

Case Study for 2006 HDR

THE SENEGAL RIVER CASE

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Introduction

This case study documents the cumbersome history of introducing commercial agriculture to the basin of the Senegal River, West Africa. This basin has been subjected to severe famines and an array of other, partly related development malaises during the past fifty years. The case study leans principally on the following documents: Varis & Fraboulet-Jussila (2002), Varis & Lahtela (2002) and Lahtela (2002, 2003).

The Senegal River

Senegal River is a 1,800 km long lifeline in the Sahel shared by four nations: Guinea, Mali, Mauritania, and Senegal. The rainy uplands of Guinea are the source of a major part of the river water. It is then conveyed through the lowlands, which become increasingly arid towards the mouth of the river.

The river and the surrounding valley have supported its population variably through the centuries in the harsh and highly variable climatic conditions. The traditional livelihood methods and ways of using the river in cyclical matters have been the only possible way until the introduction of modern agriculture in 1950s to the valley.

Through the history there has been a high frequency of dry climatic periods, which has forced people to leave the valley, causing mass starvation and conflict. The last few decades have seen an augmentation of various problems in this fragile valley. Severe droughts have hit the region, the population growth rate has been extreme, the economy has declined, food security has been unstable, and, consequently, there have been numerous mass migrations, mainly to the mushrooming cities such as Dakar, Bamako, Conakry and Nouakchott.

Inconsistent plans and policy interventions

Since the last five decades, the river has been seen as a means of enhancing the national economies of its member states. An attempt at food self-sufficiency, boosted by the problem of feeding the growing urban population and the possibility of future droughts, are the major driving forces of some national and international organisations. Large-scale schemes for modernizing agriculture, hydropower generation, and enabling navigation are listed as the major means of supporting such attempts. So far the success of these has been flimsy and mostly negative (Varis & Fraboulet-Jussila 2002, Varis & Lahtela 2002, Lahtela 2002, 2003 and Niasse et al. 2004).

After gaining independence

Guinea gained its independence from France in 1958, and the other three riparian countries in 1960. The modernization of the economy of the hitherto traditional African livelihoods and economy of the Senegal valley had started a decade earlier with the introduction of irrigated rice to the farmers. This was not successful due to various reasons. Obviously the climatic and other natural conditions were not suitable and the economic, social and institutional structures were not suited to commercial rice farming at that time. The modern institutions started to see daylight after the independence. In the case of Senegal, the key institution has ever since been the State Development Corporation SAED (Société d'Exploitation des Terres du Delta du

Fleuve Sénégal). The first international river basin organization is the OMVS (Organisation pour la Mise en Valeur du Fleuve Sénégal), which came into being in early 1970s.

The SAED continued the policy of promoting highly-mechanized irrigated rice farming on a large-scale. Its focal area was on the river delta and there were very few activities upstream. The policy continued unsuccessful with low yields, stumpy market revenues, growing indebtedness, unemployment and out-migration of large amounts of people. The main reason, after Scudder (1988) and Adams (1999) was that the peasant's own small-scale irrigation developments and organisations were demolished. The SAED initiative yielded in the accumulation of contrasts between the traditionally based small-scale irrigation-schemes and village developments (bottom-up) and the government-promoted rice irrigation schemes (top-down). No comprehensive planning was done, the governmental activities through SAED being centred to the commercialisation of agriculture (Scudder 1988, Adams 1997). The scale of livelihoods, markets and so forth, the cultural and habitual factors all were not properly understood and addressed in the governmental plans which obviously ignored the bottom-up direction and thus failed.

1970-1990

The Senegal River development schemes in their modern form date back to early 1970s when OMVS - the river organisation of Mali, Mauritania, and Senegal - issued its management plan (PNUD-OMVS 1974). It included three components: irrigation, navigation, and energy. This was to be carried out by constructing a hydropower dam in Mali (Manantali dam) and a salt-wedge dam (Diama dam) in Senegal (Figure 1). The dams have been built, but the original three goals of the project have not been fully met (Lahtela 2003); around the mid-1990s it became evident that the original goals of the project were not met. Currently, the electricity and irrigation projects are still ongoing, being heftily downsized and delayed, whilst the navigation project is defunct.

At the same time, the SAED extended irrigation activities from the Delta to the river valley. Small irrigation schemes, PIVs (périmètres irrigués villageois), were implemented in villages. PIVs were successful during the drought years, since material and equipment were provided for the farmers free of charge. Yet, when support from the state ended, the schemes failed to fulfil their goals and the costs exceeded the benefits.

After 1990

In 1994, the Senegalese government adopted a Master Plan for the Integrated Development of the River's Left Bank, which aimed to achieve the best possible compromise between social, economic, and ecological imperatives. Yet, in 1995, the World Bank approved two agricultural sector related programmes presented by the same government, which did not take into account the objectives of the Master Plan accepted only one year earlier. The discrepancy becomes important when it is noted that at the end of 1990's SAED introduced a construction and rehabilitation programme for irrigation schemes - also contradicting the objectives of the Master Plan (Adams, 1997).

Other schemes from the 1990s include the Cayor Canal project, the Fossil Valleys Revitalisation Programme, and the Manantali Energy project. These are not directly aimed at IWRM but are linked with river development. For the moment, the Cayor Canal project is shelved and the Fossil Valleys is still open. The Manantali Dam's hydropower station has been producing the planned 200 MW of electricity to the networks of Mali, Senegal and Mauritania since 2002 (Madamombe 2005).

Challenges for the future

The countries are struggling with intrinsic obstacles such as the unforeseeable climate patterns

and a traditionally fragmented society where ethnic groups form an important societal order. Other challenges include the underdevelopment of civil society with a low educational level, high incidence of human poverty, adverse economic development and political instability.

The Senegal River basin countries and the rest of West Africa have a relatively similar development history after independence. Their economies have not developed in pace with the other comparable developing regions. On the contrary, the GNP per capita halved between 1979 and 1995. In terms of human development, the region has developed far more slowly than other regions of the world have done. Food security remains a serious problem, and the food self-sufficiency has decreased in the region. It seems that the rural areas are challenged to produce the food for their own use, but are unable to feed the rapidly growing cities, which in turn must import part of their food.

With this, it is reasonable to speculate that the problems in Senegal River development arise from broad development and regional, politics related issues. Also, it is clear that, in order to improve the situation along the river, strong actions are needed to boost the area's macro-economy. In the light of this, the strong emphasis on hydropower generation and large-scale irrigation is understandable. However, improving human development in fields such as education and health is equally important in order to transfer the benefits of growth in the national economy to the inhabitants along the river. This should be the case in the rural villages especially, which now have lost their traditional livelihoods due to the river development schemes. A crucial mechanism in distributing the created wealth is due to developing the local markets and economic structures so that they are linked to the growing urban economic activities.

The future may see major trade-offs between the national and local stakeholders. Turning these into equitable solutions requires integration between different institutions and stakeholders, as well as all the environmental components along the river. Perhaps the biggest challenge is to get the two poles of development, national and local, to mirror their goals and actions in the same landscape, most importantly to get all stakeholders to express their views and affect the development options.

The Lac de Guiers Example

Let us focus to the recent developments in the surroundings of the largest lake of the basin, which is Lac de Guiers in northern Senegal (Figure 1). As the sole water reservoir in the lower Senegal River basin, it is extensively used as a stable fresh water source throughout the dry season, which lasts nine to ten months a year. On the top of growing national needs, the local population grows very fast; by 3.3 times in 25 years, which is much above the regional average.

Lac de Guiers has the mean depth of 2 m, length 50 km, and breadth 6 km. Until 1986, it was filled by low-saline water of the Senegal river during the rainy season floods. During the dry season, seawater entered the lake causing a sharp increase in salinity (e.g. Cogels et al. 1997). The volume of the lake fluctuated each year from 500-600 million m³ during the flood season to 50-70 million m³ towards the end of the dry season.

This pattern was dramatically altered by the construction of the Diama dam, which is located in the river between the lake and the river mouth. It can be used to control and prevent the intrusion of saline water upstream to Lac de Guiers. Consequently, the salinity of the lake water has been stabilized and decreased after the dam was put into operation. Changes in the lake's water quality and ecosystem, together with an increased use pressure triggered a need for an improved management and the analysis of the impact of alternative management options (SGPRE 2000, Varis and Fraboulet-Jussila 2002).

The lake is fed from its northern end, by the Taoué canal from the Senegal River. The sole outflow from the lake is a gate to the fossile Ferlo valley, where the water, which has not

yet evaporated away, will do so, over a hundred kilometers to the south. Therefore, the salts accumulate towards the south.

The lake consists of four distinct regions. The northern one has a low salinity content, heavy loading from 8,000 hectares of irrigated sugar cane plantations, particular macrophyte development problems, and limited eutrophication problems. The central region is the present source of water withdrawal to Dakar. It is more eutrophic and saline than the northern part. The southern region is again more saline. It has less algae, but very dense macrophyte vegetation, which hampers its use in various ways. The Ferlo basin is still more saline, and it can be considered as a brackish water body. The water is turbid and rich in nutrients.

Contrasts, growing inequalities and accumulating environmental problems

The Lac de Guiers, as the entire Senegal River case—represents strong contrasts in several axes (Varis & Fraboulet-Jussila 2002). Those axes include

- *Urban and rural needs.* The rapidly expanding city of Dakar is thirsty for water. The city has merits due to its developed water services, but the water is simply not enough for the present needs, and the future needs blur due to rapidly growing population. A growing share of the water is transferred from the remote Lac de Guiers. The water withdrawal enhances the need to restrict local, irrigated agriculture and is the key driver behind the destruction of the Ferlo valley. Modest restrictions to water uses are necessary for the local population in human waste management, hygienic pollution control, leakage of nutrients from agriculture, improper sanitation and some other aspects. The benefits from such restrictions benefit the communities themselves, as well as the city water supply alike.
- *Intensive and local farming.* Intensive, modern cash-crop agriculture, which does not nourish the local population but generates income to a narrow stratum of the population has been previously backed by the government. The loser is local agriculture, which cannot apply traditional methods any longer, has been largely neglected in national development priorities, but still must provide the livelihood for a large share of local population, particularly to the rural poor. The intensive agriculture must be subjected to limitations concerning its discharge to the vulnerable Lac de Guiers. This causes marked benefits to the local population and urban water supply.
- *Different ethnic groups.* The contrasts between the semi-nomadic communities and permanent villages on the shores of the lake are notable. They all stand, however, on the same boat if the water quality and accessibility of the lake are further deteriorated. The carrying capacity of the nature is very much under pressure by the excessive herds of the semi-nomads, and less by local farmers and fishermen. Traditionally wealthy and prestigious nomadic families with large zebu cattle gradually lose their respect and dignity, and find themselves among poorest of the poor.
- *Economic development goals and conservation of a fragile environment.* These should be more conscious and itemized than at present.

The lake is used by an array of competing stakeholders, and is also a significant natural asset. The most important stakeholders are described below.

City of Dakar

Dakar is located 160 km from the lake, uses the lake directly as a freshwater source. The city had 2.5 million in 2000 and the projection to 2015 is 4.1 million. Its share of Senegal's total population will grow from 24 to 30%. Dakar is one of the most advanced cities in Sub-Saharan Africa in terms of its water services: 92% of the households had an access to potable water in 1993. In the rest of the country, 36% of the population had an access to safe drinking

water.

Even though the city's income distribution is extremely uneven, the water supply covers fairly well even the settlements of the poor. The uneven distribution of income can be illustrated by noting that Dakar's richest 20% of population—including a notable expatriate population—earn 17 times the amount of the poorest 20%. The corresponding share of Mumbai is 6.7 (India), for Jakarta 6.6 (Indonesia), and for Cairo 6.1 (Egypt).

Riparian villages

These villages in the lake's surroundings represent a variety of ethnic and cultural backgrounds, the major ones being Wolof, Peul (chiefly Fulani, some Tuareg, etc.), their close Tukulor relatives, and Moor (ethnic Mauritians). They all have a strict cast system, and there is a certain hierarchy and share of tasks between ethnic groups.

The Wolof represent the majority and are traditionally on the top of the hierarchy. Their language is dominant in the region. They inhabit most of the villages along the shores of Lac de Guiers, having the privilege to catch fish on the lake, manage small-scale farming. The Wolof are less active in cattle breeding, which is the main activity of semi-nomadic Moors and Peul. Fishing is performed by semi-nomadic Tukulor during the rain season.

The ethnic dimension and balance are very important in the water management and in trade-off of different policy alternatives. If, for instance fishing benefit over, say, cattle breeding, a certain ethnic group is favored over another.

The local population uses the lake directly as a source of drinking and household water. Wastewaters are also discharged directly into the lake without treatment. Their water supply is hampered by deterioration of the hygienic quality of water as well as algal blooms (particularly bluegreen algae) and excessive macrophyte stands.

After the construction of the Diama and Manantali dams (located in Mali and built in 1987), the scistosomiasis and malaria have become very frequent. The former was almost absent and the latter was much less frequent before the dams. There have been ethnic conflicts within Mauritania and Senegal after the Diama dam construction between Moor and Senegalese (Wolof and others) population, which culminated in the riots of 1989, causing a threat of a war between these two countries.

Agriculture and fisheries

Agriculture is strictly split into intensively managed, large-scale cash crop plantations (essentially sugar cane), and local, partly irrigated, small-scale farming.

Immediately north from the lake, there are large sugar cane plantations, which are important to the economy of the northern Senegal. They employ 8,000 people, and contribute to 15% of the region's Gross Local Product, and represents 75% of the total economic contribution of the modern industrial sector (Niang et al. 1997). This sector, in turn, is responsible for generating about one-fifth of the total income of the region. The growing informal sector exceeds clearly that amount. The plantations were started as a colonial activity, and they remain in the hands of expatriates.

Small-scale, food-producing farming has been neglected by the government in the recent decades, and it can scarcely provide sufficient alimentation to the local population. In the pre-dam era, the traditional recession agriculture by the Wolof dominated in the whole river valley including Lac de Guiers. The alimentation situation is, however, better in this region than in most of other rural Senegal. This pulls immigrants to the region.

Fish is the primary source of proteins in the alimentation of the local population. Fishing is principally carried out by the Wolof, but the Tukulor enter the activity during the rainy season.

Cattle breeding

Cattle breeding can be grouped in three types. The amplest one is the semi-nomadic activity of the Peul. In the dry season, it is totally dependent on the access to surface waters or the few wells appropriate for the livestock. The number of nomads is constantly increasing due to immigration driven by the harshening conditions and population growth in other Sahelian countries as far as in Niger and Chad. The second group of cattle breeders is the Moor, whose cattle consist of small ruminants and camels. The Wolof villages also have some cattle for their own meat production.

Traditional cattle breeding of Peul and Moor has progressively been marginalized (Niang et al. 1997). On the other side of this poverty-environment time bomb, the even growing herds are excessive in relation to the carrying capacity of the dry grassland ecosystems. As a result, the vegetation cover has almost or totally been destroyed in large areas as a consequence of overgrazing. The balance is ecologically very fragile and very sensitive to climatic factors.

It is very fragile ethnically and socially alike. For the Peul nomads, the size of the family's zebu herd is a most important mark of wealth and social prestige. A zebu is never eaten, and has an immense importance to the Peul culture. Accordingly, the marginalization of their livelihood and the immense environmental problems caused by too grand cattle stocks calls for very delicate policies. The Moor nomads, in turn, are more accustomed to trading and craftsmanship, and seem to be socially less vulnerable to lifestyle changes.

During recent decades, the Peul can be progressively clustered among poorest of the poor in the northern part of Senegal, as well as in the whole Sahelian zone. During the severe Sahelian droughts from 1968 onwards, it is estimated that even several hundred of thousands of Peul nomads have starved to death, and millions have suffered from famines. Hundreds of thousands moved to and installed themselves in refugee camps in the vicinity of big cities. Those camps have in many cases become permanent squatter settlements.

The semi-nomadic, lower-cast Moors who have been expelled from Mauritania around 1989, have a similar fate in many respects, although they have been better adapted to trading with various goods, both in rural and urban conditions.

Environmental concerns

Lac de Guiers and the lower Senegal River form a unique wetland and riverine ecosystem complex which is one of the oases of biodiversity in the Sahelian West Africa. The region has originally over 800 plant species, 33 of which are endemic.

This fragile environment has undergone notable changes in the last decades (Duvail et al. 1998). They are due to several factors:

- decreasing precipitation and river flow,
- construction of the Diama and Manantali dams,
- the consequent stabilization of the water level of Lac de Guiers,
- the expanding agriculture, particularly irrigation, and
- other pressures of a rapidly augmenting population such as deforestation and of the cattle, which overgrazes the fragile pastures and accelerates desertification.

Overgrazing, deforestation and desertification remain the greatest environmental concerns of the Lower Senegal River basin since the mid-1980s. However, the side effects of modernization grow in importance.

Irrigated agriculture is a major threat to the water quality in terms of salinization, eutrophication, and chemical pollution. Local uses and urban water supply sit on the other side of the table, the lake being an important raw water source for Dakar and riparian communities.

Environmental pollution is still relatively low in the region, but the concentrations of heavy metals and traces of pesticides are in growth. Nutrient enrichment is a big problem; the

macrophytes as well as bluegreen algae are favored by the nutrients, which are mainly discharged to the lake from two sources, from the sugar cane plantations and associated with the dissolved solids which enter the lake during the rain season floods of the river. The former is the major source of micropollutants.

The concurrent stable water table of the lake favors the big horsetails *Typha domingensis*, which is seen as a threat to both local human populations and the biodiversity of the lake. Additional threats are due to invading species such as *Eichhornia crassipes* and *Salvinia molesta*, and some other species, *Potamogeton schweinfurthii* and *Pistia stratioides* in particular.

A special concern is caused by the unsustainable management of the Ferlo Valley, which has been flooded with water in the 1990s. It is merely used as a dump of outflowing waters from the southern part of the lake. The salinity of that water has already increased more than fivefold when traversing through the lake from the river to the mouth of the Ferlo Valley. The valley has no outlet for the water, and all the impurities including the salt, nutrients, and micropollutants are concentrated and accumulated in the valley. There are still some nomads who inhabit the area and breed their cattle in the shores of this saltwater reservoir, but the water quality keeps deteriorating with accumulating salts and other chemicals. The Ferlo Valley pays the price for keeping Lac de Guiers as a freshwater body.

To sum up, the management setting is characterized by the need for a careful trade-off between rapidly augmenting pressure on the resource and the sustainable development of a very fragile natural ecosystem.

Contrasts, growing inequalities and accumulating environmental problems

To benefit water resources development in as equitable and sustainable manner as possible, is a great challenge in situations such as the Lac de Guiers—like in the entire Senegal River Basin—in which the poverty and environmental problems are exhaustive. A strong contrast has prevailed for half a century between the expansion of modern agriculture—which is desperately and doubtlessly needed (Niasse et al. 2004)—and the traditional livelihoods. The challenge in the latter is the facilitation of the poor to survive in rural areas by still living mainly in their traditional ways. Another vogue of poverty is unavoidably to come at least to the semi-nomads: their lifestyle is at the speedway of conflicts with the environment due to too high herd and human populations related to the nature's capacity. Either they must escape to the mushrooming cities—most likely to their shantytowns—or find other ways to survive in a non-traditional way in rural villages. This will be another type of poverty than the present one, perhaps even a more severe one (Varis & Fraboulet-Jussila 2002).

The polarised society

The Senegal River's future management is a challenging task since the river is shared by four nations, various ethnic groups, and the two sets of development goals: national and local, which at the moment are pulling in opposite directions. The river management since the 1970s has not been carried out in an integrated way and according to various authors (e.g. Hamerlynck et al., 1999) the future development does not show much change in this matter. In developing the Senegal River, the most challenging issue is the discord between the national and local level development goals. In between these are the urban dwellers who partly benefit and partly suffer from the national development actions (Lahtela 2003).

The role of the Senegal River in attempts of boosting its riparian countries' macroeconomic development has been viable during the last decades. Yet, often the government-preferred development options come into conflict with the interests of user communities (Thébaud, 1995). In Senegal, extensive and comprehensive master plans have followed one another, putting forward an imposing increase in food production and other

economic activities that would stem from improved water resources management, rural development, and particularly from massive investment in irrigated agriculture. However, the course of events has differed remarkably from the ambitious plans. Due to insufficient production levels and socio-economic factors, the food production has not developed in pace with the world's fastest population growth (White, 2000). Rural economies have not stabilized while poverty-driven exodus to mushrooming cities prevails.

The river development plans are directly mirrored in the society. Irrigation schemes change the social hierarchy and the dam-based irrigated farming restrict the local population from their natural rhythms and processes and thus hinder their traditional economic opportunities (Salem-Murdock & Niassé, 1996). For example, reduction of the flood (especially suppression of the peak flood) changes the social and economic equity, due to the complicated and highly stratified system on access to land (IDA, 1991). The traditional access of the nomads, the cattle breeders, settled farmers, various ethnic groups that fish by the river, have all had their specific customary rights and ingenious practices which have evolved in parallel, through conflicts from time to time, over centuries. As the modern agriculture enters the valley and is accompanied by a substantial change in the timing and height of the flood, the traditional situation between ethnic groups and stakeholders gets profoundly disturbed.

Whatever the water management actions are, some ethnic groups will benefit over the others. This is partly due to the fact that ethnic groups derive themselves according to different occupations, which consequently either suffer or benefit of different development schemes. Ethnical and family ties are strong and supported when possible (Lahtela 2003).

The urban citizen can be seen between the poles of local and national development. Partly they benefit from the national development actions, such as electricity production. On the other hand, large-scale management plans hinder the traditional livelihood methods and thus push people to move into towns in search for living. Migration in the Senegal River Valley has happened since the 17th century and continues still today involving all ethnic and occupational groups. One reason for the previous rural-urban movements has been the combination of demographic growth, severe droughts and various development interventions that have changed the traditional production systems (Figure 2). Exodus from the rural areas into cities and abroad will continue in the future if the development plans are concentrated on large-scale actions (Lahtela 2003).

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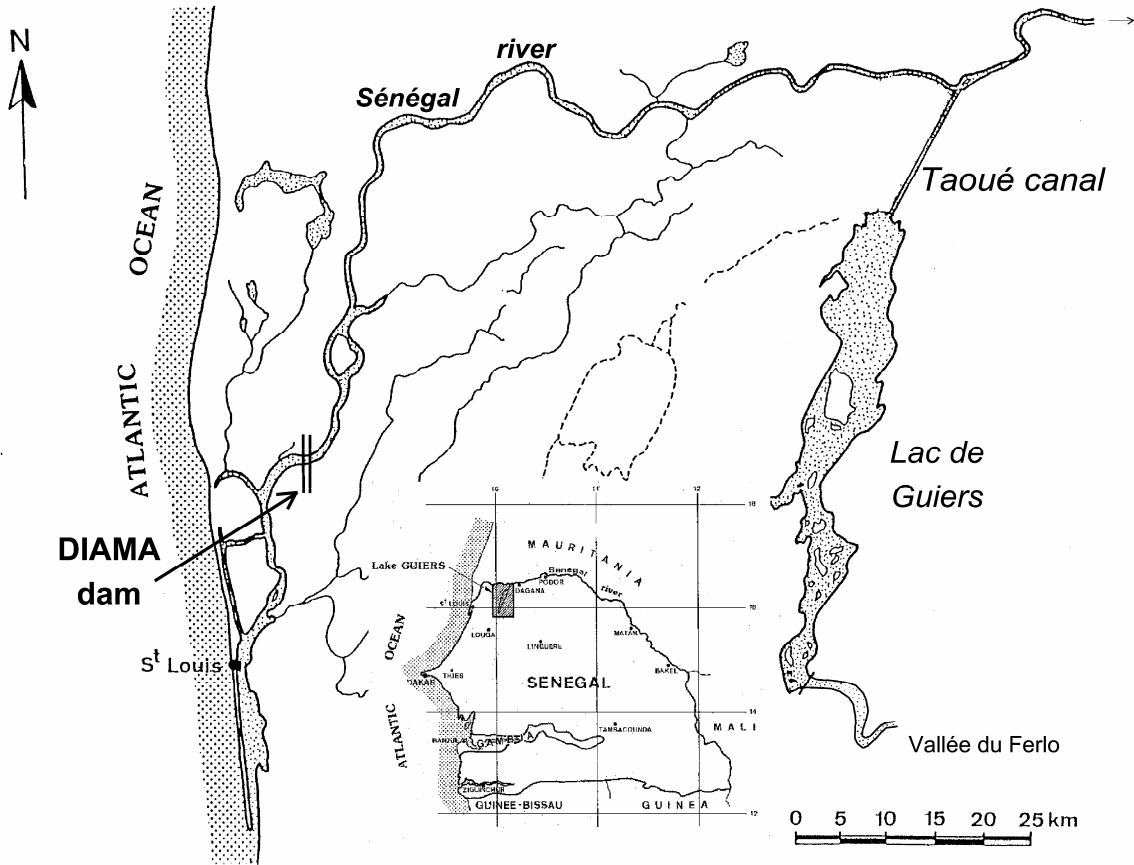


Figure 1: Map of Lac de Guiers in Senegal, West Africa.

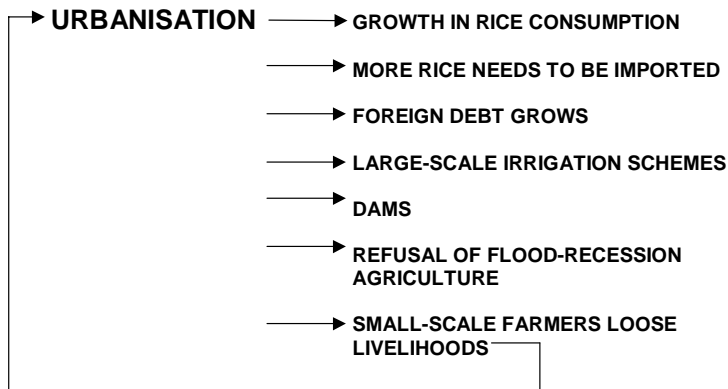


Figure 2. Urbanisation – an example of vicious circle in the Senegal River basin (Lahtela 2003).