

Integrated management of water resources in the Sahel countries: relevance, constraints and ways of improvement - case study of Senegal

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Abstract

This paper examines water issues in Sahel countries Based on Senegal's experience,. Facing with the decrease of water potential while the water demand increases steadily, public authorities develop a water policy aimed among other objectives to improve water supply particularly in the capital Dakar and promote irrigation in rural areas. However this policy is sectoral, consequently not carried out according integrated management principles. Political, socio-economical, institutional and technical constraints to sustainable water management are identified and ways of improvement discussed.

INTRODUCTION

The Sahel region is located in a the tropical zone. The mean annual rainfall in the region varies between 300 mm in the north and 700 mm in the south and is characterised by a high interannual variation.

The socio-economic behaviour of the region is characterised by a high poverty index and a high population growth (the most Sahel countries belong to the less developed countries of this planet).

The combination of unfavourable climate and extreme socio-economic situation have aggravated the degradation of natural resources in the region. An instance of this situation is an estimated 7 Million ha of land are threatened by desertification, which is 23 % of the world-wide areas threatened by desertification (Sinkan, 1995).

Particularly water availability constitutes a big challenge for the governments in the region. Facilitating the access to safeguarding drink water to the majority of people is not an easy task. Besides in a region where about 60 % of people are occupied in the primary sector, water plays a major economical (reduction of food imports), social (food security, poverty alleviation), political (conflicts) role.

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major economical (reduction of food imports), social (food security, poverty alleviation), political (conflicts) role.

Many efforts have been made by the public authorities in order to reduce the water deficits. However the failure in policy implementation, lack of appropriate legal and institutional capacity among other factors make it difficult to achieve this goal. Taking the example of Senegal, this paper examines the present water problems and the constraints to a sustainable water resources management in Sahel countries.

POTENTIAL OF WATER RESOURCES IN THE STUDY AREA

Rainfall

Senegal is located in the tropical zone marked by two distinct climatic conditions-the dry and wet seasons. The dry season begins in November and ends in May. During this period very little or no precipitation is received and the seasonal climatic elements such as temperatures, ETP, solar radiation etc.) reach their maximum value. Temperatures until 40° C are recorded in April in the south east. The rainy season starts in June and ends in October. The fluctuation of the ITF (intertropical front) releases rainfalls which amounts to 200 mm in the semi-arid zone where the season takes only two months, and more than 1000 mm in the sub-guinean zone, five months duration.

Since end of the 60^s, there is an indication of negative trend in annual rainfall. The amount of received annual rainfall has decreased. Isohyets 200 mm, 400 and 500 mm are moving on the south while the area covered by isohyet 1000 reduced. It would be important to estimate the real impact of drought and desertification on the water resources (CSE, 1997).

Surface Water

The study area is drained by rivers Senegal, Gambia and Casamance river with their tributaries (fig. 1). Senegal river originates from Fouta Djallon hills in Guinea, flows between 10° 20 and 17° 30 N latitude, and ends in Atlantic ocean. The mouth is located at Saint-Louis. The mean annual discharge is about 2000 m³/s in Saint Louis. The flow regime is bimodal with a principal maximum high flow in September and a secondary high flow in February. In the dry season particularly in April, the river flow is limited to its alluvial bed. With a length of 1700 km and a drainage basin area of about 289 000 km² (of which 19 % is found in Senegal) it constitutes a hope in this particularly arid region (annual rainfalls are inferior to 200 mm in north Senegal), traditionally occupied by farmers, herders and fishermen. Economically it represents for the riverine states (Mali, Mauritania, Senegal) an immense agricultural challenge. Their objective is the overall food sufficiency by increasing the cereal production and reducing food importation. For instance Senegal imports annually 400 000 to 600 000 tonnes of rice which correspond to 80 % of the country needs. In 1972, these States decided to create a sub-regional organisation named OMVS (Organisatin pour la Mise en Valeur du Fleuve Senegal-Senegal management river organisation). The mission of this organisation is to achieve an optimal use of the water resources and promote the development along the Senegal river valley. In this sense, several projects have been identified by the state members which concern

the irrigation of 375 000 ha land, navigation between Saint-Louis and Kayes (Mali), and energy production. To achieve this goal, two dams have been constructed along the river: Diama (Senegal) and Manantali (Mali).

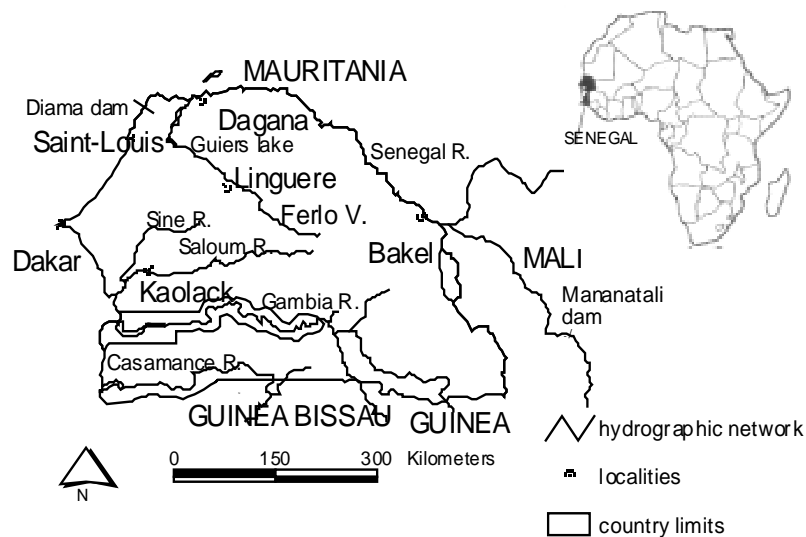


Figure 1. Location map of Senegal.

In its downstream course the river flows through gentle to flat slopes causing seawater intrusion. Annually the seawater intrusion moved as far as 400 km upstream. Diama barrage located near the mouth was constructed in 1985 in an attempt to stop this phenomenon and to reclaim an estimated 42 000 ha area for irrigation. In addition Manantali high dam was constructed in 1987 upstream, to regularise the flow river. However, because of many reasons (lack of financial means among other), these objective have been up till to now partially realised. In Senegal, only 75 000 ha among 240 000 originally planned have been effectively irrigated. The navigation project has not yet begun.

The Gambia river: it plays an important role in the south of the country. As the Senegal river, it has its source in Guinea. Its length is about 1150 Km, of which 477 km is in Senegal. It flows in a relatively humid zone, the area of the drainage basin is about 77 000 km² with a rich fauna and flora. The OMVG (Organisation pour la mise en valeur du fleuve Gambie-the Gambia river management organisation), set up by Senegal, Gambia, Guinea and Bissau Guinea co-ordinates the realisation of development projects (especially the irrigation projects).

The Casamance river is located in the south west of the country where mean annual rainfalls are between 900 and 1100 mm. The mean annual discharge volume is about 129 Million m³ at Kolda station (CSE, 1997). Due to recurrent drought in previous years, the intrusion of seawater is threatening the mangrove ecosystems in particular and precludes suitable development in the region as a result of expansion of salinised land. In addition

to the major river basins discussed, there are small complex hydrological systems which include smaller basins and lakes in the country. The largest of these is Guiers lake is. This lake is connected to Senegal river through Taouey canal for storage purpose of the flood water. With about 700 Million m³, it is the main source of Dakar's domestic water supply.

Groundwater potential

It is estimated that from 60 % (during wet periods) to 100 % (during dry periods) of rainfall amount are lost by evapotranspiration (DAT, 1986). So the aquifer recharge becomes irregular and the availability of groundwater resources is seriously compromised. Ground water remains the main source of water supply for many people. The characteristics of some aquifers are presented in table 1. It appears that the potential is not well known. Complementary studies must be carried out and efficient legislation set up to regulate the exploitation.

Table 1. Characteristics of some aquifers.

Aquifer	Area (km ²)	Depth* (m)	Quantity (Mio m ³)	Quality	Actual consumption (Mio m ³ /a)	Origin
Maestrichtien	130 000	20-600	2,600	500g/l residue	10-20	Fossil
Palaeocene	120 000	Variable	Unknown	400g/l	15-20	Infiltration + Maestrichtien
Eocene	120 000	20-180	Unknown	variable	unknown	Infiltration
Continental terminal	80 000	-	-	-	-	Infiltration

*: depth of groundwater

Source: DAT, 1986

WATER SUPPLY

Water supply problems are examined both in the cities and in rural areas. About 45 % of Senegalese are living in town (UNSD, 1997). These cities are characterised by a rapid growth due a high birth rate (2.9 % countrywide) and a dynamic rural exodus. The capital Dakar counts 3 Million inhabitants and concentrates the essential of the economical (about 90 % of the industry), social and political activities. Water demand is therefore high and the production is not sufficient to satisfy it. The water distribution network is old, saturated and cannot cope with the demographic pressure. The consequence is that some parts of the town located at high parts or near the dead end of the network are not continuously supplied. On the outskirts of Dakar where spontaneous settlements occupied by low-income people generally coming from villages dominate (30 % in Dakar region), there is hardly a network distribution. The production capacity is about 210 000 m³/d while the demand is about 300 000 m³/d. The deficit has increased from 4 % in 1984 to 30 % in 1998 (Sakho, 1999). In rural areas the major source of water supply is ground water. About 800 motorised wells exist it is not enough to cover the overall rural area. The impact of public taps in villages where they have been installed is limited because for many families the applied prices are too high in comparison with their income. Only 28 % of people in rural areas have access to safe drinking water (World Bank, 1999).

SANITATION

Only 30 % of the population living in five towns are connected to the sanitation network. It poses the problem of ground water contamination in some areas. The treatment and the reuse of waste water is not well developed. The water treated by the existing stations are overall used for irrigation in Dakar region.

WATER POLICY

In order to alleviate the water deficit; improve the supply and develop activities linked with water, the government opted for a large programme with the central points described below.

Improvement of the access to potable water

It concerns the extension of the network distribution and the reinforcement of its production capacity which is forecasted to increase an additional 60.000 m³ per day at the end of the project. Presently the authority in charge of water distribution has achieved to produce 40.000 m³ per day more. It was also envisaged to modernize the equipment and reduce the deficit significantly.

In the early 90th Senegal had designed a project, the "cayor canal project" which was expected according to the technicians to definitively resolve water problems in Dakar by the year 2000. It concerns a 240 km long channel which should drain water from the Guiers lake. Because of the high required investment, it has been finally given up. In rural areas, it is also planned to bore 70 new motorised wells as well as to maintain the existing ones until 2005.

Improvement of the management strategies

Like many other African countries and according to recommendations of the world bank, Senegal has opted for the privatisation of waters sector. The main objective of this policy is to avoid mismanagement and maintenance problems which have characterised this sector in the previous years. Since 1996 the state whose intervention is now limited to the supervision works in partnership with two other offices: the SONES (Senegal national water utility) and the SDE (Senegal water distribution company). SONES is responsible for quality and service control, management of the fund necessary for equipment the quality of exploitation and service, to manage. The SDE is responsible for production, distribution, maintenance and drafting of water pricing policy. Another company (ONAS- national sanitation office) is responsible for the sanitation aspects.

Protection of water resources

Particularly in the Senegal valley, pollution of surface water reduces significantly the possibilities of water supply. Here water is used both for irrigation purpose and for water supply without any treatment. So many diseases due to no potable water such like dysentery, thypoid fever are prevailing. A capture and treatment system is planned in the region, to improve the situation.

Promotion of agricultural activities and poverty alleviation

About 60 % of people are employed in agricultural sector. this sector severely affected by the drought and according to the authorities, irrigation is a paramount importance. In completion with the two dams construction which represent for Senegal a potential of 820 Million m³/a to be extracted from the river, another project have been set up. Supervised by the MEAVF (fossil valley investigation and management mission), its aim is to develop the main dry valleys within the country. The total fund is estimated at about 100 Billions CFA (around 166 Million \$). Up to now 6 Billions (around 60 Million \$) have been invested and only the Ferlo axe has been rehabilitated. The project poses technical feasibility and is a source of trouble between Senegal and Mauritania which asserts that its irrigation projects could be threatened. Presently an alternative irrigation development plan is being discussed by the government. The plan is called "national hydrographic network". The general idea is to promote the management of small watersheds, water harvesting technologies and storage reservoirs. So that people could practice irrigation in the dry season and rural exodus could be prevented.

LEGAL FRAMEWORK

The water code (law n° 81 - 13 of March 4, 1981) regulates freshwater use within the country. It disposes in article 2, that right of ownership is not recognized. Consequently water remains a public good. Any private exploitation must be preceded by the payment of a defined charge. It establishes too the quality standards for potable water (article 51) and sets up barriers against pollution (article 48). Besides a prioritisation of water use categories have been set: domestic use, watering animals, agriculture, forestry... This code has never been completed by a application decree and never actualised even though new factors (construction of dams, decentralisation law) must be considered (Alissoutin, 1997).

Other laws complete this legal framework: the hygiene code (law n° 83 - 05 of January 28, 1983) which establishes the hygiene regulations for water, locations, seashores... It concerns also the protection, the disinfection and the management of water supply networks, reservoirs and sources. The environment code (law n° 83 - 11 of January 05, 1983) contains dispositions referring to water pollution, quality norms of industrial waste water etc. The sanitation code regulates domestic, industrial and rainwater, evacuation systems, taxes etc. The urbanism code is related to density plots, urban management, green spaces... (Senegal has also many international conventions ratified (Ramsar convention about humid zones, desertification convention...) which play an important role in ecosystem management.

MEANING OF INTEGRATED WATER RESOURCES MANAGEMENT

There are many types of definitions but there is a consensus that integrated water resources management is a sustainable water management with consideration of "ecological, economical and social aspects" (BMZ, 1999). In its chapter 18 on Agenda 21, IWRM is defined as a concept "based on the perception of water as an integral part of the eco-

system, a natural resource, a social and an economic good, whose quantity and quality determine the nature of its utilisation". (UNSD, 1999). So water management programmes should be an integral part of development process. It means that water sector should not be considered as an isolated sector. Its interaction with other development sectors (agriculture, industry, fisheries, education, health...) must be taken in account. Achieving this goal requires the involvement of "those who have a stake in water allocation and its use, to manage water, land and related resources" (Commonwealth, 1999). Either in national or in international level (in case of transboundary rivers), using participatory methods in water resources management presents the advantage to create a forum where water issues are examined.

In Sahel countries prerequisites for an integrated water resources are not always met. Many constraints are registered which make the sustainable management of water resources difficult to achieve.

CONSTRAINTS OF SUSTAINABLE WATER RESOURCES MANAGEMENT

Legal and institutional constraints

The sectoral approach of development as practised in developing countries is not favourable to an IRM: every ministry keeps a certain autonomy and elaborates policies, rules and laws according to own interests. Coordinating structures are quite existent. Hence double use and above all contradictions are not seldom. The current land tenure policy (law n° 64-46 of Jun 17, 1964) is very ambiguous. Pastoralism and forestry for example are not recognised as a viable land use, so herders have a limited access to water and pastureland. It threatened also the protection of basins promoted by the forestry code. It constitutes a matter of conflicts with farmers. A good example is given by CSE, the centre of environment monitoring (CSE, 1999). The agricultural policy developed between 1960 and 1980 aimed to modernise the agricultural sector and increase the production of cash crops (peanuts). Large surfaces have then been reclaimed for cultivation. However no protective measures have been taken, a massive degradation of natural resources has then been observed which contributed to the wide spreading of desertification. A horizontal structure which coordinates all water projects (and programmes) and improve the legal framework is necessary. A "superior water council" has been created and it is expected that some modifications will be brought.

Water rights are in most cases not well defined. They are either not adapted to the local context (because imported from other regions and cultures, in Senegal mostly from France) or they have to compete with traditional rights of the communities, which generally dominate. The woman' role in water domain is not taken in account although as in many African civilisations water is the exclusive under the responsibility of women. Fetching, quality control, conservation are among these. Although the privatisation of the water sector present positive aspects it is not adapted to the context of poverty which characterises developing countries. Connecting the network distribution and water prices can easily become too expensive. An effective monitoring and a support programme to help the underprivileged is necessary in this case.

Political constraints

The fact that in Sahel water scarcity appears in the daily life of people constitutes for the politicians an electoral weapon. In Senegal the more important water projects (dam construction, fossil valleys, cayer canal. etc.) belonged to the so-called "big projects of the president". Although environmentalists warned against negative impacts these have been maintained. Another political obstacle to an IWRM is the centralisation of the decision power. In many countries the system is outlined in a way that the decision making concerns a minority. These called "bottom-up" approaches are still in practice. Senegal has innovated by adopting a decentralisation law (law n° 96-07 of March 22, 1996), which operates a transfer of competence to the different administrative subdivisions within the country. The main problem is the lack of financial means so that their autonomy is relatively limited. At the same time the state decided to reduce its participation in some development activities which are then to be conducted by private actors. So in the domain of irrigation (in the Senegal basin) the national irrigation office has been suppressed in favour of local peasant organisation which acquires the total right control over the hydro-agricultural structures. For the farmers this initiative means more responsibility and more autonomy. However it appears that they haven't been sufficiently prepared to face this new situation. Lack of appropriate training in management and above all in maintenance and water management constitute a threat to the overall agricultural chain. It is desirable to reinforce the decentralisation skills. Decentralisation must be interpreted as a mean which facilitates the participation of local communities and not as an electoral instrument to the service of the political power. By insisting on training would allow local communities to take part actively to the development process.

A lack of vision characterised the main applied programmes. The proposed solutions to water shortage are mostly registered in a short-term perspective and are outlined to respond to pressing situations. However, the real causes of this phenomenon are rarely discussed. So the struggle against erosion and inundation (which are rather symptoms of environmental crisis) are limited to the installation of structures. Medium-long-term preventive are neglected.

Technical constraints

Technology transfer: Particularly in rural hydraulic sector, import of inappropriate technology is not seldom and constitutes an obstacle to a sustainable water supply. Many structures are defect after a determined functioning time. Because maintenance aspects are not well-known by local communities and because local expertise are missing, many structures remain long-standing without functioning. The best alternative is to adapt the technology to the realities of the country. People have always traditionally adapted water exploitation techniques which need sometimes only to be improved. It is a pity that local knowledge is not rationally used. People need also to be sensitised, trained (in maintenance, management, monitoring...) and involved in the management of these structures. Many experiences have been done which prove that the active participation of local communities is a guarantee of success.

Lack of data: Setting IWRM approaches require a good knowledge of overall natural and socio-economical factors prevailing within the basin. A diagnosis must be carried out to evaluate among other things the potential of resources, to identify opportunities and

constraints of management, and to determine the conditions of a sustainable management (role of different actors...). Data collection is then a condition of a IWRM. In developing countries data are missing terribly. Besides research activities are not well coordinated. There are for example plenty of studies concentrated in Senegal river (and at a second plan Casamance river) while many interesting smaller basins have quite been investigated. An articulation between research and development necessities is mostly not distinct. On the other hand, the way projects are planned and implemented doesn't promote exchanges and communication between stakeholders. In the fossil valley project national researchers complain that they have not associated to the discussion about its feasibility. Thus what needed was an EIA (Environmental Impact Assessment). The Senegal river management has lead to an intense modification of its hydrology and ecosystem functioning. Because all parameters have not been taken in account during the planning phase, many problems occur presently (floods, ecosystem degradation,...). Those could be avoided if the complexity of this hydrosystem has been well-known.

Socio-economical constraints

Poverty: The link between environment and poverty will not be discussed here. It is important to note that poverty is an important source of degradation of natural resources. People need to exploit more land and resources to increase their income and their life's quality. Nevertheless it accelerates the degradation of resources and consequently increase the impoverishment of local communities.

While people are poor, they cannot connect to the water distribution and are obliged to drink no potable water. Because the connection to the sanitation network is expensive, other alternatives are found locally to evacuate the waste water with the risk to contaminate ground and surface water.

Water authorities concentrate more on natural aspects of basin management and accord less importance to social aspects which play an essential role.

Illiteracy: 66 % of Senegalese are illiterate. So it is difficult for local communities to understand the contents and the significance of laws and rules which are constantly violated. Besides because they don't have access to information, it is quite impossible to influence government policy. It is urgent for local authorities to apply efficient measures and programmes to alleviate illiteracy and its consequences.

CONCLUSION

In comparison with other African Sahel countries like Mauritania, Senegal disposes a relatively important potential of water resources which is nevertheless unevenly distributed. The prevailing drought and desertification and above all the overexploitation to satisfy an increasing water demand as well as bad management practices constitute a threat to a sustainable conservation of these resources.

Therefore it is urgent for Sahel countries to re-examine water policies and the condition in which they are implemented. As long as sectoral approaches are prevailing, as long as

legal and institutional framework are not clearly defined, as long as the democratic process is not reinforced and the local communities are not involved, the sub-regional policies in water management are not harmonised, there is a risk of degradation of water resources and therefore a risk to compromise the development process in this region.

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