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Dam Complications in Senegal: How River Dams May Hurt More Than Help Vulnerable Populations in Water-stressed Regions

Colleen Diessner*

Much of the alarm over global climate change and variability (“CCV”) concerns how CCV impacts generate shortages of food and water resources, particularly in developing regions of the world, where populations rely on direct access to natural resources.¹ Adaptation measures to counter these CCV impacts include river dams, the installment of which combat climate variability impacts of destructive floods and droughts by controlling stream flow and transferring local agricultural practices from floodplain recession to irrigation systems.² But the environmental repercussions of river dams are vast and can significantly decrease local access to natural resources;³ halting natural flood patterns is particularly trying for downstream communities who are struggling financially with the economic transition to irrigated

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¹ Mertz O, et al., *Adaptation to Climate Change in Developing Countries*, 43 ENVTL. MGMT. 743, 758 (2008).

² Barry Smit & Mark W. Skinner, *Adaptation Options in Agriculture to Climate Change: a Typology*, 7 MITIGATION AND ADAPTATION STRATEGIES FOR GLOBAL CLIMATE CHANGE 85, 99 (2002).

³ See generally Andre Desgeorges & B.K. Reilly, *Dams and Large Scale Irrigation on the Senegal River: Impacts on Man and the Environment*, U.N. HUMAN DEVELOPMENT REPORT OFFICE (2006) available at <http://hdr.undp.org/en/reports/global/hdr2006/papers/DeGeorges%20Andre.pdf>.

agriculture.⁴ Political objectives and contention of governmental dam commission members may also reverberate at a local scale, intensifying stress on food and water resources for vulnerable communities.⁵ Through examining one representative case: the social and environmental impacts of the Manantali Dam on the Fuuta Tooro region of Northern Senegal, this paper explores how river dams can significantly exacerbate vulnerability to CCV impacts and political disputes over access to water, a resource that is waning world-wide.

The Fuuta Tooro region is nestled within bordering Senegalese and Mauritanian banks of the Senegal River, extending approximately from Dagana to Matam. This region is part of the greater Senegal River Valley, whose basin begins at the town Bakel, downstream from the source of the Senegal River, the Guinean Fuuta Djalou Mountains.⁶ The basin stretches from small Bakel to Saint Louis, covering about 350000 square km, through which the river flows 800 km.⁷ Within the Senegal River Valley, the Fuuta Tooro region marks ecotonal transition between arid desert in Mauritania and semi-arid savanna in Senegal. In simpler terms, when driving northeast from Senegal's coastal capital Dakar, when you eventually reach a sandy region where even heat-tolerant Baobab trees disappear, you have reached the Fuuta Tooro.

⁴ Nina L. Saarnak, *Flood recession agriculture in the Senegal River Valley*, 103(1) DANISH J. GEOGRAPHY 99, 107 (2003).

⁵ See generally, Ron Parker, *The Senegal-Mauritania conflict of 1989: a Fragile Equilibrium*, 29 J. MODERN AFRICAN STUDIES 155 (1991).

⁶ Saarnak, *supra* note 4, at 100.

⁷ *Id.* at 101.

Fuuta inhabitants are predominantly Pulaar, one sect of the Sahelian Fulbe, who are historically nomadic and found in variegated cultural pockets throughout the Sahel, range as far south as the Central African Republic. By the mid 1700s, the Fuuta Tooro Pulaars had begun establishing sedentary communities, avidly maintaining herding practices while developing agricultural reliance along the Senegal River.⁸ Pulaar culture is largely uniform throughout both sides of the Senegal-Mauritania boundary and border traffic of Pulaars from either side of the river is permeable⁹.

I. CLIMATE NORMS AND PREDICTED CHANGES

The Fuuta Tooro's typical climate includes one rainy season from late July to early September, each month bearing less than 100mm rainfall, and even less in El Nino associated years.¹⁰ After a temperature rise in September through early November, an annual cool season sets in mid November till February, followed by the hottest season from March through June, where the hot, dry climate generally ranges from 100 to 130 degrees Fahrenheit.¹¹ These Sahelian climate conditions are not static,

⁸ David Robinson, *The Islamic Revolution of Futa Toro*, 8 INT'L JOURNAL AFRICAN HISTORICAL STUDIES 185-221 (1975).

⁹ Ron Parker, *The Senegal-Mauritania Conflict of 1989: a Fragile Equilibrium*, 29 J. MOD. AFRICAN STUDIES 155, 158 (1991).

¹⁰ C. McSweeney, M. New, and G. Lizcano, *UNDP Climate Change Profiles: Senegal*, http://www.geog.ox.ac.uk/research/climate/projects/undpcp/UNDP_reports/Senegal/Senegal.low.res.report.pdf.

¹¹ WEATHERBUG, (July 29, 2012), <http://www.weatherbug.com>.

however, and increasing trends in extreme weather have been linked with anthropogenic causes.

While evolving contexts for desertification in arid regions undergo continual debate,¹² recent climate change trends in Senegal, whatever the causes, are observable in mean annual rainfall.¹³ Significant decadal decreases ranging from 10 to 15mm are documented for southern tropical regions. In northern Senegal, however, long-term trends prove more challenging to track because this region is more prone to drastic variability over long periods of time. Any actual intense climate change is difficult to align with any specific cause or process.¹⁴ Additionally, trends in daily rainfall are indeterminable for lack of reliable data.¹⁵ Scientists are able, however, through analyzing collective climate change knowledge, to predict particular climate trends for variable arid regions like the Fuuta Tooro and compare actual, current climate trends with these models in order to suggest current climate trends are part of the global anthropogenic climate change phenomenon. Such current projection models demonstrate that while rainfall patterns vary greatly throughout Senegal, there is noticeable predicted decline, especially for the rainy seasons in the Fuuta Tooro.¹⁶ It is also important to note that while models predict decreased annual precipitation for Senegal overall, they predict increased seasonal variability and increased precipitation volume in heavy seasonal

¹² See S.M. Herrmann & C.F. Hutchison, *The Changing Contexts of the Desertification Debate*, 63 J. ARID ENV'TS 538 (2005).

¹³ See McSweeney, *supra* note 10.

¹⁴ *Id.* at 3.

¹⁵ *Id.* at 2.

¹⁶ *Id.*

rainstorms,¹⁷ meaning that though less rain is falling, when it does fall, it is increasingly catastrophic. The impact of these arid climate trends on existing political tension surrounding the Fuuta Tooro is equally calamitous.

II. DESERTIFICATION, APARTHEID, AND A DAM

In light of increased environmental stressors on natural water resources, many recent studies investigating the potential for “water wars” find that conflicts among riparian countries generally subside in cooperative effort to share their water resources rather than engage in violence.¹⁸ Such studies note, however, that in arid West Africa, demand among growing populations for water resources increases potential for future water conflicts. Specifically, because water resources are both decreasing in amount and increasing in variability (i.e. rainfall is less predictable and more destructive when it occurs), tensions arise among riparian communities who must all increase reliance on shared and dwindling rivers as sources for water.¹⁹ The racial hostility that surfaced

¹⁷ *Id.*

¹⁸ See Aaron T. Wolf, Shira B. Yoffe and Mark Giordano, *International waters: identifying basins at risk*, 5 WATER POLICY 29 (2003) available at <http://www.environmental-expert.com/Files%5C5302%5Carticles%5C5877%5C2.pdf>.

¹⁹ Madiodio Niassé, *Climate-Induced Water Conflict Risks in West Africa: Recognizing and Coping with Increasing Climate Impacts on Shared Watercourses* INTERNATIONAL PEACE RESEARCH INSTITUTE, ET AL. 2 (June 2005) http://www.dialoguebarrages.org/dialoguebarrages/index2.php?option=com_docman&task=doc_view&gid=26&Itemid=39.

in the Fuuta Tooro in the 1980s illustrates how conflict over water may unfold.

Ethnic tension between Arab and black African Mauritians dates back before the eleventh century, when the fall of the Ghana empire allowed “Beydane” Arabs to dominate and gradually enslave “Heratine” Mauritanian blacks.²⁰ Arabic entitlement was therefore threatened when colonizing France, whose conquest was based in Senegal, grouped Mauritania’s governmental administration and economy with Senegal’s.²¹ In 1946, Mauritania was politically separated from Senegal and in 1960, when Mauritania became an established country, their ruling Beydane regime promptly redistributed power to their own Arab population through a variety of measures.²² Some of these apartheid policies include: reducing the number of black Africans in governmental positions to 30%, Arabicizing national education programs, deeming Arabic the official national language, and simultaneously joining the Arab League while withdrawing from the West African Monetary Union.²³ Though slavery was officially abolished in 1980, the Arab-master over black-slave relationship is still embedded in Mauritanian culture, maintained in the attitudes of Mauritanian citizens and in some rural areas, through persevering slave policies.²⁴

²⁰ Parker, *supra* note 5, at 156-157.

²¹ *Id.* at 156.

²² *Id.* at 156-157.

²³ *Id.* at 157.

²⁴ *See generally*, Parker, *supra* note 5.

Severe drought struck the West African Sahel in the 1970's and 80's.²⁵ Because the Beydane herders rely on rain-fed and floodplain agriculture, the drought hit them hard and many herders became refugees, their communities pushed further and further South into black African-cultivated land along the Mauritanian bank of the Fuuta Tooro.²⁶ In 1988 the Mauritanian government abolished traditional land-holding rights in the Fuuta Tooro, distributing black African (mostly Pulaar and some Soninke) agricultural plots along the Senegal River to Beydane herders.²⁷ Beydanes receiving expropriated Pulaar fields also obtained investment capital from the Mauritanian government to be applied for modern irrigation farming.²⁸ The Mauritanian government, an active member of OMVS (Organisation pour la Mise en Valeur du fleuve Senegal –the dam commission for the Senegal River), was encouraging irrigation farming as a subsequent development of the Manantali Dam, constructed upstream in Mali in 1987²⁹. Any black farmers who protested or fought the agricultural reforms were “imprisoned en masse”, and many were killed.³⁰

²⁵ Parker, *supra* note 5, at 158.

²⁶ *Id.*

²⁷ *Id.* at 158-159.

²⁸ See generally Parker, *supra* note 5.

²⁹ Niasse, *supra* note 19, at 7.

³⁰ Michael M. Horowitz, *Victims Upstream and Down*, 4 J. OF REFUGEE STUDIES, 164 (1991); see Parker, *supra* note 5.

III. THE MANANTALI DAM

In 1972, the OMVS was formed with the objective of damming the Senegal River in order to advance irrigation agriculture, hydrologic energy, and navigation for transporting goods throughout the Senegal River Valley.³¹ OMVS, representing hydrologic interests of government officials in Mali, Senegal, and Mauritania, was created to replace the 1968 founded Organisation des Etats Riverains du Senegal (OERS) after Guinea withdrew membership.³² In 1972, the newly formed OMVS stated the following goals:

- 1) "To provide a secure and steadily improving livelihood for the inhabitants of the river basin and neighboring areas"
- 2) "To safeguard as far as possible the ecological balance of the river basin"
- 3) "To make the economies of the three member states less vulnerable to climatic conditions and external factors"
- 4) "To accelerate the economic development of the member countries by the intensive promotion of regional cooperation."³³

³¹ Peter Bosshard, *A Case Study on the Manantali Dam Project*, INT'L RIVERS (Mar. 1, 1999) available at <http://www.internationalrivers.org/resources/a-case-study-on-the-manantali-dam-project-mali-mauritania-senegal-2011>.

³² ADRIAN ADAMS, THE RIVER SENEGAL: FLOOD MANAGEMENT AND THE FUTURE OF THE VALLEY 5 (2000), available at <http://pubs.iied.org/pdfs/7419IIED.pdf>.

³³ *Id.* at 1-2.

Despite avid warning against damming the Senegal River from agronomists, economists, sociologists, and journalists, OMVS overlooked this educated advice, as well as recommendations to consult with and inform the river valley residents of the coming change in flow regime.³⁴ OMVS planned to build two dams -the Manantali dam on the Bafing tributary in Mali and the Diama dam nearer to the river delta in Saint Louis, Senegal, which was intended to retain ocean salt water from the delta and lower valley for improved irrigation.³⁵ The Manantali dam, located upstream and bearing greater effect on the Fuuta Tooro study area, will be the greater focus in this discussion.

Construction for the Manantali dam began in 1981 and was completed in 1987, at which point all \$500 million invested in the project was spent, leaving nothing for the remaining power station and navigational structuring of the river. (It should be noted that later in 1998, Mauritanian OMVS high commissioner Baba Ould Sidi Abdallah was arrested for illegally diverting funds.)³⁶ Manantali dam investors included several Arab governments, the Islamic and the African Development Banks, Italy, the French CFD, the German KfW, the Canadian CIDA and the European Union.³⁷ Because of projected negative impacts, the World Bank declined funding the dam, though they did contribute to a later collection of funds allocated for the un-built power station; other

³⁴ *Id.* at 2-3.

³⁵ *Id.* at 2. The Diama dam was intended to retain ocean salt water from the delta and lower valley for improved irrigation. *Id.*

³⁶ Bosshard, *supra* note 32. It should be noted that later in 1998, Mauritanian OMVS high commissioner Baba Ould Sidi Abdallah was arrested for illegally diverting funds. *Id.*

³⁷ *Id.*

donations for the power station came from the French CFD, the German KfW, the European Investment Bank and European Community, the Arab Fund for Economic and Social Development, Canadian CIDA, the African Development Bank, the Islamic Development Bank, the West African Development Bank, and the Nordic Development Bank.³⁸ In 1997, however, Norway withdrew plans to contribute to the power station out of disapproval for the dam's severe health impacts on Senegal River Valley inhabitants.³⁹ But the drastically rising rates of malaria and schistosomiasis were only one of many problems caused by the construction of the Manantali dam.⁴⁰

After riparian land rights in Mauritania were redistributed to Beydane herders, many of the expelled Pulaar farmers sought refuge across the river, on the Senegalese side of the Fuuta Tooro. Pulaar community leaders along the Senegal banks quickly became sensitive to the injustice, organizing self-defense committees and declaring the Mauritanian agricultural reform a national problem that concerns all Senegalese and not only the workers of the river valley.⁴¹ The committees rallied for fair land distribution and the continuation of allowing freely trafficked goods and people to cross the border, measures that were simply ignored by officials in both Nouakchott and Dakar. At the time, the Senegalese government's apathy toward heightening tension in the Fuuta Tooro disappointed the Pulaar defense committees. Soon however,

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ Parker, *supra* note 5, at 159.

compiling disputes in the Fuuta Tooro became an issue Dakar could no longer overlook.⁴²

The Manantali dam was officially closed in 1988. As the dam took effect and the river lowered from adjacent floodplains, Senegalese farmers drew in closer to the river and began receiving harassment from Mauritanian border guards, who chased Senegalese farmers off their own land.⁴³ In November of 1988, Mauritanian camel herds were caught violating grazing rights in Senegal and were ousted from the country. Nouakchott officials consequently refused Senegalese trucks at the border, inspiring Dakar officials to form a river blockade in the Senegalese border town, Rosso. The following year, Dakar refused certain Mauritanian food imports, like fresh fish and mineral water, stimulating Nouakchott's embargoes on Senegalese vegetable oil, animal feed, and fresh vegetables. Though this trade battle eased through a series of meetings coordinated by the government of Cote d'Ivoire, on April 8, 1989 a violent skirmish resulted after another Mauritanian herd was caught grazing on Senegalese land, and in accordance with established grazing laws, the Senegalese land owners captured and kept the herd. Two of these Senegalese men were killed on April 8, and the other thirteen were taken under Mauritanian custody.⁴⁴ Failure of Nouakchott to seriously indulge Dakar's request for investigation left Senegalese communities seething. From April 19-20, villages along the Senegal River experienced violent outbreaks, rioters in Dakar attacked Mauritanian shops and the Mauritanian embassy, stirring rumors in Nouakchott that Arabs were being actively sought and killed in Dakar. This was indeed not the case, but the following April 25 came to be known as 'Black Tuesday' for the hundreds of Senegalese and black

⁴² Niasse, *supra* note 19, at 7; See Parker, *supra* note 5.

⁴³ Niasse, *supra* note 19, at 7.

⁴⁴ *Id.*

Africans hunted and killed in Mauritania that day. At least fifty Arabs were killed in Dakar during the resulting 'Mauritanian Hunt' from April 27-29. Foreign aid intervened to assist the 'mass exodus of refugees', as some 75,000 Senegalese and 170,000 Mauritians were documented as displaced from the massacre,⁴⁵ not counting those citizens who did not seek or receive foreign transport for repatriation, or the thousands of Mauritanian blacks who were denied reentry to their country and deported back to Senegal.⁴⁶

Because the three main factors causing the 1989 conflict are critically worsening, these being 1) *climate change* 2) *historical animosity between Mauritania and Senegal* and 3) *environmental impacts of the Manantali dam*, potential for future hostility has not subsided.

- 1) Climate change is predicted to increase damaging measures through drought and rain variability.
- 2) Political violence against Pulaars in Mauritania actually worsened after 1989, according to Amnesty International, reporting "Extrajudicial executions, torture, and the cruel, inhumane or degrading treatment of villagers has reached a very alarming level in the south of the country."⁴⁷ Also, current Senegalese president, Abdoulaye Wade has a major water diversion project on the backburner. The Fossil Valleys Project (FVP) entails

⁴⁵ Parker, *supra* note 5, at 160 .

⁴⁶ Niasse, *supra* note 19, at 7; *See generally* Parker, *supra* note 5..

⁴⁷ AMNESTY INTERNATIONAL, HUMAN RIGHTS VIOLATIONS IN THE SENEGAL VALLEY, 1 (2 Oct. 1990).

diverting the dammed water from Manantali to Senegalese fossil tributaries for agricultural use.⁴⁸ Due to Mauritanian protest, the FVP was not enacted, and when Wade brought it up again in 2000, Mauritania swiftly prepared once again ejecting Senegalese citizens from its borders.⁴⁹ Wade responded by publicly assuring the project's dormancy, calming Mauritanian upset; suspicions certainly remain.⁵⁰

3) The Manantali Dam, despite an onslaught of criticism and injurious ramifications, is not going anywhere.⁵¹

Negative impacts of the Manantali tend to outweigh the benefits in most investigative studies regarding both human and ecological well-being. Aside from the fact that very little energy is actually produced by the dam, most of which supplies OMVS capital cities, and aside from the fact that the Senegal River is still today unfit for any navigational use, the Manantali dam has also caused mass community displacement, deforestation, groundwater and fishing depletion, rise in water-cultivated diseases, and discontinuation of sustainable agricultural practices.⁵² All of these problems affect the downstream Fuuta Tooro region

⁴⁸ ADAMS, *supra* note 33, at 16.

⁴⁹ Niasse, *supra* note 19, at 7.

⁵⁰ *Id.*

⁵¹ ADAMS, *supra* note 33, at 28.

⁵² See Desgeorges and Reilly, *supra* note 3, at 636-37, 640, 642.

At the actual Manantali site in Mali, some 12,000 Malinke citizens were forced out to make way for the reservoir.⁵³ Downstream in the Fuuta, tracking relocation proves more difficult, due the number of contributing causes, such as the political battles (incorporating Mauritanian genocide) over agriculture discussed earlier; the irrigated land reformations in Mauritania and the depleting water levels in the river were both due to the Manantali dam and created over 170,000 refugees.⁵⁴ But there are also less political causes for relocation.

Damming a river “regulates” floodwaters and in doing so suppresses the seasonal cycle, disrupting and depleting groundwater aquifers, endangering downstream forests.⁵⁵ The most prevalent tree species, *acacia nilotica*, used for firewood, charcoal, construction, and grazing, depends on these affected aquifers, which are now diminishing.⁵⁶ There is added concern that if Mauritanian refugees relocated to the Senegal bank of the Fuuta Tooro become too concentrated in areas or if care is not continually taken to ensure provisions of woodland resources, increased demand could exacerbate deforestation problems.⁵⁷ Like the native trees, many fish populations are also dependent on natural fluctuations and sedimentary composition of ground water and floodwaters; their numbers have also greatly reduced.⁵⁸ Changing salinization levels and flow rates permitted the invasion of certain water

⁵³ Bosshard, *supra* note 32.

⁵⁴ See Niassé, *supra* note 19, at 7.

⁵⁵ Bosshard, *supra* note 32.

⁵⁶ Horowitz, *supra* note 30, at 185.

⁵⁷ Richard Black & Mohamed Sessay, *Refugees, Land Cover, and Environmental Change in the Senegal River Valley*, 41 GEOJOURNAL 55, 65 (1997).

⁵⁸ See Desgeorges and Reilly, *supra* note 3, at 638.

plants, such as *Sylvia molesta* and *Pistia stratiotes*, further disturbing ecological stability, specifically fish reproduction, consequently harming village-scale fishing practices.⁵⁹ These changing riverbank conditions have nurtured conditions for malaria and schistosomiasis vectors, drastically raising disease rates among riverine communities.⁶⁰ Nutrition is another health issue. It is no secret that OMVS plans to switch natural flood-recession agricultural practices to irrigation reliance permanently.⁶¹ Not only does the irrigation crop, rice, have lower nutritional value than traditional sorghum and millet used in flood recession fields,⁶² but irrigation also increases soil depletion, requires high capitol investment unaffordable for many villagers, and limits individual control and management of villagers in their food production.⁶³ Irrigation does produce high crop yields more consistently, but flood recession agriculture is still an important supplementary food source (and primary for many villagers and communities) in the Fuuta Tooro.⁶⁴ OMVS also does not hide prioritizing hydroelectric production of the Manantali reservoir, requiring constant flow through the turbines and discouraging supplying water for flood recession purposes. Even when the reservoir is full

⁵⁹ M Mietton et. al., *Water Management in the Senegal River Delta: A Continuing Uncertainty*. 4 HYDROLOGY EARTH SYSTEM SCIENCES DISCUSSIONS 4297, 4303 (2007) available at <http://www.hydrol-earth-syst-sci-discuss.net/4/4297/2007/hessd-4-4297-2007-print.pdf>.

⁶⁰ V.R. Southgate et al., *Studies on the Biology of Schistosomiasis With Emphasis on the Senegal River Basin*, 96 MEMORIAS INSTITUTO OSWALDO CRUZ SUPP. 75, 75 (2001), available at <http://www.scielo.br/pdf/mioc/v96s0/28x.pdf>.

⁶¹ ADAMS, *supra* note 33, at 9.

⁶² Bosshard, *supra* note 32.

⁶³ Saarnak, *supra* note 4, at 109-110.

⁶⁴ *Id.*

enough to provide for both purposes, the dam managers do not supply adequate floods for traditional farming downstream.⁶⁵ Dam management also fails to decrease flood risk, as unwanted floods continue and the potential for flood disaster remains.⁶⁶ Flood risk is exacerbated by the reputation of OMVS for failing to notify river valley residents of any water resource or flood conditions.⁶⁷

Life in the Fuuta Tooro has never been easy; indeed the natural climate variability and flood patterns are fairly disobliging for sustainable living,⁶⁸ and CCV projections heighten this situation. The installment of the Manantali has hardly fixed any of these climatic challenges, and with the exception of a case made for irrigated agriculture, has actually made water struggles in the Fuuta Tooro more challenging. “This wholly human-wrought environment can be considered as a learning experience”, as increasing Fuuta Tooro residents are forced to relocate due to damaged habitat conditions that can no longer sustain their livelihood.⁶⁹

IV. SUMMARY

It is clear that Senegal and Mauritania face considerable obstacles toward effective, humane water resource management, and that this weighs heavily on the Fuuta Tooro communities who rely on safe, affordable, and reliable access to water and water-affected resources. Fuuta Tooro residents must cope with increasingly stressful climate

⁶⁵ ADAMS, *supra* note 33, at 24.

⁶⁶ M. Mietton et al., *supra* note 62, at 4304.

⁶⁷ Desgeorges and Reilly, *supra* note 3, at 11.

⁶⁸ M. Mietton et al., *supra* note 62, at 4298.

⁶⁹ *Id.*

conditions, ever-present political tension, and damaging impacts of costly river dams that continually threaten local well being. The strength and endurance exhibited by the Pulaar community in the Fuuta Tooro are nothing short of admirable. Sociopolitical interference and unaccommodating environment aside,⁷⁰ Pulaar population and culture have persevered through nomadic and sedentary lifestyles. The term *water crisis* is used frequently today for water-stressed regions that are vulnerable to climate change, like the Fuuta Tooro. Yet this term seems somewhat unfitting for a region whose very existence is defined by arid conditions. It is rather the potential for sociopolitical stressors, such as the anthropogenic forces of climate change and an ill-managed river dam, which manipulate and exacerbate the given arid conditions to create an increasingly unforgiving environment that defines the real water crisis in the Fuuta Tooro. It is imperative that those considering river dams as a means for CCV adaptation take these potential repercussions into account.

⁷⁰ Saarnak, *supra* note 4, at 111.