Water Infrastructures Facing Sustainable Development Challenges: Integrated Evaluation of Impacts of Dams on Regional Development in Morocco

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Summary

During the past century, large hydraulic infrastructures have been considered as the most effective tools for increasing water supply and rationalise water management. According to this approach, large infrastructures are seen as catalysts for territorial development and economic progress. More recently, international surveys of results of water supply policies and performances of large dams, show that these structures need to be integrated in more comprehensive Integrated Water Resource Management strategies at catchments' scale, to promote equitable and sustainable regional development. The aim of this communication is to present the role of large hydraulic infrastructures within the regional development dynamics with particular attention to the Sebou basin in Morocco, in order to assess some relevant impacts on local communities and their ecosystems. The Sebou region is one of the most important basins in Morocco, in the context of the national strategies and policies of management of water resources, established by the Water Law of 1995. The development of hydraulic infrastructures in the Sebou Basin begun in 1935, with construction of a complex of ten large dams and nine small dams, to provide water for agriculture, domestic and industrial use, and to generate hydropower and control floods, in line with the national water policies that, from the 1960s onwards, looked at large dams as core infrastructures for regional development. A critical view will be given about the coherence of this strategy with the sustainability principles.

Keywords: Water Policy, Morocco, Dams, Sustainable Development, Impacts

JEL Classification: Q25, Q28, H76

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1. Introduction: Large dams and development

During the 20th century, large dams are been considered internationally as fundamental tools for water resource management. More than 45,000 large dams has been built around the world, making water available for domestic use, food production, energy generation and flood control. Current estimates suggest that some 30-40% of irrigated lands worldwide rely on dams, which also generate 19% of total energy supply (WCD 2000). The construction of large dams was a physical demonstration of national development and economic progress, as dams were promoted as important means for meeting human increasing needs of water and energy services, and as a long-term investments able to deliver multiple benefits, as infrastructure development, job creation and increased revenues from cash crops. These benefits were considered as self-evident, and dams were justified as highly competitive options, because the construction and operational costs tended to be limited to economic and financial considerations for the short term, without sufficient attention to environmental impacts at the basin scale and in the long run.

It has became more evident in the last years, that engineered works heavily modified and diverted river flows, affecting existing rights and access to water, and causing significant impacts on ecosystems. To secure the benefits associated to large dams, in various cases unacceptable costs have been paid in social and environmental terms, by people displaced and by various impacts on affected communities, by wetlands and deltas. Moreover, the international evidence about the lack of equity in distribution of costs and benefits related to engineering interventions, have induced to open an international debate to compare the benefits of storing and transferring water and producing hydro-energy, with alternative options (WCD 2000). Consequently, the role of large dams in human development must be reconsidered and reoriented in the contest of the Integrated Water Resources Management, for which a water management based only on increasing mobilization is not sufficient to solve water scarcity questions, while a demand management needs to be addressed through adequate regulations.

2. Water scarcity in Morocco

Water availability has an uneven distribution within the country: the north-western areas, influenced by the Atlantic Ocean, receive annual average precipitations of 500-2000 mm per year; while the arid southern and eastern regions receive less than 100 mm. Inter-annual irregularities occur, with peaks of heavy precipitations and drought phenomena. Morocco's available water resources are facing a great scarcity, much below the critical threshold of 1000 m^3/person/year, and quantified as 830 m^3/person/year in 1996, with a foreseen value of 411 m^3/person/year in 2020 (Ministère de l'Environnement 2001). The situation is worsening for a trend of increasing water needs, generated by various pressures:

a) A population growth at an annual rate of 3%, passing from 11,626,470 persons in 1960 to 29,891,708 in 2004 (Haut Commissariat au Plan, Direction de la Statistique 2006);
b) Positive economic development trends causing an increase of consumption patterns (UNDP 1988). According to the Human Development Report (2003), Morocco's socio-economic situation is improved from a Human Development Index of 0,426 in 1975 to 0,630 in 2002;
c) Urbanization is grown from 29.1% in 1960 to 55.1% in 2004 of the overall population (Haut Commissariat au Plan, Direction de la Statistique 2006), with a particular concentration in the north-western coast: Great Casablanca, for instance, counts 3,6 million people (12,1% of the national population) (NOSTRUM-DSS 2005);

d) Extension and modernization of the irrigated agriculture, particularly to integrate water deficits due to drought events. During the season 1993-1994, which received good rains, irrigation only contributed by 35% to the agricultural added value; while in the dry season 1994-1995, this contribution increased to 70%. It has to be noticed that the irrigated agriculture only represents 16% of the overall agricultural cultivated fields at the national level; hence, it contributes by 45% to all agricultural added value, and by 75% to the sector exportation. The creation of large irrigation schemes has allowed an intensification of cash crops, due to the combined effect of irrigation, fertilisers and mechanisation (FAO 2005).

The water resources also suffer for a quality degradation caused by various forms of pollution. The discharge of the industrial and domestic wastewater, without preliminary treatment, harms the quality of the rivers; the great concentration of activities in limited areas generates a pollution that exceeds the capacity of self-purification of the aquatic environments. The national monitoring campaign on water quality of in 2000-2001 has recorded a low quality over 45% of freshwaters and over 51% of groundwaters (MATEE 2001).

3. Water policy and regulations

The unequal distribution of water resources in Morocco, both in space and time, has led to the definition of a national strategy based on increasing the water supply. This meant a relevant State intervention by creation of physical infrastructures ensuring the availability of water between the cyclic periods of drought and expanding the farming districts.

The strategy initiated in 1967 by King Hassan II was justified by the economic and social development needs of the post-colonial period in Morocco. A declared target of this policy was “the irrigation of one million of hectares by the 2000” (Ministère des Travaux Publics et des Communications 1973), as a mean to reach food security, intensification of agricultural production, increase of cash crops for external markets, and improved income levels for farmers. Other important objectives were a generalised access to drinking water, supply of water for industrial needs, hydropower generation and mitigation of the effects of drought and flooding events.

The same strategy was confirmed in 1986, with an increased emphasis on physical infrastructures, as expressed by another slogan: “Building of a dam every year until the year 2000”, which accompanied the realization of a hundred of dams throughout the country.

During the same decade an acceleration of dam constructions was seen worldwide, moved by international financial flows by grants and loans. This trend has continued in practice, but from the Nineties a strong criticism started by environmentalist groups and spread to the public opinion.

At the national level, the need to reconvert the water sector policies prepared the ground for the formulation of the Water Law (1995), a fundamental legal framework in line with the principles of sustainable development and of integrated water resource management. The innovative aspect of the law is the creation of the River Basin Agencies (RBAs): decentralised institutions with full authority over water resources at the catchments scale, establishing river basin management plans, and responsible over water supply and distribution, surface water storage and allocation, groundwater pumping, water quality and pollution, flood control and water-related emergencies.

Another innovative aspect of the law is a significant reorganization of water administration. For instance, the General Directorate of Hydraulic, in charge of water development and control, was moved from the Ministry of Public Work to the Ministry of Territorial Management, Water and Environment (MATEE). More relevant is the initiation of a coordination of various stakeholders in the basin. RBAs collaborate with various sector partners, such as Regional Irrigation Water Authorities (ORMVA), the National Authority of Potable Water (ONEP), Province Authorities, Water Users Associations, and also

private sector companies, either national or international. Foreign investment and international expertise are considered as essential inputs to improve the overall performance of the urban water sector (Doukkali 2005), and for this reason, their involvement has been facilitated by various World Bank programmes.

Although the 1995 law formally agrees with the main international principles of Integrated Water Resource Management, and introduces significant innovations in national regulations, still many resistances impede a real shift from the traditional supply-side approach. In fact, the water plans still propose water mobilization by large infrastructures, while the recognised importance of the demand management approach remains in theory. For instance, the improvement of cost-recovery systems is needed to overcome the financial difficulties suffered by water providers. The Sebou Agency only receives fees from the energy sector, while for irrigation, drinking and industrial uses, various difficulties practically impede the application and collection of tariffs (communication to the authors by MATEE functionaries in 2005).

4. The Sebou Basin

The Sebou Basin is one of the nine hydrographic basins in Morocco. Its extension, from the Rif to the Atlantic Ocean is of 40 000 km² approximately (5,6% of the national territory), with a total population of 6,7 millions of inhabitants (22,7% of Morocco), 57% of which living in rural areas. The population is mainly concentrated in the urban centres of Fès, Meknès, Kénitra, Taza, in the agricultural plains of Saïs, Gharb and Mnasra, and to a minor extent, in the forestry and pastoral areas of the Middle Atlas, the Rif and the Prérif.

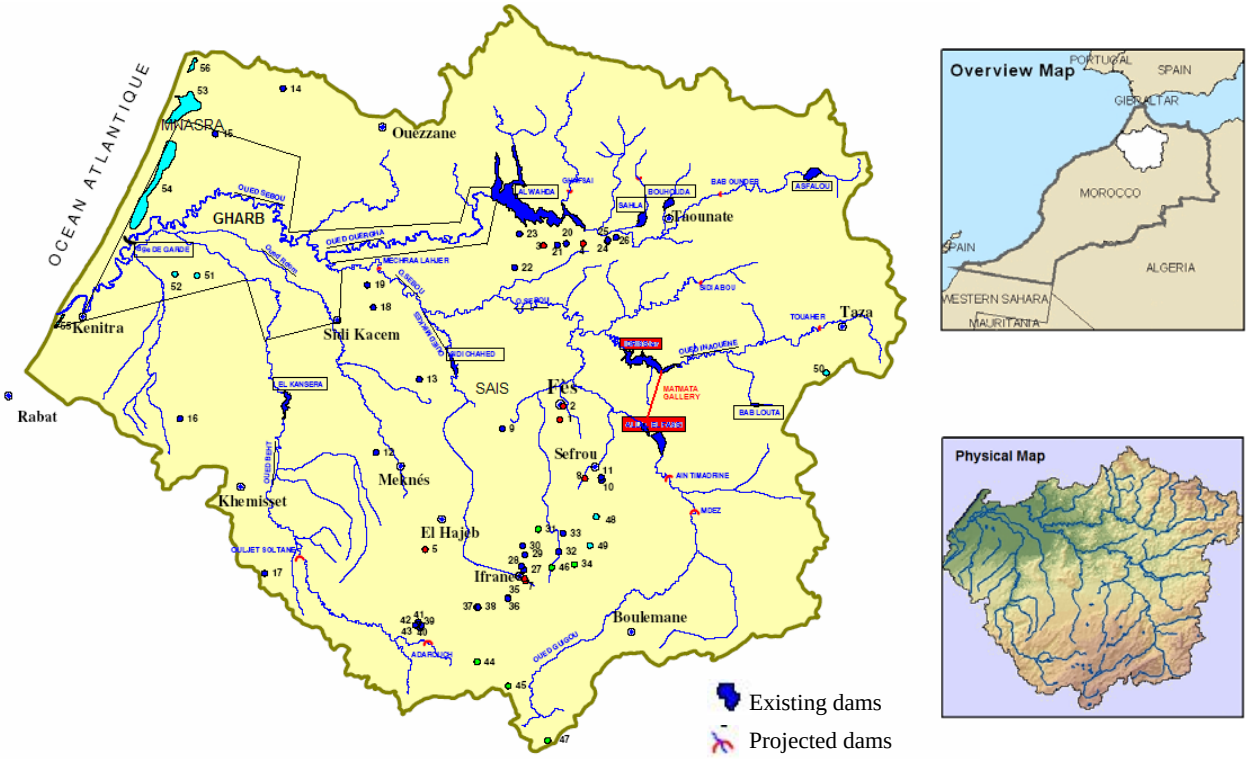

Fig. 1: The Sebou Basin

The Sebou river rises in the Middle Atlas, with the name of Oued Guigou, and flows for about 500 km towards the Atlantic Ocean, after having received various tributaries, among which the main *oueds* are: Ouergha, Inaouène, Lebene, Mikkes, Rdom and Beht. Annual average precipitations vary from 400 mm on the High Sebou and the valleys of the Beht to 1800 mm on the Rif. The course is irregular in space and time; the High Sebou, upstream of Allal Al Fassi Dam, is characterised by a perennial flow, while other tributaries, especially Ouergha and Inaouène, follow a seasonal regime depending on precipitations, with the occurrence of important floods. Despite the high annual evaporation, the Sebou basin is one of the richest in water resources in Morocco, as it amounts to an average of 5,000 Million m^3, corresponding to 28% of the national freshwaters. Groundwaters also contribute to the hydraulic patrimony of the basin and of the country, in terms of 20% of the national assessed quantity, with annual exploitable volume 800 Mm^3. The volume of water utilized nowadays in the Sebou Basin is about 1680 Mm^3, including 1000 Mm^3 from freshwaters and 680 Mm^3 from groundwater sources.
Agriculture is the most important economic activity in the basin and the main water-consuming sector, with annual water supply for irrigation of 1500 Mm^3, including 970 Mm^3 from freshwater (97% of all mobilised freshwaters), and 530 Mm^3 from groundwater. The usable agricultural surface in the region is of 1,880,000 ha (20% of the national potential). The irrigable surface is of 375,000 ha, which 268,800 ha are nowadays irrigated (116,800 from large irrigation schemes and 152,000 Ha from small and medium irrigation schemes) (Agence du Bassin Hydraulique du Sebou 2003)

4.1. Hydraulic infrastructures in the Sebou basin

The development of hydraulic infrastructures for the mobilization and regularization of freshwaters in the Sebou Basin begun in 1935 with El Kansera Dam on the Beht Oued; but the great territorial investments started from the Sixties, when the region was considered by the post-colonial State for its development potential, particularly through an intensive agricultural exploitation. Having considered water as the scarce resource, functional for the national production, the State launched the "Sebou Project" with the support of UNDP and FAO.
Since then, the infrastructural works were intensified, in order to supply drinking water, extend the agricultural space and productions, control floods and provide power generation. The accomplished infrastructures now include 10 large dams (indicated in table 1), 44 small dams (for a total storage capacity of 5,872 Mm^3, for regularization of a total volume of 2970 Mm^3); the Matmata gallery (15 Km) for water transfer; and four hydropower stations. Moreover, thousands of wells have been drilled, to complement the water needs by groundwater sources.

Table 1: Main dams in the Sebou Basin

Dam	Oued	Starting date	Aim*	Surface km^2	Height m	Volume Mm^3	Utilized Mm^3	Irrigable surface ha	Hydropower (GWh/year)
El Kansera	Beht	1935	AEPI, I, P	4500	68	230	200	29.050	30
Idriss 1er	Inaouene	1973	P, I	3330	72	1182	270	72.000	66
Allal El Fassi	Sebou	1990	P, AEPI, T	5400	67	69.6	570	26.000	270
Garde	Sebou	1991	I	27000	17,5	37	0	11.500	-
Sahla	Sahla	1994	I, AEPI	122	54	62	32	2.000	-
Sidi	Mikkes	1996	AEPI,	1010	60	170	50	1.200	-

Chahed			I						
Al Wahda	Ouergha	1996	E, I	6190	88	3714	1740	115.000	400
Bouhouda	Sra	1998	AEPI , I	478	55,5	55.5	20	1.500	-
Asfalou	Asfalou	1999	AEP, I	560	112	317	75	8.300	-
Bab Louta	Bousbaa	1999	AEP	124	55	35	10	-	-

* I: irrigation, P: hydropower, T: transfer, AEP: drinking water, AEPI: drinking and industrial water (DGH 2006)

The Sebou Project is not yet fully accomplished. Fig.1 includes a number of dams to be realised, for a total of 10 small-medium dams and 4 large dams, namely: M'Dez and Aïn Timedrine Dams, upstream the Allal Al Fassi Dam, meant for hydropower production and irrigation in the Gharb plain; a water transfer from Ouergha Oued to the Gharb and Beht Plans, called the G Canal, for irrigation purposes, and the Ouljet Es Soltane Dam for drinking water and irrigation.

4.2. Centres and peripheries, strengths and weaknesses

The Sebou basin presents the features of a *core region* (Reynaud 1988); internally, a non-homogeneous development can be observed. Some areas are in fact reached by new services and their economies have been improved, while others suffer for the negative impacts of new infrastructures, both socially and environmentally.

In particular, the main aim of the project was to collect and rationalise available water resources for the agricultural exploitation of the Gharb Plain, a surface of 616,000 ha between the towns of Kénitra, Sidi Kacem and Souk El Arba. The leading approach was to provide a physical support for the economic and social development of the plain, with industrial equipment and irrigated lands, and to reduce the gap between *archaic* rural areas and *modern* urban centres. Water infrastructures would have protected the Gharb plain from floods and would have regularised water volumes for irrigation uses.

The construction of the Gharb *centrality* is produced by drainage of resources from other areas, supporting an inverse process of territorial marginalisation. In order to assess some impacts of the *dam policy* proposed by the Sebou Project, the Haut Sebou area has been focussed, and particularly the hydraulic complex of Idriss 1er on the Oued Inaouen (Fès Province), Allal Al Fassi Dam and Matmata Gallery (Sefrou Province).

Gharb Plain

The strong investments in the region are visible in the irrigated perimeters of the Gharb plain. The system of dams has created a capacity of 850 Mm^3 of water per year, producing an irrigable potential area of 250,000 ha, although less than 50% is practically equipped by canalisation networks: 107,000 ha within large irrigation schemes and 13,000 ha within small and medium irrigation schemes, which also complement the water volumes by direct connection to springs, wells and oueds. The main products are: rice (100% of the national production), sugar beet (69%) and sugar cane (22%), plus cereals, olive, cotton, vegetables and fodder, which sustain an important livestock (MESOE 2001).

Within the Gharb an intensive industrial activity has also been developed, the main productions being of paper, olive oil (65% of the national production), leather (60%), sugar (50%) and refined oil (3.300 tons); but it must be noticed that the industrial water supply, as well as for drinking water, mainly originates from springs and wells, for 83% of the needs, 150 Mm^3.

Even the Gharb agricultural plain cannot be considered as a primary centre, but only at a secondary level, in relation to the core centralities remaining in the urban poles. From a water point of view, a drainage of resources is seen either internally in the Sebou basin, with a transfer of 650 Mm^3 of water from the High Sebou to the Inaouene, by means of the Matmata gallery, or out of the basin, as 20 Mm^3 a year are transferred for drinking water supply of Salé.

Another point of criticism is related to the reductive vision of the economic and infrastructural strategies, which underestimate and endanger the value the environmental characteristics of the plain. In fact, the Gharb Plain is naturally characterized by the presence of important wetlands. It includes two Ramsar sites: Sidi Bou Ghaba Lake and Merja Zerga, and other wetlands: Merja Halloufa, Merja Bargha and Marais Larache. Although their biodiversity importance is recognised by law, these sites are threatened in practice by a decrease and degradation of the sustained ecosystems, due to the pollution from agricultural run-off, the conversion of marshlands to agricultural fields, the discharge of large volumes of industrial and domestic effluents, and the aggressive extractions of the groundwater table (BirdLife International 2005).
The irrigation is done principally by gravitational system, based on considerations of investment and energy costs, respect to the large availability of manpower. However, the local irrigation system has a low performance, and an average of 50% of water loss is observed at the level of irrigated fields, due to bad maintenance and operational practices, which cause a degradation of canal networks.
A full modernisation of the irrigation farming would need the presence of large fields; but this is one of the most critical problems as only 31% of land is privately owned (*melk*), and only 2% of the *melk* land has a size of more than 50 ha, while 69% are less than 5 ha (MESOE 2001).
From an *allocative efficiency* point of view (Allan 1999), the cultivated crops are water demanding; however bad impacts are also produced by the agro-industrial processes, highly contributing to the river pollution. In fact, the Sebou is the most polluted river of the country; and the contamination is also due by the municipal discharges of Fès, Meknès, Sidi Kacem and Sidi Slimane. More than 50% of the sampling sites present bad - very bad quality, due to organic matter (BOD_5 and COD) and phosphorus.
As for groundwater quality, the average values are good to medium for the three principal aquifer (Fès/Méknès, Maamora and Gharb); but local high concentrations of nitrates (more than 50 mg/l) are assessed in agricultural zones with strong agricultural activity, and high water salinity is assessed in the Gharb coastal section caused by high abstraction rates (MATEE 2006).

Idriss 1er complex
The complex, located in the Haut Sebou, is formed by three infrastructures. The barrage Idriss 1er, built in 1973, with a capacity of 1182 Mm^3 is nowadays the third big dam in Morocco. It provides water for irrigation of an area of 72,300 ha and has a hydropower capacity of 40,6 MW. It also contributes to the flood protection in the Gharb Plain. The second infrastructure is the Allal Al Fassi dam, built in 1990, has a capacity of 69.6 Mm^3, and provides water for drinking and industrial uses to the city of Fès. The third infrastructure is Matmata Gallery, connecting the two basins for 15 km, with flow capacity of 38 m^3/s.
The Idriss 1er complex area has not been targeted by similar development process, as for Gharb. This is primarily due to the morphology of the Medium Atlas, which allows production of water and hydroelectric power, but does not allow a local extensive utilisation of the produced resources, and certainly pose physical constraints to establishment of large irrigation schemes.
For various reasons, the implementation of the Sebou Project has widened the disparities of the Idriss/Matmata area respect to the Gharb and especially to the main cities, particularly Fès.
The need to promote a development also outside the Gharb was reflected in the "Moyen Sebou and Inaouen Aval Project", launched in 1995 and funded by the French cooperation (Caisse Française de Développement). The aim was to collect 90 Mm^3/year of water from the Idriss 1er – Allal Al Fassi complex for the irrigation of 15,000 ha under the Rif, from the dams immediate downstream until the valley entering the Gharb. Besides the infrastructure development, the project wished to support the farmers' incomes by expanding their working activity throughout the year, from 50 to 135 days/ha, thus increasing their incomes from 1,300 Dh year/ha to 12,000 Dh year/ha. The scheme proposed a change

of crop, from a previous prevalence of cereals to a prevalence of fodder, to sustain livestock and milk production; and also of the management system, from a government centralised control, towards a general entrustment to farmers associations, equipped by the donor, and coordinated by farmers federations, deciding rules and quotas for water uses in each sector. The institution of associations would have possibly overcome the constraints to modernisation, originated by the small size of land tenures, as mentioned for Gharb area. Unfortunately, however, the good intentions of the project were stopped by a suspension of the works in 1999, after having accomplished only a first phase. The utilisation of water for irrigation had to face the problem of serious pollution of the Sebou River, after intake of the Oued Fès, highly polluted from industrial sites. This matter has particularly affected the cash crop productions that were directed to international markets, as local productions could not respect certain quality standards for exportations; while the same water is still used for productions devoted to local markets (Ministère de l'Agriculture et de la Mise en Valeur Agricole 1995 and authors' interviews at the Agricultural Province Direction in Fès 2005).

Another technical problem affecting the dams' efficiency is due to the sedimentation, for the strong upstream erosion, particularly from the Rif. The yearly sedimentation rates for Allal Al Fassi is 1,2 Mm^3 and for Idriss 1^{er} of 2,2 Mm^3, which decrease the reservoirs capacities, thus the same water availability for which the embankments were built. From Allal Al Fassi, the government has calculated a decrease of irrigation potential of 128 ha per year in the Gharb Plain, and an economic loss of 1,024,000 Dh per year (Direction régionale des Eaux et forets du Moyen Atlas, 1997).

In terms of flood control, the efficiency of the system cannot be fully appreciated, as the projected complex has not been completed. While the hydraulic effectiveness (parameter expressing the protection capacity) would be increased by 3,5% by activation of the whole complex, the working dams present a ratio of 1,5%. However, it has to be considered that the equipment of wider irrigated surfaces would also expand the risk of large flooding and production of worse economic, social and environmental damages (NADECO/CID, 1985).

In terms of provision of drinking water to the urban centres from the complex, serious deficiencies are still assessed. Fès is supplied by an intake downstream the dam Allal Al Fassi and an adduction feed by the dam Idriss 1^{er}. In 1994, the number of users was 80,909 with a connection rate of 66%; while non-connected people were 251,600, particularly in the medina and the poorest districts. Since then, improvements are seen, however the supply is still deficient. As for downstream areas, the superficial networks of the basin do not necessarily serve the towns, and in fact the city of Kenitra fully depends on the Maamora aquifer.

As for hydropower production, the objectives settled in the original projects have been reached, with a good service during the peak period in winter. There is sufficient power to supply local needs in the Centre-North area (Provinces of Fès, Taounate, Sefrou, Boulmane, Taza in the Sebou Basin), however the local consumption rate is lower than the national average. This allows savings for the Government of Morocco, while at national level the main energy use is based on oil products (68% of the total energy consumption).

As for the environment and the related services for human livelihoods, some impacts need to be observed, like those regarding the ichthyic fauna. The site of dam Idriss 1^{er} is reach in fish, particularly of recently introduced exotic species like the carp and the black bass. The typical species of the Sebou River, the eel (*Anguilla* spp.) and the allice shad (*Alosa alosa*), being migrant species, find physical obstacles to their movements for the barrages; therefore their number is seriously decreased. The allice shad was traditionally a food and revenue source for the local population, and until the Seventies, in the Oued Sebou three co-operatives of fishers were active. Two of them, based in Fès and Had Kourt, closed their activity, while only one in Kenitra is still working, although in crisis. Also the agricultural

and industrial activities, by their polluting effluent, have contributed to the decreased presence of fish (ONEM 1994).

5. Concluding remarks

The proposed analysis has shown that the sustainable development of the Sebou Basin could not be achieved only by a politics of water supply, despite the important efforts paid during the last 40 years, to equip and modernise the region by dams and multipurpose schemes. While an acceleration of engineering projects has been produced by a national "rhetoric of dams", proposing structural targets only limited to supply management and water transfer ("one dam every year until 2000", "irrigation of one million of hectares by the 2000"), no attention was seriously paid to social or environmental issues.
The basin area has various enclaves of poverty, caused by the changes induced by the new infrastructures. An overview of the impacts has defined the following problems: the issue of access to water still remains a serious constraint, particularly in rural areas; water quality is worsened by pollution from agricultural runoff, and from untreated urban and industrial wastewater; irrigation networks are inefficient because of bad maintenance and siltation; excessive water abstractions are not targeted by effective demand management policies and controls over exploitation rates; wetlands are shrinking and endangered by extension of farming lands; change of agricultural and fishing products have impacted the traditional livelihood systems.
The primary goal of the "Sebou Project", to create a fully productive district in the Sebou basin, has also met various barriers, as the new networks and flows could not simply be over imposed on the traditional territorial structures. As an example, though a combined agricultural value and energy self-sufficiency has been produced, a real modernisation of the agricultural sector has not been fully accomplished, because of various reasons, like: a traditional system of land tenure parcelization, contrasting the constitution of large irrigation schemes; an overall limited extension of valleys for the presence of mountains and erosion processes on the slopes, accelerated by the presence of dams and causing sedimentation in reservoirs; inadequacy of cost recovery system by water tariffs. From a technical point of view, the incomplete construction of the designed irrigation schemes have decreased the dams efficiency, as the overall capacity of water stored in the reservoirs is under-utilised.
However, the water policy has produced different results within the Basin, and a process of *polarisation* (Reynaud 1988) has been enhanced. Two areas have been particularly observed: the Gharb Plain, which has been better equipped for agro-industrial development, and can be considered as a central pole within the region; and the Idriss I^{er} complex, from which a water extractive production has been established, mainly for the sake of the Gharb and the urban centres. The water policy of the "Sebou Project" could not be homogeneously applied in the region with the same effectiveness, but has to adapt to the original morphology and territorial characterisation, The socio-economic gaps between the two areas have been widening so far, as the whole development process is based on the functional value of water resources as production means.
In fact, waters are not valued as common goods, nor their functions to sustain ecosystem life and biodiversity are fully recognised. Various wetlands have already been endangered, and the current area protection by law cannot change this trend. This could only be reversed by a protection of water quality and by saving waters upstream – or better, at a catchments scale. The application of IWRM approach has been mainly proposed by international agencies with a top-down approach but is still far from being fully adopted either in Morocco and in most developing countries, which still rely on supply-side policies to face the risk of drought and flooding events, and aim to ensure their national development by water-consuming sectors.

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