

Niger Basin

Nexus Profile

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INTRODUCTION

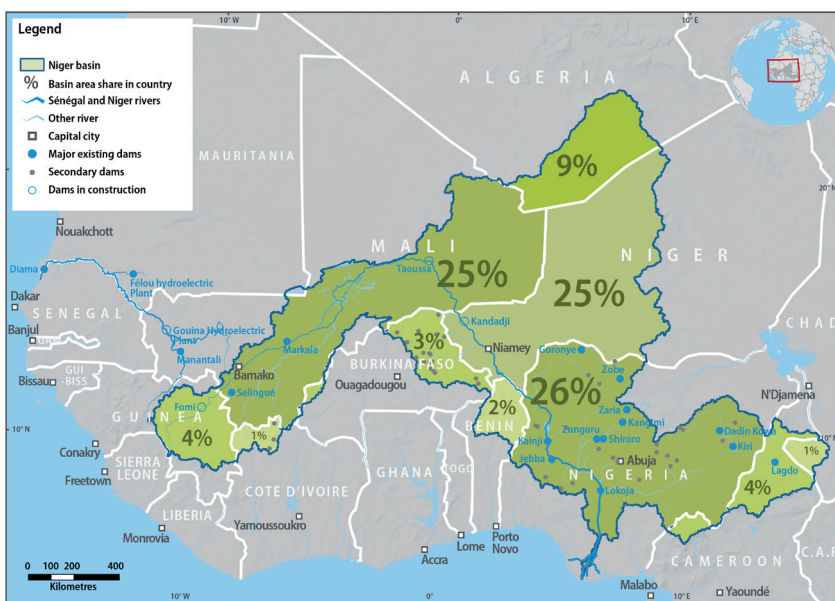
The Niger River Basin (NRB) in West and Central Africa covers a total area of 2.13 million km² and its active basin is home to over 130 million people throughout nine countries: Benin, Burkina Faso, Cameroon, Chad, Ivory Coast, Guinea, Mali, Niger, and Nigeria. Seven of the nine basin countries are among the 20 poorest countries in the world, with large income disparities in the richer basin countries. In fact, all 9 riparian states are in the bottom third of the 189 countries according to the UNDP's Human Development Index (2018), with 5 in the last 15. Most of them face rapid population growth (an estimated annual average of 3.2%) and urbanisation (currently 64% of the population is rural but by 2025, urban population is expected to account for more than half of the people) in a vulnerable environment characterised by pockets of political instability, insecurity and difficult climatic conditions.

The Niger River and its tributaries provide water for drinking, agriculture, industry, energy and transport to the nine riparian countries, making it an invaluable resource which has to be properly managed to overcome the above mentioned challenges and ensure long-term and fair benefit sharing. Climate and river flow variability, enhanced by climate change, provide elements

of uncertainty in planning resource use. Over 70% of the basin's population live in areas where food security depends on unreliable rainfall and highly variable inter-annual and intra-annual river flows and agriculture is currently by far the largest sector, employing 80% of the population. Significant poverty levels and a high dependency on small-holder agricultural production persist in the region [1].

A sound integrated and transboundary management is necessary to address these challenges and to promote development in the basin. This pressing issue is highlighted by the Sustainable Development Goals (SDGs) indicators. While progress is being made within the basin, 30% of the population still do not have access to an improved water source, 75% do not have improved sanitation facilities and only 35% have access to electricity [1]. A water-energy-food security Nexus approach can provide an appropriate paradigm to design policies to holistically attain these development objectives by seeking efficiency of resource use.

ABN – NBA



[2]

L'Autorité du Bassin du Niger (ABN) or the Niger Basin Authority (NBA) is an intergovernmental organisation responsible for the joint management of the river and for sustainable development of the basin. The "River Niger Commission" was first created in 1964 and was restructured as the Niger Basin Authority (NBA) in November 1980. All nine riparian countries are members of the NBA, which promotes coordinated development in a broad range of sectors: water, energy, agriculture, live-stock, fisheries, forestry, and society. It is increasingly called upon to link national-level investments to regional processes such as mining, transport, and communication. The NBA has an increasingly central role in facilitating decisions and building consensus among governments, water users, civil society, and other key partners.

KEY NEXUS ISSUES

The NBA has identified key issues to be considered for the sustainable development of the basin [3]. These issues include interactions between key sectors (i.e. water, energy, agriculture, and environment) such as hydropower development using multi-purpose infrastructure; irrigation to increase crop production and food security; navigation development to enhance commerce and development and environmental protection; and protection of ecosystems. In this section, each issue is briefly presented and analysed along with important issues in the basin such as erosion and siltation.

Hydro-power Development

There is a high hydropower potential in the basin (close to 30,000 GWh) and only 20% is currently exploited. Governments in the basin are therefore pushing for large reservoir development as a solution to meet growing water, energy and food demands as well as to regulate the high inter-annual variability in water availability [4].

Current reservoir developments include the ongoing and planned construction of dams, such as Fomi (Guinea), Touassa (Mali) and Kandadji (Niger), which are expected to jointly contribute to flow regulation, especially during extreme events, and improve productivity. Investments in such multi-purpose infrastructures, if done in a participatory manner, have the potential to help reduce poverty and boost shared prosperity in the basin countries [5]. The following table shows existing and planned dams in the basin including the full storage volume and the installed capacity.

Major planned and existing dams in the Niger basin [4]

Name	Country	Status	Full storage (MCM)	Dead storage (MCM)	Installed capacity (MW)
Selingue	Mali	Existing	2,630	470	44
Markala	Mali	Existing	0	0	15
Kainji	Nigeria	Existing	15,000	3,000	15,000
Lagdo	Cameroon	Existing	6,000	1,450	6,000
Talo	Mali	Existing	180	14	not applicable
Jebba	Nigeria	Existing	3,880	1,000	3,880
Fomi	Guinea	Planned	6,160	670	6,160
Kandadji	Niger	Planned	1,597	38	1,600
Djenne	Mali	Planned	357	60	186
Touassa	Mali	Planned	3,150	453	3,150

The Fomi dam is a good case study to assess the cooperation potential as well as the potential environmental impacts. The project, which would consist of a dam and large storage reservoir in Guinea, aims to provide water storage for the whole basin, hydropower in Guinea and the West African Power Pool, as well as significant irrigation potential in Mali and also in Niger. In fact, this dam was identified by the countries of the Niger Basin as a priority in the 2010 Sustainable Development Action Plan, with the recognition that extensive riparian coordination would be necessary for its success. Like other transformative infrastructure projects, the potential of Fomi to help address the Niger Basin's water and energy challenges is tremendous – and like all others, it has considerable potential impacts [5]. Therefore, the operational rules are being determined jointly by the riparian countries to share the benefits and reduce the negative impacts. There is strong awareness about the possible environmental and social impacts on the wetlands in the Inner Niger Delta as well as about other impacts further downstream. This is especially important because the Inner Delta is one of the largest wetlands and multi-use systems in Africa, covering three million hectares and being home to over two million herders, fishermen and farmers [6].

Irrigation and Food Security

Agricultural activities in the basin can be classified into four groups: pastoral livestock, agro-pastoralism, fisheries and irrigated farming [7]. The spatial distribution of these activities, apart from fisheries and irrigation, follows the agro-climatic zones and the agricultural production depends on annual rainfall variability.

Nomadic pastoralists represent 2-3% of the rural population. They exploit the rangelands adapting to the limited amount of biomass by constantly displacing the herd. Herds are usually composed of approximately 100 cattle or several hundred sheep adapted to this mobility [8]. These pastoral movements lead to regular conflicts between nomadic pastoralists and sedentary agro-pastoralists, mainly caused by disputes over access to resources such as fodder and water [8].

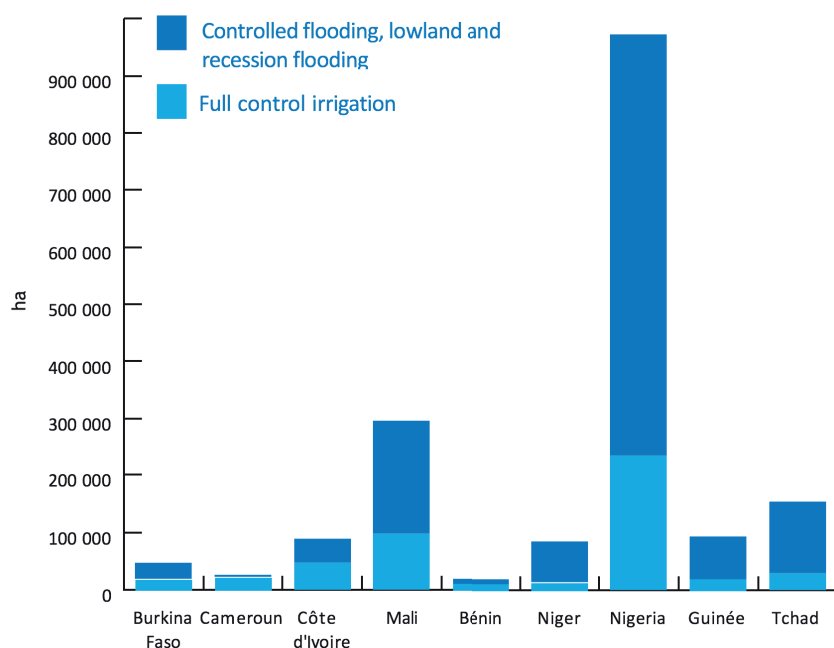
Furthermore, close to 50 million people practice agro-pastoralism, growing subsistence crops during the rainy season, and complement this with livestock by-products, traditional food gathering and market gardening, typically for vegetables. This type of rain-fed agriculture supplies 78% of the total agricultural production in the basin [8]. Rainfall distribution determines the type of crops cultivated in the basin. In the extreme north, rainfall is just sufficient for seasonal pasture. Moving south there is millet and sorghum, then banana, plantain, cassava, yam and finally rice in the south as well as in irrigated areas in Inner Delta in Mali, and in Niger and Nigeria [6].

Fishing is also an important activity, contributing to food security at the same time. Fishery is mainly practiced around the large floodplains of the Inner Delta or in the Sélingué, Kainji, Jebba and Lagdo reservoirs. Fishers in the basin can be classified as full-time fishers, mostly belonging to ethnic groups recognised as fishers; agro-fishers, who spend part of the year growing crops; and occasional or part-time fishers, for whom fishing is a secondary activity. Total fish catch in the basin is about 240,000 tonnes per year and represents an important animal protein source [6] contributing to food security and nutrition.

Country	Annual rainfall in the basin area (mm)		
	min.	max.	mean
Guinea	1240	2180	1635
Côte d'Ivoire	1316	1615	1466
Mali	45	1500	440
Burkina Faso	370	1280	655
Benin	735	1255	1055
Niger	0	880	280
Chad	865	1195	975
Cameroon	830	2365	1330
Nigeria	535	2845	1185

Average, maximum and minimum annual rainfall for the nine countries of the Niger Basin [9]

This table shows the uneven distribution of rainfall within the basin. The differences in rainfall and climate pose unique challenges for each country and province. In countries such as Chad, Mali or Niger, where precipitation is scarce, irrigation has a great potential to increase crop production and food security as well as for poverty reduction. Currently, only 1% to 5% of the cultivated land within the basin is irrigated and projects are in progress to expand irrigated land. However, there are different visions on how to approach this challenge. On one hand, the NBA traditionally favours large-scale irrigation developments and on the other hand, some donors favour small-scale irrigation [6]. Still, most of the irrigated surface rely traditional techniques such as free flooding practiced in floodplains and recession flooding which takes advantage of the residual humidity of the soil and capillary action as the flood recedes. Full control irrigation is predominantly found in Mali (117,000 ha), Niger (46,000 ha) and Nigeria (84,000 ha) and potential exists to increase these perimeters in other countries [8].



Irrigated surface by country [8]

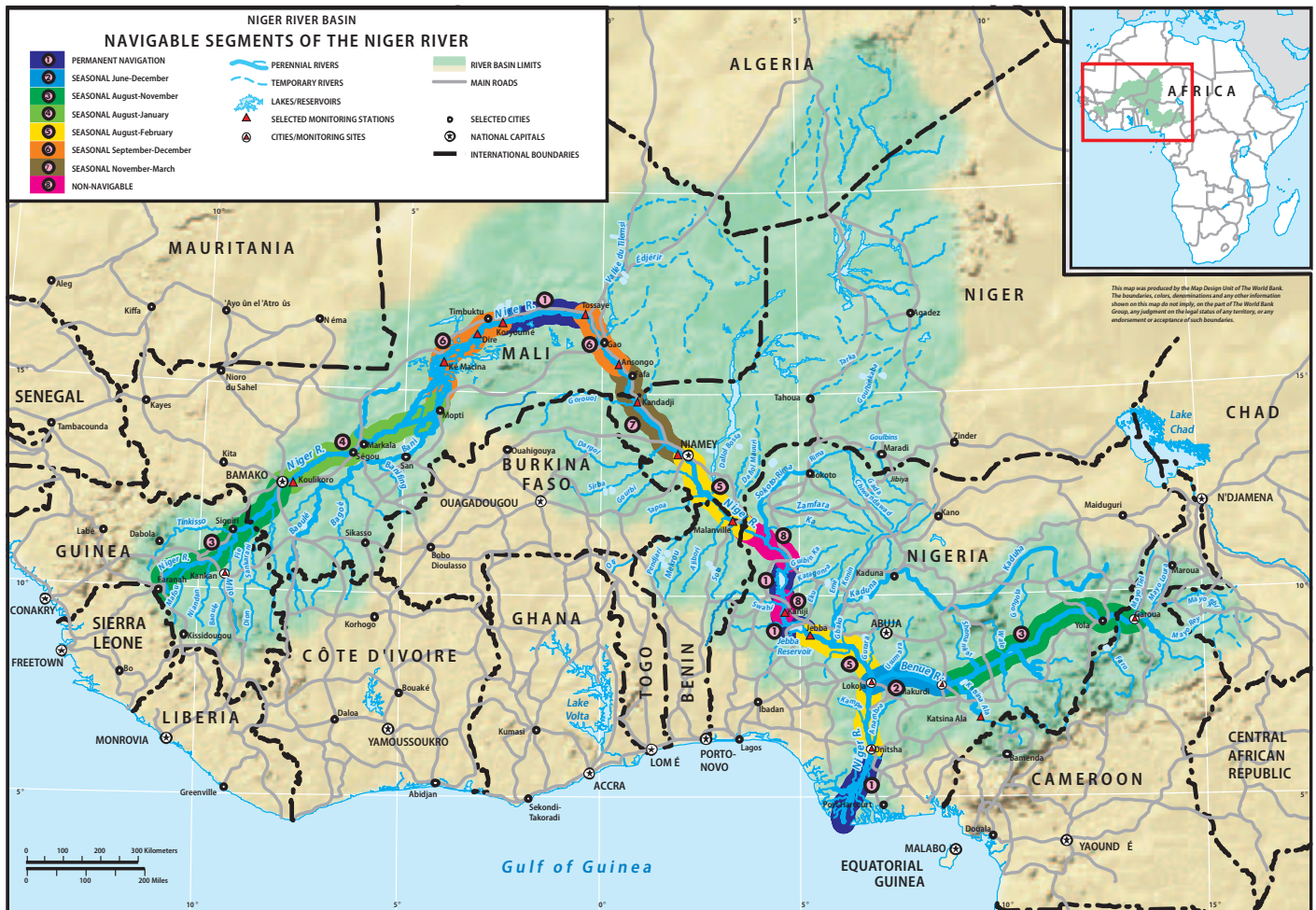
Although irrigation can positively contribute to the development of the region, its risks and potential negative impacts must also be considered. Surface water cannot supply the total amount needed for the planned irrigated land. This is especially critical during the dry season where agricultural withdrawals could impact hydropower generation, drinking water availability and the environment in the Inner Delta wetlands in Mali. As a result, water efficiency will need to improve in irrigated agriculture as will the economic gain derived from the water used, to justify the heavy investments it demands [6].

Navigation

Navigation has been identified as key sector by the NBA to boost economic development in the basin. The NBA has navigation as one of its mission objectives: “to ensure the control and regulation of all forms of navigation in the river, its tributaries and sub-tributaries.” Furthermore, there is a potential to increase intra- and inter-country trade through navigation offering market access to isolated farmers.

However, no full assessment of the navigation potential has been undertaken in the last 40 years. Seasonal flow variability and a substantial runoff decline in the last decades have limited navigation to only several months per year during the rainy season.

Famines faced in the past were caused by several factors including climatic conditions, poor infrastructure, political instability and lack of access to markets and trade (or of mechanisms to affect prices). Therefore, navigation development could contribute to enable access for farmers to trade their products and, at the same time, facilitate assistance in times of need due to natural hazards or human conflicts.



Navigable segments of the Niger river [10]

Sedimentation

Land-use changes, such as deforestation and agricultural expansion, have large impacts on the environment. For example, less canopy coverage leads to soil exposure and erosion which causes severe morphological changes leading to watercourse degradation, fish habitat destruction, flooding and impeded navigation. The problem is particularly acute in the Sahelian part of the Niger River Basin. Both the Inner Niger Delta and the marine Delta in Nigeria are affected by high siltation levels.

Furthermore, erosion and consequent sedimentation can shorten the life of high-investment reservoirs. Possible impacts are a reduction in the hydropower potential as well as reduced water storage. These problems require further research and assessment to be able to design ad hoc land-use management strategies to reduce soil erosion.

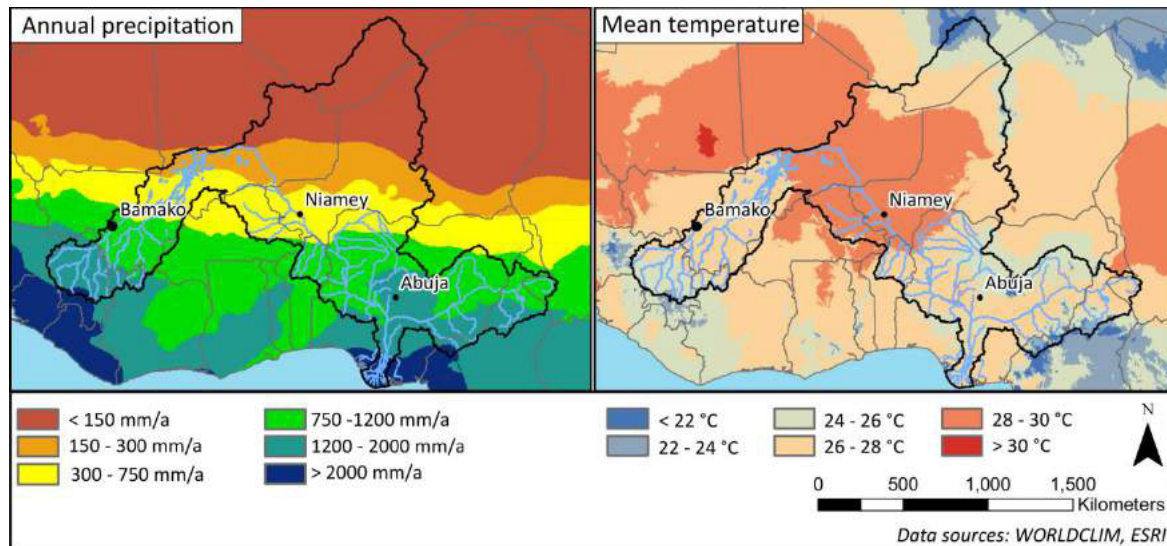
Mining

The nine riparian countries have significant mineral resources including gold, bauxite and uranium. Furthermore, there are large oil and gas reserves in the basin, mostly located in the Niger delta in Nigeria. Mining is an important economic activity but also a large water and energy user, as well as a strong political player. Mining activities also exert a large pressure on water resources by polluting them. Therefore, the exploitation has to pursue a maximisation of the socio-economic benefits whilst limiting the negative impacts on the environment. Oil extraction in the Niger delta in Nigeria has had huge environmental and social impacts due to continuous spills in the third largest wetland worldwide. Society now demands more environmentally friendly technology and cost-benefit sharing.



CLIMATE AND WATER SECTOR

The basin covers six agro-climatic zones and presents a cross-section of the complex development challenges of West African societies. Climatic zones vary from hyper-arid to sub-equatorial and annual rainfall fluctuates from over 4,000 mm in southern Nigeria/Cameroon to less than 400 mm (with no rain in some years) on the limits of the Sahara Desert in northern Mali and Niger [6]. The map below shows how annual precipitation and mean temperature are distributed in the basin to highlight the heterogeneity that poses specific and diversified challenges to manage water resources sustainably.



Average annual precipitation and mean temperature in the Niger Basin [11]

The Intergovernmental Panel on Climate Change (IPCC) has declared the Niger Basin as one of the most vulnerable regions to climate change worldwide. The main reasons are that seven of the nine countries are listed among the Least Developed Countries (LDCs), are subject to frequent droughts, and have a high dependency on natural resources, high population growth and fragile institutions. Although 64% of the population live in rural areas, rapid urbanisation is creating challenges faced in cities to provide drinking water and sanitation.¹

In the Niger Basin, agriculture uses 85% of freshwater withdrawals. Industrial withdrawals are negligible at the basin scale, but account for 13% of the total withdrawals in the Lower Niger [12]. Drinking water is the second most important use accounting for almost 10%. In absolute terms, the volumes withdrawn remain low (6 km³/year), but this figure does not illustrate important spatio-temporal variations. In the Upper Niger, at the Markala dam for instance, withdrawals in the wet season represent less than 5% of river flow but in the dry season they reach 80%, exerting pressure on water availability downstream [8].

In order to satisfy growing water demand, the NBA Investment Program and Operational Plan suggests the development of large-scale infrastructure. Withdrawals and water consumption will increase to meet future food, drinking water and industrial demands in the basin, which is why the NBA member countries have agreed on minimum water flows at strategic points in the basin to ensure protection of ecosystems and prevent conflict. In order to face the growing competition for water and reduce the negative impacts downstream, water users will be increasingly required to minimise water consumption to optimise the benefits from water use [8].

¹ <http://www.ipcc.ch/ipccreports/sres/regional/index.php?idp=18>



FOOD SECTOR

Significant poverty levels and a high dependency on small-holder agriculture persist in the region [1]. Productivity is very low due to a lack of irrigation infrastructure and access to inputs such as fertilisers. Almost 3/4 of the population faces food insecurity due to unreliable rainfall and highly variable river flows. According to Niasse [13], subsistence agriculture is predominant, accounting for 78% of the total agricultural production. Agriculture represents a large part of the Niger Basin's countries GDPs, with crops making up 25–35%, livestock 10–15%, and fishery 1–4%. The main livelihood agricultural systems in the basin include dry and wet season cropping, pastoral systems, crop-livestock systems and fishing. The major crops are yams, cassava, rice, groundnuts, millet, sorghum, plantains, cocoa beans, maize, sugarcane and cotton [6].

As described in the irrigation section, irrigation projects have the potential to increase crop yields and food security. However, water productivity must be increased in these projects to enable other sectors such as energy generation or drinking water to also contribute to regional development by ensuring access to electricity and water.



ENERGY SECTOR

The annual primary energy consumption in the basin is only 0.3 toe per capita, compared to the African and world averages of 0.63 toe and 1.76 toe, respectively. Regarding electricity, the average annual consumption per inhabitant in the basin is 70 kWh, less than a tenth of the African average of 740 kWh [14]. However, an increasing energy demand due to population growth, rapid urbanisation, and industrialisation is a concern in the basin [15]. Plans such as the West African Power Pool aim to facilitate exchange of energy across borders in the region. The use of biomass, especially firewood and charcoal for cooking, and their link to deforestation, soil erosion and siltation remain at the forefront of any Nexus discussion in the region.

The main challenges identified by the ABN in 2007 include: (i) setting up institutional frameworks, (ii) exploiting the basin's energy potential, in particular the hydroelectric potential, (iii) the substitution of energy wood and (iv) the improvement of cooperation between States (in particular with the harmonisation of national policies).

ENVIRONMENT SECTOR

Morand et al. [16] identified five aquatic ecosystems in the Niger Basin: the sub-basins of the upstream area, the narrow river stretches, the river and its floodplains (notably the Inner Delta), the natural lakes connected to the river, and the dams and the artificial reservoirs. In the first two biotopes, fishing is largely a subsistence activity, whilst in the other three, fishing is a commercial activity.

The minimisation of the impacts of reservoir development is a topic of ongoing discussion and negotiation. For instance, the Inner Niger Delta is a very important feature of the basin, as the largest river floodplain in West Africa and a designated Ramsar site providing important ecosystem services [17] and there are concerns about the impacts of the Fomi dam on the natural flooding processes in the wetlands and the potential repercussions on aquatic ecosystems.

The NBA, in line with international and financial institutions as well as NGOs, promotes the introduction of new norms, notably participatory governance requirements and recommendations to protect the environment. Development projects in the water sector and NGO interventions also create additional responsibilities and create new structures, such as water user associations and committees, responsible for managing resources with a special attention given to negative environmental impacts [8]. The National Coordination of Basin Resource Users in the Niger Basin contributes directly to the NBA's governance of the basin's resources.

LINKS BETWEEN THE WEF NEXUS, STABILITY AND PEACE

As the pressures on water, land and energy resources increase, the potential for conflicts over these resources increases. Some examples of conflicts are between farmers and herders over scarce water and land resources (especially if changes in rainfall or water availability force the latter to migrate into areas claimed by the former), conflicts between the agricultural and the energy sector in the context of large infrastructure schemes and their respective impacts, or even conflicts between neighbouring countries over diverging resources development priorities. Conflicts can also be triggered more indirectly, for instance through lack of development and employment opportunities (especially among young men) which can lead to radicalisation and increasing support for extremist groups. The Niger River Basin is thus described by some commentators as a telling example of the vicious cycle of resources scarcity, competition, conflict and instability. Resources-borne conflict and instability threaten the overall security of the basin countries and the entire region, especially in areas of conflict between state and non-state actors (for example between Mali and Nigeria, and most recently Burkina Faso and Niger).

Of course, it is not just about managing natural resources; many factors at the geopolitical and socio-economic levels also play a role. But managing resources through a Nexus approach could generate many positive externalities.

OUTLOOK

Recommended interventions include developing infrastructure (wells, reservoirs), multiple-use systems (notably integrating livestock and fisheries with crop production), full control irrigation, adapting crop demands to water supply and vice versa (sowing dates, water harvesting, supplemental irrigation), minimising fertiliser use, and introducing best management practices (BMPs) adapted to the different agro-climatic zones. Improving rain-fed agriculture can have an important impact on food security and poverty reduction due to the large population dependent on it. Solutions to reduce soil-water stress and the risk of crop failure, such as rainwater harvesting and drought tolerant crops, are necessary if farmers are to invest in fertiliser and other inputs that are essential to boost yields [6].

At the regional level, the NBA plays a crucial role with its mandate to ensure the coordinated and equitable development of the basin and its water resources. The interconnections between the WEF sectors, together with the need for economic development and poverty reduction in the region, requires novel approaches that can quantify and assess these interconnections to propose management strategies accordingly.

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