineering Development deals with issues about life and sustainable water-related needs of the society. It is essential to protect the ecosystems, natural resources and consciously try to solve the problems arising there from. The human kind, and other lives or living things are growing extensively day by day, so therefore to meet the challenging needs of the community in rural and municipal areas, industrial concerns, agriculture maintain steady potable water supply from the surface or the aquifers in underground water harvest, good and purpose driven recreation navigation generation of hydro- electric power, control of storm water and flood become very imperative activities man must undertake.

Hence the importance of Water Resources Engineering Development cannot be overemphasized.

2. Discussion

The sustainable management of water and land resources is fundamental in the delivery of health services and food security. This discussion will set the scene highlighting the need to put into operation water resource and land management in Nigeria and indeed Africa.

The discussion on the subject matter will be handled in the following specific micro or sub-divisions:

I History of Water Resources Engineering Development

II Milestones in Water Resources Development

III Strategies for Water Resources

IV the Future of Water Resources Engineering Development in Akwa Ibom State and indeed Nigeria

V Conclusion VI References

2.1 History of Water Resources Engineering Development

Water Resources Engineering falls into one of the several major specialties in Civil Engineering. The Civil Engineer as it is known all over the world serve the public in various capacities. One of such is by solving problems and articulately addressing the societal needs involving development and maintenance of physical infrastructure protecting and restoring dignity to the environment. In-fact the engineering family as a whole strives very hard to achieve this objective.

In-fact when problems centre around water – either in scarcity or in abundance the inability to manage either extreme in life consciously poses threat to human/life existence. When there is scarcity of water – the wilderness experience, life becomes unbearable, uninteresting, starvation creeps in drought inevitable, living things begin to experience gradual degradation and unpleasant ending.

Historical Background of water resources development stem from the emergence and studies of an ancient science. Hydraulics and Fluid mechanics, the Egyptians and Babylonians constructed canals, both for irrigation and for military defense purposes. At the time knowledge of laws of fluid motion was lacking.

Greeks tried to propound rationalized nature of pressure and flow pattern. Later popular laws of hydrostatics and buoyancy were unveiled.

The Romans played very significant role in development of hydraulic equipment such as piston pump. The popular Archimedes principle and law of flotation was then on course. Prior to and during the Renaissance, scientists like Leonardo Da Vinci worked on conservation of mass (known as continuity of flow velocity of surface waves, and flow resistance.

2.2 Contributors to Water Resources Engineering

Few important contributors amongst many will be recognized here who had made tremendous debut in the discipline and related subject matter.

An Italian engineer, Polemic 18th Century investigated the concept of discharge coefficients. The 17th Century Scientists who impacted much included; Descartes, Pascal, Isaac Newton, Samuel Boyle with the famous Boyle's law, Thomas Hooke and Leibnitz who did much on mathematical physics of motion – a foundational approach.

This led to the great perception in logical pattern delving into various aspects of mechanics by the following – Bernoulli, Euler, Clairant and D'Alembert. These people laid sound mathematical framework in analyzing physical phenomena.

Subsequently, Henri de Pitot now led the way by constructing a device which enabled the measurement of velocity of flow.

Actually Antoine Chezy (1718 – 98) followed by Eytelweia and Woltmann, developed a rational equation to describe the stream flows. DuBuat, Bossut, Borda, Ven Te Chow went ahead to ensure further growth in the disciple and thus the spread of information and knowledge became very easy.

Dr. Woltmann and Venturi used Bernoulli's work to develop flow measurement principles.

In order not to bore you with names but it is worthwhile to track the works of Hagen (1778 – 1884) who investigated the effects of temperature on pipe flow called the Newtonian fluids – employing the knowledge in describing nature of fluids viscosity.

Similarly, a French doctor Poiseuille also made significant observations on flow in pipes in an attempt to understand the flow of blood in blood vessels, which led to the development of equations for laminar flow in pipes and capillary flow equations. Further contributions were made by Darcy propounding law of flow in porous media and the Du-puit. Theim well formula evolved (Du-puit, 1863).

Weisbach, Bresse and Henri Darcy developed the equations for frictional resistance in pipe and channel flows – the 'Boundary layer' phenomena of the 19th Century. Currently, much work is ongoing still on Hydrodynamics begun by Navier Stokes, Schwarz, Christoffel Sherman's unit hydrograph, Horton's infiltration theory and Theiss non-equilibrium approach to well hydraulics.

The modern trends have made it possible for the advent and continued development of high-speed digital computers in both a practical and an economic sense, extensive work in the discipline. There are few soft wares in the subject area such as:

(1) Mike 11 (HD 1 Software 2003) and
(2) HEC – RAS (Rivers Analysis System) (US Army Corps of Engineers, 2002).

Computer programmes are dynamic with competitive innovations emerging at very fast rate periodically.

(3) EPANENT Pipe Network Water Quality Analysis
(4) ELDWAV – Flood Wave Model
(5) HEC-FEA – Flood Frequency Analysis
(6) SEC – HMS – Hydrologic Modeling System
(7) SWMM – Storm water Management Model
(8) SWAT – Soil and Water Assessment Tool.
(9) MODFLOW – Modular Groundwater Flow Model.
(10) WRAP Water Rights Analysis Package
(11) River Wave Reservoir and River Operations

However, there is serious need to develop programmes that can attend to our own need in the state and the country at large. This is very possible as we have in abundance computer experts who know the science and have grasp of the technology/language.

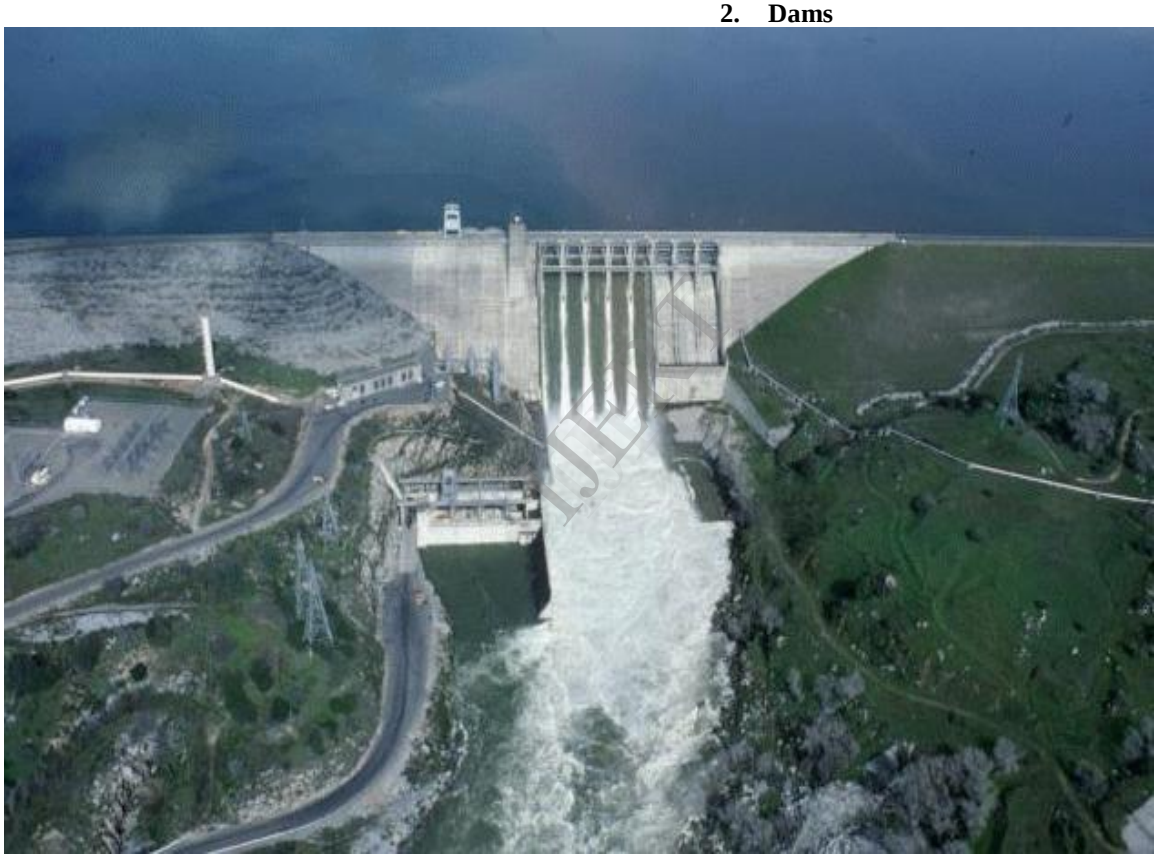
2.3 MILESTONES IN WATER RESOURCES DEVELOPMENT IN AKWA IBOM STATE

In order to discuss about mile stones one should try to get to the existing development infrastructure linked to Water Resources Engineering.

1. **Canals For Irrigation**

Still in primitive nature, the infrastructure really needs good attention. No conscious development to make use of our waters and technology.

2. **Dams**



Often it is said or assumed that Akwa Ibom and indeed the South- South of Nigeria is blessed with water but the waters, streams, rivulets, rivers, oceans and others have not been utilized for the purpose constructing dams. Kainji Dam, Goronyo Dam, Saminaka, Hadeija and the like are all located in the northern part of the country. Attempt would have been made to impound some of our water courses, and then construct, suitable and functional dam to ease the problem of power (shall seek Hydro Electric River, SHP)

3. **Recreational Facilities**

There is a little effort in this wise by private entrepreneurs - Little Streams Farm in

Ibesikpo Asutan is a clear example. Recently attempts are being made to develop similar or slightly different facility at Ntak Inyang on Ikpa River channel exploits.

4. Navigational and Transportation

There was government intension to develop water transportation during the development of Le Meridian Resource Complex, Nwaniba. It appears this had been abandoned. Features included well developed landing platforms or jetty facilities, speedboat/hover crafts and other means of transportation are supposed to be provided. History had it that there were many local harbours established around the state linking other parts of the country and outside by water transportation – boats, canoes, submarine, ship, pontoon and ferries at stations/town like Oron, Itu-Okopedi, Nsiak, Uta Ebua in Ikot Abasi, Opobo in Eastern Obolo, Use Obio in Uyo, Nwaniba. Some places in Ibiaku Ishiet/Ituk Mbang, Ibeno, Eket and Onna are also natural ports available. Today only pockets of these remain functional and are being used as fishing terminals.

Conscious and abundant resources remain here. Canals can be built from the existing river channels to farm lands for irrigation. Earth and reinforced concrete walled canals are probable types sufficient to serve the purpose. Most of the river channels have very difficult terrain and surrounding beaches are very inaccessible because of thick vegetation and swamps. Where the channels are contiguous with rocks or mountainous boundary coast it becomes more difficult to establish anything construction but with involvement of huge financial resources this can be abated.

5. Construction of Gretchen

Gretchen are navigable channels/canals constructed in the city periphery along streets arterials to aid water transportation within city, Uyo for example will need Gretchen as additional means to promote water transportation and reduce congestion and vehicular mode of transport. The scenery of structures of embankment inter land in a city periphery is very lovely.

6. Refreshing Water Fountain Construction

Fountains form very beautiful panorama in an environment. They give reliefs to dull atmosphere and very dry locations. When music is added consciously displayed afternoon and evening, the environment becomes friendly and appreciating with colourful fountain runs. This infra structure is beautifully constructed in the metropolitan city of Uyo at not less than five(5) modern intersections in the city and ancient towns of Ikot Ekpene and Abak to showcase the uncommon transformation being undertaken in Akwa Ibom State. The most colourful are the ones located at Nwaniba by Major General Edet Akpan Avenue with varying water altitudes and intermittent water colouring/music background. This is very spectacular at night

7. Drainage, Storm water Management and Flood Mitigation

Akwa Ibom State is in the tropics. Prevalent in the Mangrove Rain Forest is heavy rain at its season. Hence during the rains, uncontrolled rains usually cause serious damage to farmlands, property and infrastructure - roads and bridges. The new trend in the state is the construction of deep control sewers along Itam Calabar Highway. This is a wonderful drainage system in the West African Sub region.

7.1 ***STATISTICAL DATA*** shows that this very year flood occurrences all over the country have been disastrous and worrisome. In areas that used to be termed 'Arid Zones' now become flood plain prone zones all of a sudden.

Kano flood two weeks ago displayed so many thousands of people rendering them homeless. Properties worth millions of Naira were lost in the menace.

Just last week Kogi State and parts of Nassarawa got submerged in flood incidence

Bayelsa and Rivers: Last night, in fact three days ago after hours of rain events and continuous natural flows from the heavens over 560 people were displaced in the littoral territories of Bayelsa and River State. Report also claims that in some parts of *Sokoto State* Flood had taken over the farm lands. Reasons are still free releases from the heavens. Most of the communities lie within the natural flood plains and water courses.

Good water resources management strategy is very essential to mitigate the problem of flood and overtopping. Torrential water flow caused by storm can be very dangerous even

to structures if not properly cared for or positioned.

7.2 Effects of Erosion

Clear example of erosion prune area is the gaping site of erosion site along Oron Road at Oron Town in Akwa Ibom State, Nigeria. This is a- one kilometer length active gully erosion site after many years of neglect. The arm of erosion could just erupt where soil texture and cropping system enhances development ground leaching as shown below.

Soil conservation districts works to mitigate land erosion and manage land and water resources are essential.

7.3 Ground Water Conservation

In order to manage aquifers around water conservation districts are created. Ground water monitoring agency has to be established to monitor the aquifer and detect sharp contamination from human action and other activities avoiding hazardous deposits and ground water poisoning.

3. Strategies for Water Resources Engineering Development

- strengthen the existing government agencies for effective resourcefulness
- establish definite centers to cater for the development of the water resources related projects/programmes within the already existing river basin
- enlarge the scope of operations of the basin authority
- Re organize the basin authority from its present status for effective and efficient water resources engineering management
- Re - consider the existing staffing structure and retrain the technical and indeed overall staff of Cross River Basin Authority and other river basin authority institutions throughout the country to serve the established and desired needs.
- formulate development plan and concrete projects with execution plans

7.4 Future of Integrated Water Resources Engineering Development in Akwa Ibom State and indeed Nigeria

With the attention of Akwa Ibom State government on development of infrastructure, creation of enabling environment for the paradigm shift from low density development to high and intensive development area or state to march the spirit and objectives of millennium development goals MDGS' of the administration. In order that these objectives are realized with the highest cost – benefit ratio, the holistic review of all possible projects is carried out. In essence, the best kind of project will be multi- purpose in nature. This is a project which has been designed and operated in to serve more than a single purpose. There are examples of such single purpose project: flood control project and or hydroelectric power project. The government can undertake a hydraulic based multiphase project to involve the following facets

a) Flood and erosion control by constructing channel modification structures and enlargement. Development of various beaches at strategic locations within the state.

b) Bridge and Dam construction project to ease transportation and enable multipurpose ventures.

Example: Small Scale Hydro Electric Power Generation

c) Aquatic life development (Fish and wild life)

d) Quality Water Supply Installations with modern facilities and methods like Reverse Osmosis (RO) Process plants

e) Navigation and Recreational facilities

f) Irrigation for Integrated Agricultural Production

The multiple use of water makes this very attractive. The unique feature of a multipurpose project design is basically on the selection of construction works integrated in such a way that efficiency in operation is obvious. Individual works like dam for storage, outfall structures for discharge control, spillways for energy built up and delivery, weirs, sluice gates, power plant units, hydraulic jump structures and cut off structures. Dam projects are favored more in regions where rain water is scarce. In Akwa Ibom harmattan period which usually forms the peak of planting season is often dry. Hence, the siting of dam project across the state is very important to ensure all year round cropping. Specifically, in Okobo, Nsit Atai, Nsit Ibom, Uruan, Ibiono Ibom, Ukanafun, Ikot Ekpene and Urue Offong Oruko it would be very helpful if dams are constructed. The benefits will not only be in huge and fantastic agricultural output but will also ensure power generation, fish and wild life preservation. During the low flow of river channel, carrying industrial waste and sewage, the river flow maybe enhanced by releasing water from the reservoir to assimilate the waste water. However, the release of reservoir water may cause pollution of the area due to sudden rise and upsurge in water quality. Dissolved salts may be increased in reservoir water by evaporation and leaching from adjoining soils and rocks. Furthermore, decay of prevalent vegetation in the reservoir may result in decrease in dissolved oxygen content at the lower levels as the case may be.

Flood Control and mitigation are very important the reservoir serves. The reservoir becomes the adequate storage where excess water from the flood plain is released at appropriate flood season.

The future of Water Resources Engineering Development is therefore very bright following the tempo at which the current government responds to the establishing and undertaking laudable projects in the state. Maintaining this tempo even after the tenure by succeeding government administrations will ensure fruitful investment in the area of concern.

Gretchen Development: As earlier mentioned, the use of Gretchen is gaining ground world over as artificial canals are built across city arterials enhancing transportation and healthy, sound environment. Useful are the virgin semi dry valleys of our land.

5. Conclusion

Emphasis nowadays has been the utilization of enormous resources accruing from oil revenue to plan for the future. The wisest engagement would have been consolidating on strides made so far and establishing base for even development throughout the state in one hand and the nation in general.

Reviewing the strategies for establishment of effective/efficient water resources engineering development the road map is already drawn. Good guidance is necessary for achieving this goal in Akwa Ibom State and throughout the entire country. The time is ripe to further open the state up for meaningful, enduring and sustainable development.

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