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Opinion

Kandadji Dam Construction in Niger: What Implications for Public Health?

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Dams are world widely recognized as a key factor for accelerating economic growth through increasing energy access and industrialization, increasing potable water access, and promoting food security through increased agriculture [1]. They are essential for water resources control and management [2]. West Africa region is characterized by 28 transboundary river basins with the most important like the Niger River covering 11 countries, the Senegal River covering 4, the Volta covering 6, the Lake Chad covering 8, and the Comoé covering 4. Also, there are several billion of m^3 of fresh water stocked in the groundwater of the region [3]. Even with these potentialities, the region suffers from water scarcity, lack of electricity access, and food security, due to the unequal distribution of rainfall, climatic conditions, and the lack of hydraulic infrastructures for Water control [2]. That's why building dams constituted the response of countries' governments to the challenge of water control [3].

In the Niger Republic particularly, the reality is that even with the presence of the Niger River, the country has one of the lowest electrification rates in the world, at 10% of the population and less than 1% in rural areas. More than 40% of the population, accounting for more than 9 million people live in extreme poverty according to data in 2019. Also, there is scarce access to potable water and sanitation, particularly in rural areas where access to water is 44.2% and 7% for sanitation. More than 11 million people, 51.7%, suffer from severe food insecurity (2016-2018), exceeding twice the average for Sub-Saharan Africa [4]. In front of all of these vulnerabilities, the Niger Republic, in collaboration with its partners, started in mars 2019 the construction of the Kandadji dam on the Niger river, which is distant from 187 and 489 kilometers upstream of the Capital Niamey and to the Nigerian border respectively, and distant from 60 km downstream to the Malian border [4]. (See Photo 1). The project is programmed to finish in 2031.

The project forms part of the Kandadji Ecosystems Regeneration and Niger Valley Development Programme P-KRESMIN. The main aims of the project are to contribute to reducing poverty, improving food security, and increasing energy access [4]. According to

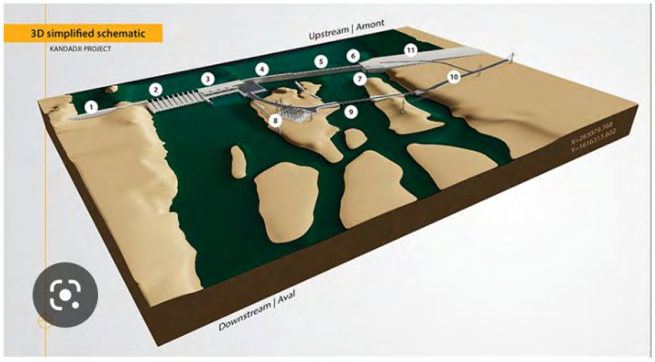

Photo 1: 3D simplified Schematic of Kandadji Project, Copyright World Bank 2020.

1. Saddle dam, 2. Spillway and outlet works, 3. Powerhouse I x 4 turbines, 4. Concrete dam, 5. Auxiliary spillway in Roller Compacted Concrete, 6. Water intake for agriculture, 7. Pirogue Sluice, 8. Substation, 9. Access bridge, 10. Access Road, 11. Earthfill dam [4].

the updated summary of the Environmental and Social Impact assessment published in 2018 [5], the main benefits excepted at the end of the project are i) Regeneration and conservation of river ecosystems on the Nigerien portion of the river allowing a water flow rate of 120 m^3/s in Niamey ii) Irrigating 45.000 ha to improve agricultural production, food security and living conditions of the beneficiary communities; iii) Improve potable water access to people, livestock and other users and increasing the incomes of beneficiary communities through a secure system of livestock and sustainable development of agro-pastoral activities and iv) Increasing Niger's energy security through the production of electric energy with the construction of a hydropower plant with an installed capacity of 130 MW. In addition to these cited expected benefices, linked to the reservoirs resettlements, the project includes the rebuilding of the town of Ayorou and the building of a dozen new resettlements villages and associated communities infrastructures and services like roads, schools, clinics, markets, 8.000 ha perimeters of irrigation for displaced farmers, 10,000 new houses, extensive agricultural and non-agricultural livelihood restoration programs, employment opportunities for youth and women, improved water infrastructure for improved health and education outcomes [4]. The resettlement program will concern 9,000 people at the dam site and 50,000 people in the reservoir area related to the reconstruction of the town of Ayorou [4], and almost 12,000 ha of farmland [5].

Behind the known potential benefices of dams in general, and those related to Kandadji particularly, landscapes and rivers ecosystems changing which result from dams construction are mostly associated with potential health impacts leading to a serious public health challenge, as largely reported by the literature [6-8]. The permanent water of the reservoir leads to an increase in the density of arthropod vectors [9]. Hydroelectric dam construction affects 1) people who inhabit the area surrounding dam reservoirs and 2) those who are displaced and resettled to leave a way for the dam, catchments, and dam-associated infrastructures [10]. Among the ''reservoirs communities'' or the first group, the most frequent diseases reported and linked to their proximity to reservoirs include parasitic and viral diseases transmitted by the vectors (biologically or mechanically) like Malaria [11], Schistosomiasis, gastroenteritis [12], Yellow Fever, Lymphatic filariasis (elephantiasis), Japanese encephalitis, Dengue, onchocerciasis (river blindness), trypanosomiasis (African Sleeping Sickness), Visceral Leishmaniasis [10]. In addition, nomadic breeders using the reservoir for watering animals increase their vulnerability to Rift Valley Fever Virus if the virus circulates in the area [9]. In another hand, those who are displaced and resettled are usually challenged to adapt to the new ecosystem which makes them in contact with animals with zoonosis or who are reservoirs of arboviruses [10]. The development activities associated with the resettlement and poor sanitary hygiene related to inadequate water supply and lack of methods of excreta management [9,10] are in favor of the development of water-borne diseases. There are several diseases reported among resettled people ranging from waterborne diseases to mental health illnesses: Malaria, Dengue, Yellow fever, Schistosomiasis, ancylostomiasis, ascariasis, onchocerciasis, pneumonia and respiratory diseases, gastroenteritis including cholera, diarrhea, dysentery and others, malnutrition and food insecurity, mental health concerns [10]. The short and long-term effects of these diseases can sometimes invalidate affected persons at short and long-term, then compromising their economic productivities [10]. In West Africa particularly, studies have shown increased incidences of diseases after dam construction: for example after Diama Dam construction in Senegal in 1986, Schistosomiasis has become endemic among people living in the Senegal River Basin [13]. Also the first epidemic of Rift Valley Fever in the region, notably in Senegal in 1987, has been associated to Diama dam [14]. In Mali, the Manantali dam has increased prevalence of malaria, Schistosomiasis and gastroenteritis [12]. A

case control study done in Ghana has showed that Barekese dam has increased incidence of Urinary Schistosomiasis, Malaria and Diarrheal diseases among people living near the dam compared to control people [8]. That's highlight the potential public health challenge associated to dams.

That's why, in the Kandadji context, particular attention must be paid to the public health implications of the dam for the well-being of the targeted populations. Solutions to the health concern were indeed envisaged in the component B.B1 of the last updated environmental and social impact assessment of the project [5], but our work aimed to strengthen reflections on possible solutions for better addressing the public health challenges related to Kandadji dam. Several solutions based on evidence have been suggested from many parts of the world, we try to report most of them as follows:

- Housing communities away from reservoirs [15], can allow reducing people exposition to vector bites, particularly malaria vectors. In other term, creating a buffer zone separating populations from reservoirs [16], is more likely to reduce disease transmission.

- Systematic fluctuations in water level in reservoirs can reduce breeding sites of malaria, Schistosomiasis, and arbovirus vectors [9];

- Among people leaving around reservoirs, latrines should be built at least 15 meters away from any water supply and household to decrease the risk of transmission of water-borne and water-washed diseases [9].

- Implementing community education on good health practices, linked to vector-borne diseases and diarrheal diseases, including larval source destruction and snail breeding site destruction, recognition of disease symptoms, and personal protection measures [9].

Further research should be conducted by inventorying vectors circulating both in the area surrounding reservoirs and the new resettlements area, with screening pathogens that circulate among these vectors. A sero-screening of pathogens circulating among natural reservoirs like mice and birds inhabiting both surrounding reservoirs and new resettlements areas should be conducted.

Competing Interest

The authors have declared that no competing interests exist.

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