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Challenges of Continued River Niger Low Flow into Nigeria

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Abstract

Over the last 4 decades River Niger has continuously been affected by the impact of climate change and abuse from human activities to the extent that in June 1985, the river was completely dry in Niamey (Niger Republic) for the first time in history. Similar low flow was recorded 2003 that was among the lowest in 50 years and the month of April, May and June are its most critical low flow periods.

The continued low flow, which is as a result of the impact of climate change coupled with the enormous negative human activities is now increasing the rate of movement of Sahara desert southward towards the Atlantic Ocean. The low flow has also lead to the continued reduction in storage of reservoirs (e.g Kainji and Jebba dams) and also reduction in food crop production, water shortages due to increasing water demand, river pollution, weed encroachment, increasing water borne diseases, mortality rate, famine, urban migration and poverty.

According to the 1995 UNESCO Study Report No. 52 on the hydrology of selected discharge of rivers in Africa, the river Niger 'loses' nearly two-thirds of its potential flow due to seepage and evaporation in the Inland Delta, the latter being aggravated by the fact that the river here touches the southern flanks of the Sahara desert. The Inland Delta, located in Mali, is swampy with the sandy soil that has a network of tributaries, channels, swamps and lakes covering about 30,000 km^2 during the wet season which also extends into the Sahara Desert.

Experts have been particularly worried by the proposed construction of a dam at the downstream of the Inland Delta at Taoussa in Mali that was approved by all the 9 NBA member countries (including Nigeria) for the NBA Shared Vision and Sustainable Development Action Plan. The location of Taoussa dam just downstream of the Inland Delta could technically aggravate the tremendous inundation in the Inland Delta deeper into the Sahara desert. On the other hand, the approval the Fomi dam in Guinea and Kandaji dam in Niger are regarded by experts as the most effective measures for sustainable water resources and ecosystem conservation of the river Niger.

Today, Lake Chad has almost completely disappeared from its basin, with many unfolding tragic consequences for victims in the affected region of Nigeria and Chad. Unlike the case of Lake Chad, however, it is believed that the consequences of the disappearance of River Niger in Nigeria will have all the makings of the proverbial Armageddon, in terms of its cataclysmic socio-economic and political effects on the nation.

Key words: Low Flow; Climate Change; Inundation; Conservation; Disappearance; Reservoir Storage; Sustainable Development; Ecosystem Conservation.

Introduction

According to the report of the United States National Center for Atmospheric Research (NCAR April 2009), unless urgent actions are taken, River Niger in West Africa is one of the world's great rivers predicted to die in few decade from now as a result of their gross abuse in the different countries through which they flow, in addition to the effect of the Climate Change. Others include Rivers Ganges and Colorado in North America, as well the Yellow River in China. River Niger is the third longest river in Africa and takes its source from the Fouta Djallon highland in Guinea at an approximate altitude of 800 m, before traversing over a distance of about 4,200 km to empty into the Atlantic Ocean in Nigeria. The initial catchment areas of the Niger basin was about 2,000,000 km^2, covering 10 Countries

including Algeria, but as a result of desert encroachment, it was reduced to an active catchments area of about 1,500,000 km^2 with the exclusion of Algeria as shown in Figure 1. The remaining 9 Countries covered by the basin active catchment's areas, namely Benin, Burkina Faso, Cameroun, Cote D'Ivoire, Guinea, Mali, Niger, Nigeria and Tchad, formed the Niger Basin Authority (NBA), initially knowned as the River Niger Commission (RNC) in 1964, with the view of fostering cooperation among its members countries in the use and management of the basin's resources among others. RNC was changed to the NBA in 1980, with additional mandates for the enhancement of effective integrated water resources management and development of the basin in all fields, notably, energy, water resources, agriculture, animal rearing, fish breeding, transportation, communications and industry. NBA, in conjunction with the National Hydrological Services of its member countries, monitors the flow discharge of Niger River, using both the manual and automatic hydrological gauge stations for the proper control and management of the transboundary water resources of the river, in accordance to its mandate.

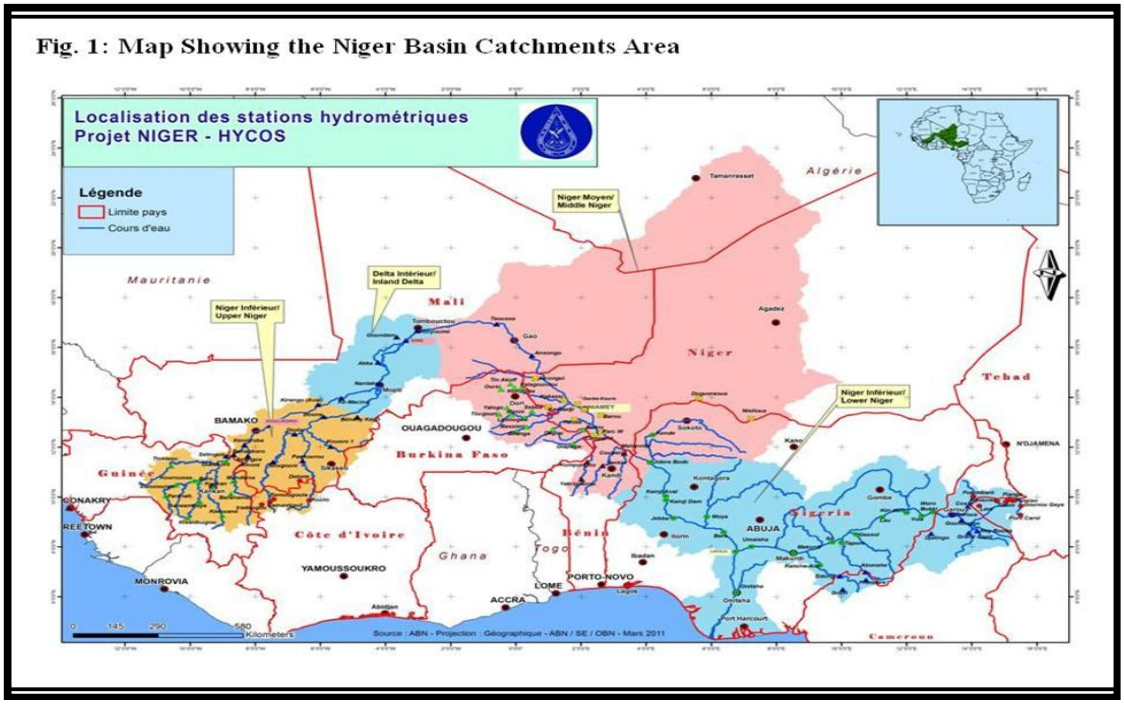


Fig. 1: Map Showing the Niger Basin Catchments Area

As stated previously, the continued low flow is as a result of the impact of climate change, coupled with the enormous negative human activities contributing towards the increasing the rate of movement of Sahara desert southward towards the Atlantic Ocean. The flow reduction has also led to the continued reduction of the reservoir storage capacities, reduction in food crop production, water shortages due to increasing water demand, river pollution, weed encroachment, increasing water borne diseases, mortality rate, famine and urban migration.

River Niger Flow Analyses

For effective understanding of Niger River discharge characteristics, the entire Niger basin is usually sub-divided in four hydrological sub-catchments areas, namely, the Upper Niger Basin; the Inland Delta; the Middle Niger Basin; and the Lower Niger Basin, as shown in Figure 1. These sub-basins are usually respectively represented by the following hydrological gauge stations located at Koulikoro in Mali, Dire in Mali, Niamey in Niger and Lokoja (including river Benue) in Nigeria.The representative hydrographs at these stations are shown in Figure 2.

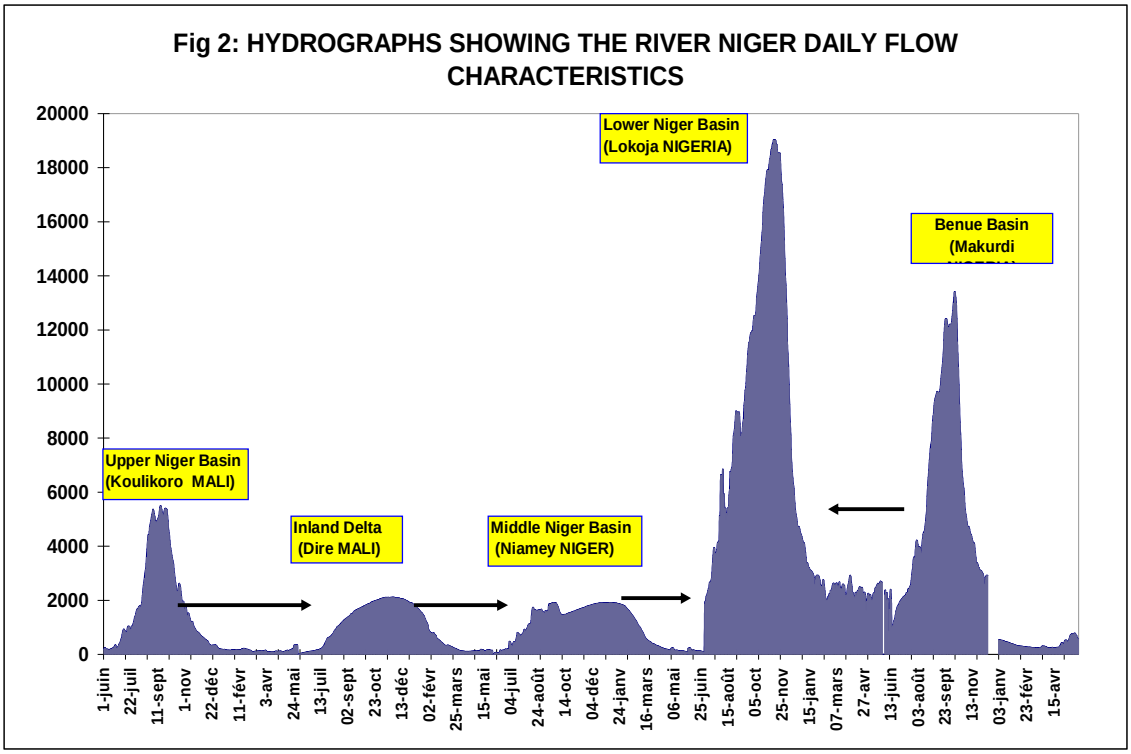


Fig. 2: Representative hydrographs at gauge stations located on Niger River, including that of the Benue River

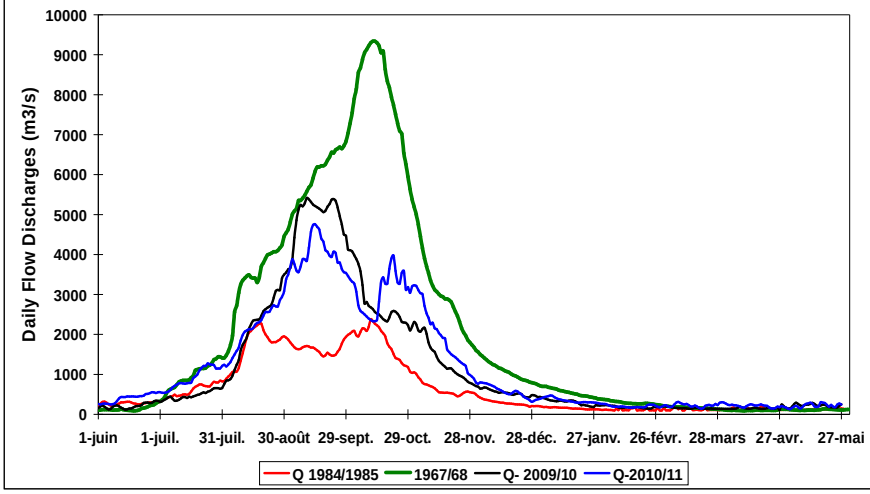
Upper Niger Basin

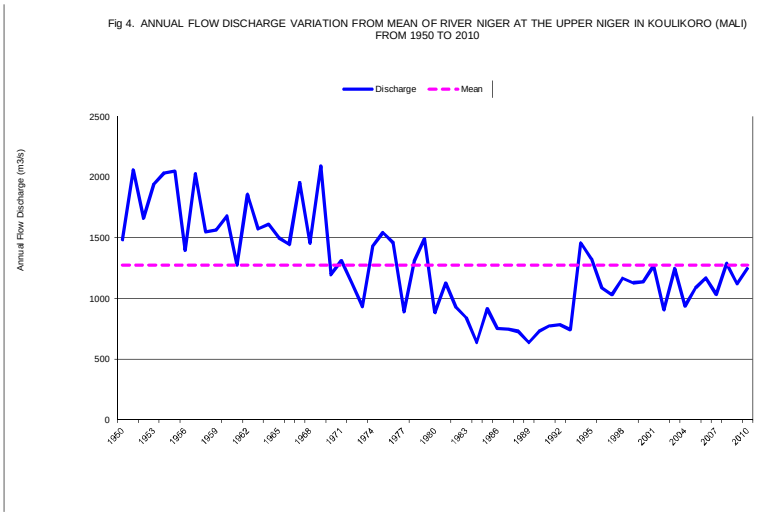
The Upper Niger basin covers part of Guinea, Mali and Cote D'Ivoire with a total surface area of about 740,000 km^2. Rainfall ranges from 800 mm in the hinterland to about 2000 mm in the coastal areas. The main tributaries of Niger River in this area are: Tinkisso, Niandan, Milo and Sankarani River (location of Sélingué dam).

The hydrological gauge station at Koulikoro in Mali was established in 1907 and is used to represent the hydrology of the area. The maximum discharge recorded at this gauge station was 9340 m^3/s in 1968 and the minimum of 13 m^3/s was recorded in 1984, with the mean flow of 1350 m^3/s, as shown in the Comparative Hydrograph of River Niger of the Upper Niger Basin at Koulikoro in Mali in Figure 3. The figure shows a remarkable reduction of daily flow discharges of River Niger in the seventies.

Figure 4 shows the annual flow discharge variation (1950 to 2010) from the mean annual discharge of 1276 m^3/s at Koulikoro. From 1950 to 1970 the river flow was steadily above the average, with a maximum annual discharge of 2094 m^3/s recorded in 1969 and a minimum annual discharge of 638 m^3/s recorded in 1984. From 1971, the flow has been consistently below the mean due impact of climate vagaries.

Fig. 3: Comparative Hydrograph of River Niger in the Upper Niger at Koulikoro (MALI)

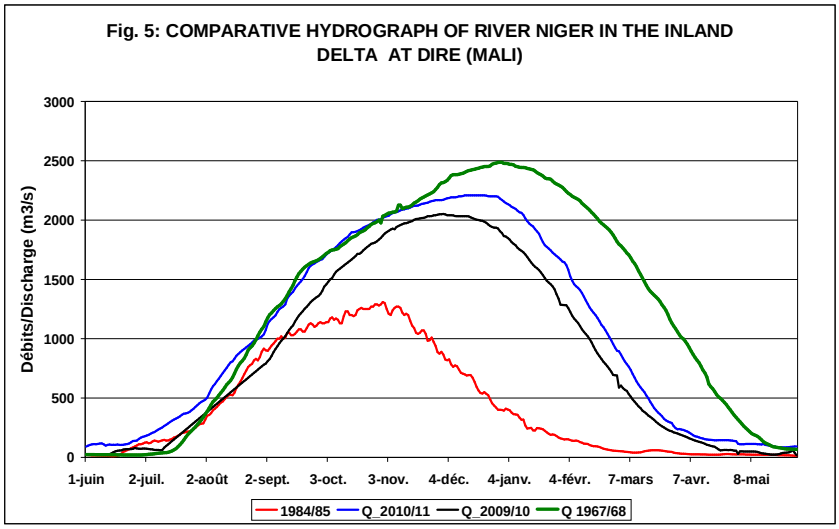




Inland Delta

The Inland Delta of the Niger Basin is a zone in Mali characterized by wide floodplain with a gentle slope, wide channels and the absence of tributary for over 300 km stretch. The zone has a total catchments area of about 80,000 km^2. The rainfall ranges from 200 mm to 800 mm and the evapotranspiration rate is about 2200 mm/yr. Most of River Niger flow is lost

in this area through seepage and evaporation. The gauge station at Dire in Mali, which was established in 1924, is used to represent the hydrology of the area and has a maximum daily discharge of 2477 m^3/s recorded in January 1968 and a minimum of 4.0 m^3/s recorded in June 1984. The pattern of reduction of daily flow discharges of River Niger at Dire is shown by comparative hydrograph in Figure 5.



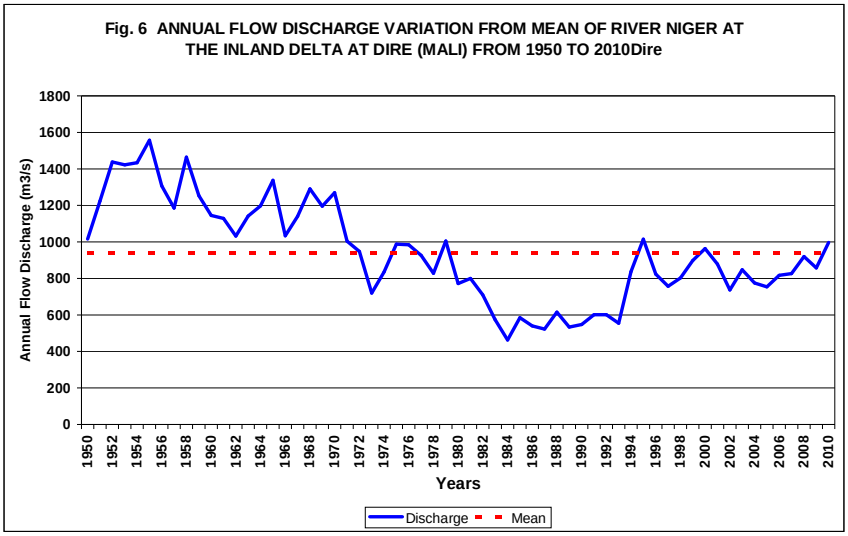
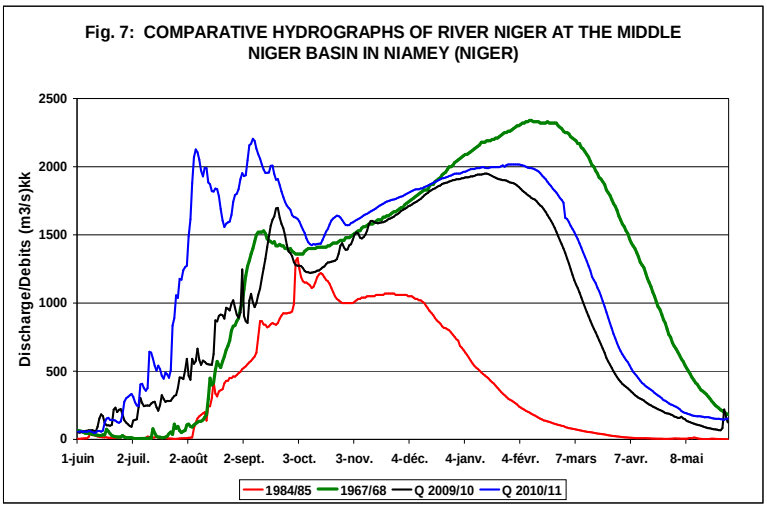


Figure 6 also shows the hydrograph of the variation of the annual flow discharge at Dire from 1950 to 2010 from mean annual flow discharge of 1276 m^3/s. The hydrograph shows the reduction of maximum annual flow discharge from 1557 m^3/s recorded in 1955 to the minimum annual flow of 463 m^3/s recorded in 1984, which can mostly be attributed to the impact of climate vagaries.

Middle Niger Basin

The Middle Niger basin essentially covers part of Burkina Faso, Niger and Benin with a surface area of about 530,000 sq km. The rainfall ranges from 200 mm in the North to 700 mm in the South. Niamey in the Republic of Niger has the representative gauge station established in 1928. From the comparative hydrographs of the river Niger in Niamey in Figure 7, the maximum daily discharge of 2340 m^3/s was recorded in February 1968 and a minimum of 0 in June 1985. River Niger has continuously been affected by the impact of climate vagaries, to the extent that in June 1985, the river was completely dry in Niamey for the first time in history. Similar low flow was recorded in 2003 which was among the lowest in 50 years. The remarkable reduction of daily flow discharges of River Niger in Niamey is also shown on the comparative hydrograph in Figure 7.



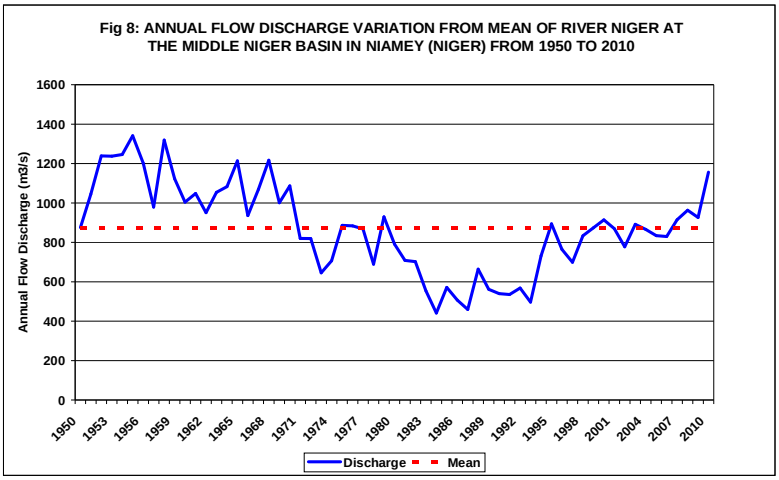
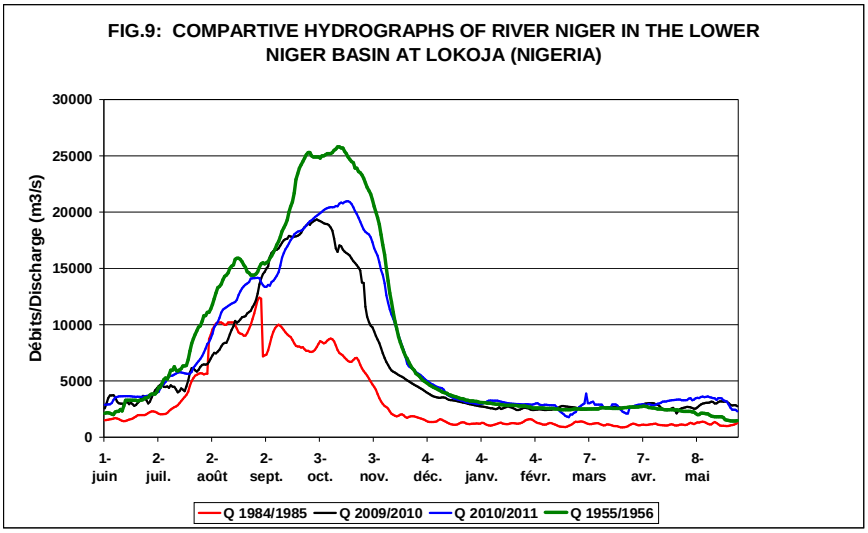
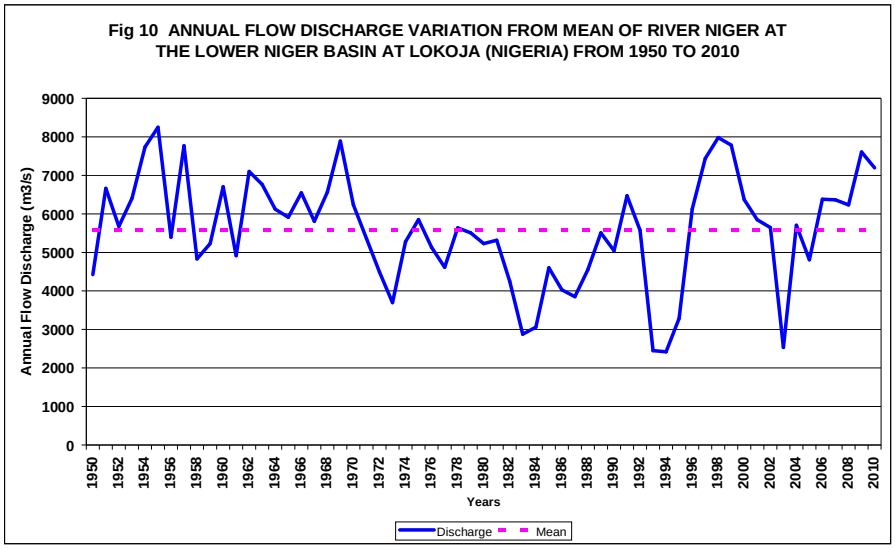


Figure 8 shows the hydrograph of flow variation from mean of annual flow discharge of River Niger in Niamey from 1950 to 2010. The mean annual discharge is 1276 m^3/s and the maximum annual discharge of 1557 m^3/s was recorded in 1955 while the minimum of 463 m^3/s was recorded in 1984.

Lower Niger Basin

The Lower Niger covers major parts of Nigeria and part of Central Africa in Chad and Cameroun with a total surface area of about 650,000 km^2. The rainfall ranges from 700 mm in the North to 3000 mm in the South. River Niger flows into the lower Niger in Nigeria through Jidere Bode into the Kainji and Jebba dams in Nigeria. Other dams in the Lower Niger are the Shiroro dam along the River Kaduna in Nigeria and Lagdo along River Benue in Cameroun. River Benue is the biggest tributary of Niger River and it forms a confluence with it at Lokoja in Nigeria, River Benue also contributes the highest flood flow to River Niger in a short duration, as shown in Figure 9. Lokoja hosts the gauge station which has been established since 1915.





From the comparative hydrograph in Figure 9, the maximum daily flow ever recorded was 25,800 m^3/s in October 1955 while the recorded minimum daily flow was 599 m^3/s in June 1981.
Figure 10 showed the hydrograph of the annual flow discharge variation of River Niger at Lokoja from 1950 to 2010 where the maximum annual discharge of 8247 m3/s recorded in 1955 and the minimum of 2531 m3/s recorded in 2003 while the mean annual discharge was 5590 m3/s. The river Benue has considerable contribution of flow discharge into the river Niger at Lokoja.

River Niger Water Losses

In June 1985, River Niger was completely dry just upstream in Niamey (Niger Republic) for the first time in history as shown in Figure 11 . According to hydrological records on flow situation on River Niger, a similar situation was almost recorded in 2003/2004 hydrological year when flow situation was among the lowest in 50 years. The months of April, May and June are usually the critical low flow periods in Niger basin. According to the historical records from 1930 to 2011, the river Niger, over the last 4 decades, has continuously been affected by the low flow situation attributed to the impact of climate vagaries and abuse from human activities.

Fig. 11 Photo of River Niger Dry in Niamey in June 1985

River Niger Water Losses in the Inland Delta

The Inland Delta in Mali is an area of major water losses, thereby creating low flow along River Niger. According to the 1995 UNESCO Study Report No. 52 on the hydrology of selected discharge of rivers in Africa, River Niger 'looses' nearly two-thirds of its potential

flow due to seepage and evaporation in the Inland Delta. The evaporation losses are being aggravated by the fact that the river, here, touches the southern flanks of the Sahara desert. The Inland Delta, located in Mali, is swampy with the sandy soil and during the wet season, it extends into the Sahara Desert. It has a network of tributaries, channels, swamps and lakes covering about 30,000 km^2.

Table 1 shows the 10 years average maximum flow from 1970 to 2011 of River Niger at Koulikoro, (Upper Niger), Dire (Inland Delta), Niamey (Middle Niger) and Jidere Bode (lower Niger in Nigeria). Table 1 showed average water losses at Dire, Niamey and Jidere Bode to be about 60%, 64% and 52% respectively in comparison to the flow at Koulikoro. Figure 12 is the aerial picture of the Inland Delta.

Table 1: Average Maximum Flow 1970 To 2011

Gauge Stations	1971-1980	1981-1990	1991-2000	2001-2011
Koulikoro	5189	3494	4565	5442
Dire	2130	1545	1879	2104
Niamey	1888	1454	1592	1799
Jidere Bode	2117	1851	2352	2685

The Irreversibility of Inland Delta Water Losses

The spread of water into the Sahara desert as a result of the construction of Taoussa dam and its attendant water losses is irreversible. The consequences could be catastrophic to the downstream countries, particularly Nigeria. It is therefore believed that the construction of the Taoussa at the downstream of the Inland Delta will not only inundate the area further into the Sahara desert, but also create an extremely low flow with drastic consequences on downstream countries, such as Niger and Nigeria with irreversible consequences.

Fig 12: Aerial Photo of Niger Delta (source: NBA, 2003)

Consequences of Low Flow in Nigeria

The following are the negative impact of continued low flow of River Niger into Nigeria:

i. Inadequate inflow into Kainji and Jebba dams
ii. There will be increase in unemployment.
iii. Inadequate inflow for navigation from Baro to Wari.
iv. Over 80% of the population of Nigerians in Niger basin will be affected.
v. There will be extremely low agricultural food crop production and food scarcity.
vi. Socio-economic activities in the country will be directly affected.
vii. There will be continuous low fishing output.
viii. The ecosystem will be endangered.

Challenges Facing Nigeria in NBA

Nigeria, which is located downstream of River Niger and surrounded by Francophone countries, is facing the following challenges in the NBA:

i. Inadequate views and attention on negative consequences on Nigeria by other countries in the advent of River Niger's acute extremely low flow or drought because of human abuse and insensitivity
ii. Nigeria's insensitivity to water losses in the Inland Delta and escalation of losses as a result of the proposed Taoussa dam construction downstream.
iii. Lack of adequate preparation to NBA meetings.
iv. Lack of involvement of experts on potential challenges to be faced by Nigeria in the advent of River Niger's extremely or total cessation of flow into Nigeria.
v. Nigeria's interest in the leadership of NBA at the expense of competent technical and administrative staff members.
vi. Lack of consistency of Nigeria's representatives to NBA high level meetings.
vii. Inadequate preparedness to NBA high level meetings and understanding of subject matters.
viii. Untimely reception of document with translation (often mixed with French language) for Nigeria.
ix. Inadequate employment of Nigerians in NBA.
x. Nigeria's total absence in the NBA's internal high level technical meetings.
xi. NBA member countries, directly or indirectly, deciding for Nigeria because of unpreparedness and total dominance.
xii. Advert publications in webpage often mainly in French language.

Conclusion

The continued extreme water losses in the Inland Delta have been taken for granted for years which is spreading into the desert without control. The construction of the proposed Taoussa dam located just downstream will further spread the inundation deeper into Sahara desert. If this happens, it is not reversible and the consequences will be dire on Nigeria downstream. The incidence of Lake Chad is a strong warning for Nigeria that should take a cue from the stand of Egypt on River Nile. Water is life and River Niger is the greatest legacy given to Nigeria by nature. The threat of losing it is real and must be resisted to save the river for the future generations.

References

The NBA Monthly Bulletin on River Niger Hydrology, Volume 2002 to 2009, website; https//:nigerhycos.abn.ne

The NBA-INFO; Volume 01 to 5 website; www.abn.ne,

Report on the Stakeholders Meetings, Niger Basin Authority Archive.

WHYCOS Report, WHYCOS Portal Website (www.wmo.int,)

United Nations Framework Convention on Climate Change; Website (www.unfccc.int)

Intergovernmental Panel on Climate Change (IPCC), Website www.ipcc.ch,

Olomoda, Impact of climatic change on river Niger in sub-Saharan region of west Africa (International Workshop on "Managing shared Aquifer Resources in Africa, Tripoli, Libya 2-4 June 2002).

Report on 2nd GEOSS African Water Cycle Symposium Addis Ababa, 23-25 February 2011

Report on 1st Global Earth Observation System of Systems (GEOSS) African Water Cycle Symposium (Tunis, 2009)

Niger-HYCOS Monthly Bulletins http://nigerhycos.abn.ne/portal/

Report on Seasonal Forecast For West Africa 2009

Document on NBA Shared Vision , NBA Archives 2010

Revised Convention Creating the Niger Basin Authority 1989, NBA Archives

Seasonal Forecast for West Africa (PRESAO) 2010

Ould Oumar Aly , Regional Conference on Nutrient Pollution, Chisini, Republic of Modovia 2006

Impact of Climate Change in the River Niger Basin 2006 http://archives.riversymposium.com

Olomoda Ibraheem; Report of the 6th EUMETSAT Users Forum in Africa 2004

Report on the 17th, 18th 19th 20th 21st Session of NBA Council of Ministers

Working Document on the Workshop on the NBA Shared Vision 2025

The Study on the Nigeria National Water Resources Master Plan Vol 1, 2 and 3 By JICA March 1995

Niger-HYCOS (IWRM2) Annual Work Plan 2012 (NBA Archives)

Reader, John (2001), *Africa*, Washington, D.C.: National Geographic Society, ISBN 0-620-25506-4

Thomson, J. Oliver (1948), *History of Ancient Geography*, Biblo & Tannen Publishers, ISBN 0-8196-0143-8

Welcomme, R.L. (1986), "The Niger River System", in Davies, Bryan Robert; Walker, Keith F., *The Ecology of River Systems*, Springer, pp. 9–60, ISBN 90-6193-540-7

Presentation for the Women in the New Nigeria for Development and Positive Change (WINN) by JK Lawal on 1st August 2011.