



# Under What Management Practices and Mechanisms Water Resource Can Be Considered As a Public Good for Sustainable Development in the Developing Countries?

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## ABSTRACT

In this article, we present two empirical examples of water governance failures and its conflicts from coastal zones of Indus Delta, Pakistan, and Cap Bon, Tunisia. Results reveal that there is lack of secure equilibrium between sustainable, equitable and efficient uses of limited water to serve for economic sectors. While the water in both zones having high importance for economic contribution (irrigation, tourism and industrial use) and landscape attractions (touristic sites). Based on the results obtained from the case studies, we have proposed a new mechanism for water supply, management and conservation, which may be extended to the developing countries. Prospectively, we try to disclose that how this mechanism will ensure water resource sustainability to local communities and to contribute in economic development at national scale. Finally, the need for new modes of governance and institutional arrangements for water management mechanism is highlighted and suggestions for its application are made.

*Keywords:* Water resource; conflict; management; Indus Delta; Cap Bon; developing countries

## 1. INTRODUCTION

Water is not however equally or even equitably distributed to every-one, but the gap between its demand and supply across the regions has increased conflicts in the developing countries. Simultaneously, importance for development of new dams for water reservoirs or for hydro-electric generation and adopting water conservation measures have been highlighted (Scudder, 2005; UNEP, 2004). In reality today millions of people live in a highly water-stressed environment (Lannerstad, 2002), where the major drivers affecting water scenarios are demographic (population growth, migration pressures and urbanization), economic (output, trade, prosperity,

water infrastructure), technological (hi-tech expansion, water efficiency, adoption of new crops, water sanitation investment, desalination and reuse water treatment plants), social (global lifestyle, inequity distribution, tourism), governance (power structure, management mechanism, globalization), environmental (water born diseases, soil salinity, groundwater quality, ecosystem and health) (Gilberto et al., 2000). Therefore, to understand the logics and causality chains which lead to this overexploitation of the of the resources (a phenomenon observed in most of the parts of the world) is essential and must be objective of the empirical and analytical research, in order to condition the eventual interventions in the domain of management and allocation of water resources.

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It is obvious that the attitudes towards water allocation and consumption vary across regions (Courcier et al., 2005). In this regard the equation of sharing common pool resources like water between agriculture and other economic sectors have been discussed in many conventions, but led all communication and coordination ineffective due to; strong competition among different sectors, conflicts of interests, lack of cooperation and lack of effective consultation mechanisms. Such finding is not specific to developing countries as it is observed is a more or less severe over worldwide. Therefore, this article reviews the role of the public authorities in water management practices as well as their impacts on rural development in the developing countries, especially in Pakistan (Indus delta region) and Tunisia (Cap Bon region). Moreover, this research also emphasizes the issues and options particularly focusing on integrated water resource geopolitics (Colombi and Robert, 2003) in the respected case study zones and to propose a new water management mechanism (based on supply, management and conservation) for developing countries. This research can be considered as a microcosmic analysis of water management governance and the results can be extended as a management tool to all similar water basins<sup>1</sup>. Mainly, this research is qualitative in nature and descriptively distributed in various parts; first part is focusing on the methodology adopted for this study, second part gives the actualities of our case studies, third part consist over the recommendations and conclusion.

## 2. METHODOLOGY

To accomplish the objectives of our research we have used two sources (primary and sec-

ondary) of data collection. In order to collect secondary information we have extracted the facts by analyzing various individual and group research reports, published by public and private and/or national and international organizations. In order to develop a discussion on public voices on their needs, rights and justice, as well as the weight age given by public authorities, the additional secondary data have been collected by referring different daily regional press.

In order to avoid biasness and to compare the reliability of secondary data for the development and propositions of a best model on water management mechanism, we have organized field trips in the study zones<sup>2</sup> and collected primary information through personal observations, while discussing with researchers and key persons from various professional backgrounds as well as water users, i.e., farmers, tourists, domestic users, etc, using a semi-structured questionnaire. These interviews were conducted in order to collect public opinion information about the availability and the management of water resources in study areas. Several questions were asked such as; is water resource sufficient; which sectors consume more water; do institutions intervene for better water management, if yes then which and how; and are natural resources and income of end-users have severely been shrank during last five year? All these questions are designed to understand issues, behavior and relationships between water users and the public authorities as well as conflicts of uses and landscape degradation in order to find new management strategies that can resolve these conflicts. Although due to unavailability of databases, differences in political and sociological environment of both the countries we have faced many difficulties, but this joint venture

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<sup>1</sup>River basin is a geographical area containing watersheds, which converging into rivers and terminus to sea or inland water bodies (Molle, 2007).

<sup>2</sup>In this regard we have divided ourselves into two groups colleagues from Tunisia have visited in Cap Bon region during July 2012, and colleagues from Pakistan have visited in Indus Delta region during June and July 2012.

allowed us to better understand both study areas and to identify their main conflicts and water management practices and governance structure.

### **3. CONFLICTS OVER WATER RESOURCE MANAGEMENT IN THE DEVELOPING COUNTRIES: EVIDENCES FROM PAKISTAN AND TUNISIA**

In an economy, water management tools are based mainly on upgrading its infrastructure and management and rationalization of its uses, where its management increasingly requires cooperation/compromise and consensus if solutions to problems are to be formulated and implemented. Thus it is commonly found that conflicts over water resource management emerge when different stakeholders compete for different stakes. Therefore, water decision makers are increasingly called upon to manage people as well as the resource. Therefore, we are trying to Figure out the need, availability, distribution, conflicts and water management in the following case studies (Indus delta and Cap Bon). This will give us the macro picture of prevailing governance structures in the respected basins, which may help to formulate a best water management model.

#### **3.1 The Indus delta: location and description**

The Indus Delta<sup>3</sup> consists of 0.6 million hectares, with 17 major creeks, many minor creeks and fringing mangroves. The Indus Delta is a typical fan-shaped delta which was made up by the discharge of large quantities of silt washed down from upland and mountain areas of Indus basin (see Figure 1). The mangrove ecosystem of the Indus Delta is

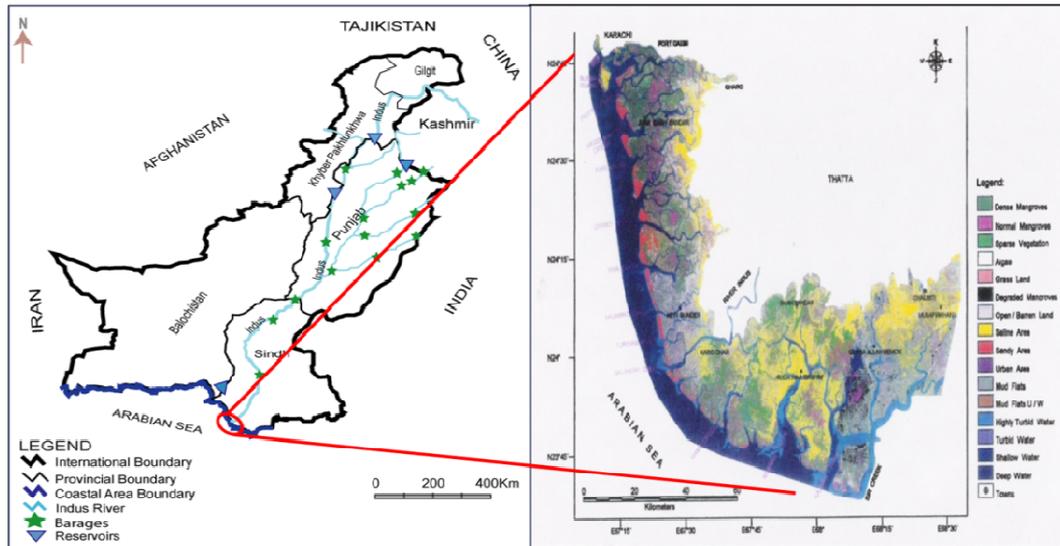
perhaps unique in being the largest area of arid climate mangroves in the world (IUCN, 2003). The man-made changes in the Indus River system have most adversely affected the Indus Delta. The critical degradation of the delta has been recognized by most of the studies but there is still no advancement to fulfill environmental required flow. The Indus delta nowadays is facing severe environmental, social and economic crisis due to upstream irrigation development (Memon, 2004; Rajput, 2006).

The major economic activity of the Indus delta indigenous communities has been fishing, followed by agriculture and livestock herding (Baxamoosa, 2007). Indus delta was recognized as rich in fisheries, abundant in agriculture and attractive point of tourism, but nowadays facing environmental degradation and devastation of the lives and livelihoods. The lives of the local people went from a subsistence living to a sub-human existence (Atif, 2012).

Before the dam and barrage constructions in upstream, people had an abundance of drinking water, but today they have to pay exorbitant rates to purchase a gallon of water that is even remotely potable. Behind descriptions of the causes and consequences of the degradation of the Indus delta laid profound governance and institutional failures at all levels: in terms of water miss-management, inappropriate resource allocation practices, lack of law enforcement legislation, corruption, inequalities, violation of rights and entitlements. Although a minimum escape of freshwater to sea has been recommended by the environmental protection agencies about 27 million acre feet (MAF) to sustain the ecology and ecosystem of the delta, but the recommended amount of water has not been released constantly to downstream (IUCN, 2003).

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<sup>3</sup>Delta is a "flat area of alluvium formed at the mouth of some rivers where the main stream divides into several distributaries before reaching a sea of lake." Alluvium refers to the area that is created as a result of the build-up of sediments that are transported by a river and deposited on its bed and floodplain.



**Figure 1** Location map of the Indus delta, Pakistan

### 3.1.1 Indus water distribution, management and governance

The Indus river system in the country, creating world's largest contiguous man made system of 61,000 km of canals and 105,000 water courses, which irrigating about 35 million acres of land (WAPDA, 2008). The Indus River and its tributaries lie in the north of Punjab province, which flow throughout the country by feeding numerous reservoirs and irrigation channels until to southern province of Sindh (Baxamoosa, 2007) up-to meet the Arabian Sea (see Figure 1). Sindh (highly dependent on Indus water) has controversy on water distribution. According to the water accord (1991), Sindh has to be allocated at least 48 MAF for both the dry season (Kharif) and rainy seasons (Rabi) but the province is receiving much more less share (IUCN, 2007), which is due to water diversion to dams/reservoirs at upstream to control the flow of water. This has not only created an agricultural and social tension in the province, but has also politicized the issue to a great extent (Rinaudo, 2001). Access to and control of water, depends primarily on the available technology and engineering feats, such as river diversion structures, canals and dams. As

growing human pressure on water resources brings actual water use closer to potential ceilings, societies usually respond by adopting conservation measures and by reallocating water towards more beneficial uses (Molle, 2003).

The management and distribution of the Indus water is a highly volatile issue between the four provinces of the Pakistan. This all has created opposition towards building of dams or reservoirs at upstream to control the flow of water. Sindh, being at the tail-end of the Indus, anticipates that these disputes will lead to even more limited supplies of water. There is an atmosphere of resentment among people of the province who is trying to avert an environmental catastrophe due to the ever-diminishing share of natural resources.

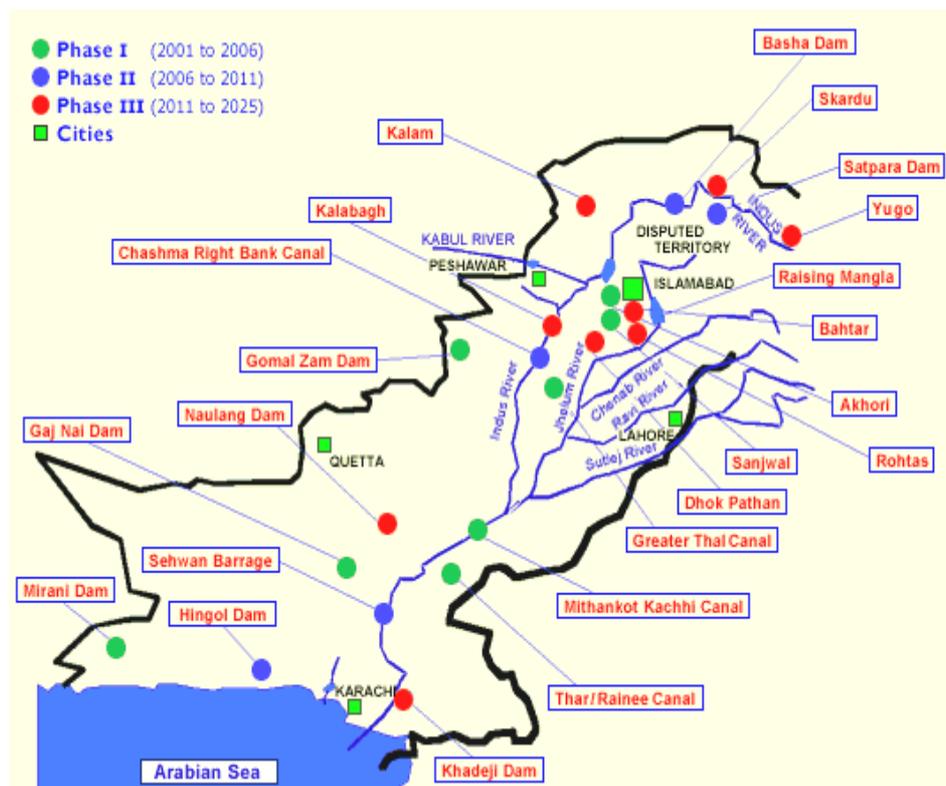
The water resource in Pakistan is under great pressure, where its availability is not enough in the system to entertain the luxury of so many projects on the Indus River system. Because of irregular Indus flow, priority is given to drinking water for the human being and animals, followed by agriculture and industry, while its other considerable uses including hydropower, tourism generation and environmental protection (Government of Pakistan, 2012). In order to overcome this

water shortage the country has envisaged a Vision-2025 and planned numerous projects for construction without appropriate consultation of Sindh (lower stream and home of delta) (see Figure 2). If the Vision-2025 is implemented as it is planned, the water will no more be available in the Indus delta (Kazi, 2004). According to the experts that this vision will create an imminent ecological disaster in the lower Indus basin that would eventually create a famine situation in the province, rather to prosperity.

According to Magsi and Atif (2012), in Pakistan the water bureaucracy is still acting as builder but not as manager. There are a number of organizations and agriculture departments on federal and provincial levels which are responsible for water management. Thus a huge pile of Laws have been passed but their implementation is still ineffective due to lack cooperation and confidence among those organizations.

### 3.1.2 Conflicts: economic, social and environmental

Since the Sindh province is home of delta, which depends on freshwater, because without freshwater there would be no delta, and no livelihoods to indigenous communities. The negative impacts of large dams have generally faced by those who lived at the tail-end of the downstream riparian (Scudder, 2005). According to regional press, the cost of development (infrastructure like dams, barrages, reservoirs, canals, etc) is paid by the people of the delta in terms of the destruction of their resources and livelihoods in the country". This development has reduced annual flow of water discharge to sea (see table 1), which has perpetuated confrontations. It is this crisis that forms the investigations and the crux of this study.



**Figure 2** Water sector projects: Vision-2025

**Table 1** Reduced water flow in to the sea due to construction on Indus River

Period	Discharge to sea (MAF)	Reduction in flow of base period (%)	Main constructions	Silt load (million tons)
1940-54	84.7	–	Sukkur barrage (1932) Kalabagh barrage (1955) Kotri barrage (1955) Marala barrage (1956) Taunsa barrage (1958)	225.0
1955-76	79.9	5.66	Guddu buarrage (1962) Warsak dam (1965) Mangla dam (1967) Chashma barrage (1971) Tarbela dam (1976)	
1977-92	46.0	45.7		100.0
1992-present	10.0	88.19	Chotiari water reservoir (2003)	30.0

Source: Baxamoosa, (2007)

During field visits the indigenous communities from delta express their view that before construction of dams they used to throw a net into the sea near delta and catch three months worth; but today fishermen go-out to sea for days and return with nothing. By adding they said that before the restriction of flow to delta they lived comfortable and content lives, with their livestock and agriculture, while now they do not even know where their next meal will come from. Therefore, the absolute existence of these local communities is threatened every single day by seawater intrusion and tidal creeping from the Arabian Sea (Atif, 2012; Baxamoosa, 2007).

When the flow of the river was not yet restricted, the soil of delta region was rich and fertile. This is because the flow of the river was large enough to push back the sea currents. The river also brought with it large amounts of silt deposits into the delta which made the Indus delta an optimum place for agriculture. Red rice was main agricultural commodity produced in this area, which was of a high quality and was exported to many neighboring countries. Besides that people used to cultivate different kinds of fruit and

vegetables, as well as they kept livestock along the delta pasturelands. Those local communities used to earn their livelihoods by fishing and boating entertainments to the tourists as well as from timber trading and firewood supplying from mangroves forests of the delta. As the shortage of water is witnessed the economy of this area has been tremendously declined. For example, rise in unemployment, migration to other areas, reduction in agriculture and tourism, costal ecosystem damages, rise in crime/bribes and other social conflicts. Due to the water shortage, the drinking water supplies have dwindled and degraded in quality in delta region, which became the source of water born disease like; kidney, stomach, intestine, eyes and skin diseases.

The delta region was characterized as wetlands which are hosting many species of birds, flora, and fauna with wildlife (Kazi, 2004), where economic and aesthetic benefits drawn from these wetlands are being lost due the mismanagement of Indus water distribution. The reduction in the discharge of freshwater to the Indus delta has precipitated the destruction of mangroves (Amjad et al.,

2007). The mangroves (trees) grow in brackish water and need an estuarine environment to thrive. The mangroves in the Indus delta were categorized as sixth largest in the world, and known as an important flyover for migratory birds, livelihood of millions of directly and indirectly dependent indigenous people. The mangrove area has significantly reduced from 263000 hectares in 1977, 158500 hectares in 1991 and 73000 hectares in 2000 (ADB, 2005; Memon, 2004). The Indus delta mangroves are considered a major breeding area for shrimps and crabs. In 1989 about 242000 tons of fish (worth US \$ 26 million) was exported from Pakistan (netted from Indus delta), but now it has been reduced as 92 percent (Baxamoosa, 2007; SAP, 2001). Whereas, decrease in flow of freshwater has changed the optimum environmental conditions for mangroves the delta.

Through reduction in freshwater flows in the Indus has increased seawater intrusion and accelerated the erosion of the coastline (Inam et al., 2007). Recent studies witnessed that seawater has encroached about 100 km in the coastal areas of Thatta and Badin districts damaging about 0.5 million hectares in both districts (Amjad et al., 2007; IUCN, 2007) (see table 2). The seawater in Thatta and Badin districts has dislocated a quarter million people (Kazi, 2004), and has already inflicted financial losses over US \$ 2 billion (SAP, 2001).

### 3.2 The Cap Bon: location and description

The Cap Bon (see Figure 3) is characterized by its intense agricultural activities, specific landscape, climate and culture; which attract large industrial and tourist activities. Therefore, all those economic activities are grounded on water resource. Thus water resources of Cap Bon derived primarily from groundwater (180 thousand m<sup>3</sup>/year), especially on the eastern flank of Jebel Abderrahman (60 per-

cent of total) and in the plains of Grombalia (20 percent of potential), while the rest is contributed from El Haouaria where most important watersheds are located from south west to north east, i.e., Mornaguia, Laabid, Zogag and Mgaiz valleys respectively (APAL, 2003). However, groundwater cannot cope with the rapid increase in demand: in agriculture, tourism and industrial sectors (Gafsi and Ben-Haj, 2009). No doubt those sectors having their economic importance, but they are also large water consumers, that is why the existing water reserves are reaching their limits.

Therefore, management and allocation of water resources between agriculture, industry, tourism and domestic use, constitutes a prior issue for sustainable development in the region. Giving importance to this issue, several studies were conducted on water management in Cap Bon region (Benalaya et al., 2009; Gaaloul, 2008; Gafsi and Ben-Haj, 2009; Ghariani, 2005; Zghibi, 2007), but the issues of inadequacy, poor water distribution, weak operational approaches, wastage of water and its pollution are still prevailing around the region. This is may be due to lack of best model proposition or lack of good governance. Therefore, we aim to explore different sources of water in Cap Bon, focusing on multiple uses and their conflicts as well as to explore new forms of governance to be carried out on the path of integrated water resources management mechanism.

#### 3.2.1 Water scarcity and conflicts

In order to provide a best answer to this question that “is Cap Bon capable of meeting the water needs of its various productive sectors in long term?”, several studies have been carried out on different areas of Cap Bon like; on Grombalia Plain, Kélibia and Beni Khair (Zghibi, Tarhouni and Gaaloul, 2009); lagoons Maamoura, Tazarka and Korba (Bac-

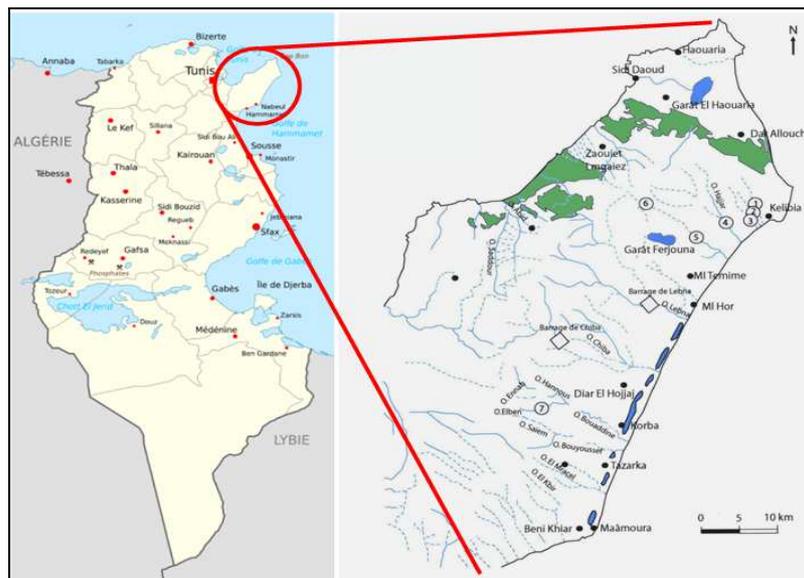
car, Moussa and Ben-Hamza, 2001) and on Lebna Kamech (Omere, 2010). The researchers tried to provide methods of integrated water management, but seemed inefficient either due to institutional failure or the durability of the proposed models. In order to meet increasing demand of water by different economic sectors (agriculture, tourism, industry as well as domestic use) the state has built dozen of dams, water reservoirs and also implemented an infiltration system to reuse wastewater, but all seemed to reaching their limits, and seemed in efficiently distribute the water among different sectors.

In order to attempt to establish a dialogue process on the situation of water allocation in Cap Bon, the field visits have been conducted on the eastern coast between Kélibia and Beni Khiair, which is about 45 kilometers long strip (see Figure 4). In this strip, despite of numerous wadis (wadis Bouleddine, Libnah, Chiba, Abidis, El K'bhir and El H'jarr), the lack of water has been justified. On one hand we have observed that in some areas local population were engaged with the use of shallow groundwater (wells)<sup>4</sup> to meet their minimum needs. On the other hands some farmers were using extra water and flowing the effluents to sea (Zghibi et al., 2009).

**Table 2** Land degradation due to seawater intrusion in various districts of Indus delta region

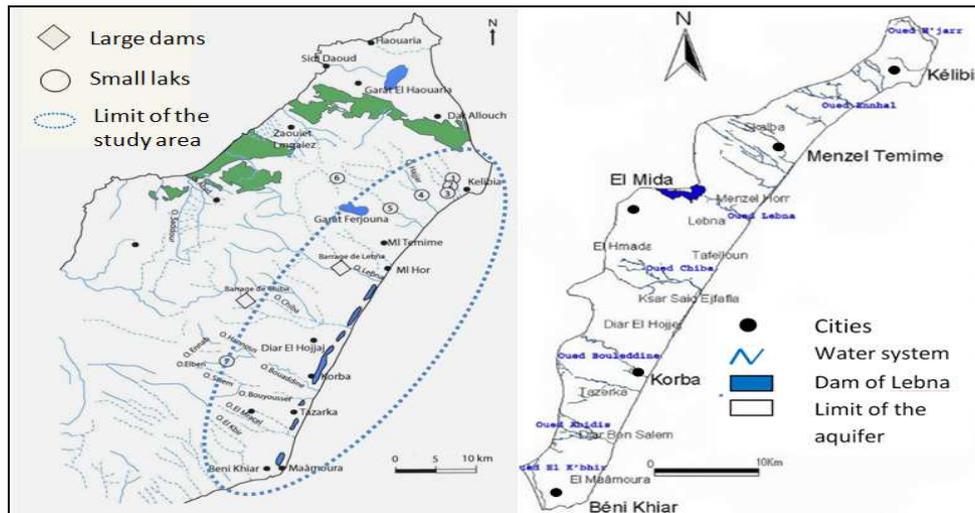
Districts	Talukas	Total area (ha)	Affected area (ha)	Percentage of affected area
Thatta	Shah Bandar	297707	240995	80.95
	Ghorahari	94686	12853	13.57
	Karochoan	192902	48091	24.93
	Mirpur sakro	300629	24560	8.17
	Jaati	357215	191480	53.60
	Keti Bandar	81467	46514	57.10
Badin	Golarchi	179798	12500	6.95
	Badin	143951	20073	13.94
Total		1648355	597066	36.22

Source: IUCN, 2007

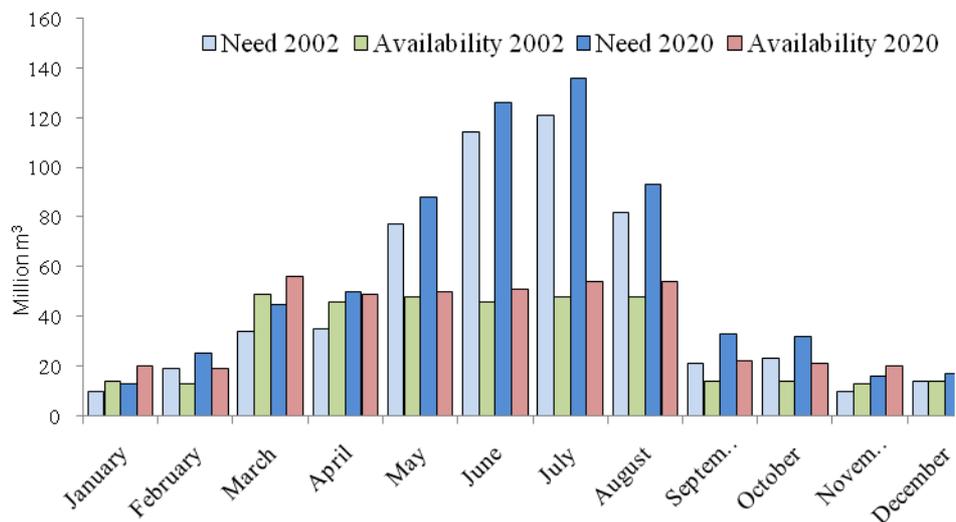


**Figure 3** Location map of Cap Bon

<sup>4</sup>Therefore, there were about 22 wells, 13 used for agriculture, 6 for domestic use and only 3 wells were found in industrial use (Zghibi et al., 2009).



**Figure 4** Hydro-geographical location of the eastern coast of Cap Bon



**Figure 5** Need and availability of water by the year 2002 to 2020 in Cap Bon

In the above region, agricultural is recognized predominant part in its economy. It is the largest water consumer, which consumes about 80 percent of water resource. Due to rapid population growth in the country the farm business owners are engaged to increase their farm production in order to ensure food sustainability. Therefore, it is supposed that agriculture might require a lot of water in future. The pace of increasing farm productivity, water shortage and unawareness among farmers, some farmers used to feed their crops with different sources (effluents, sewage, well water, and saline water, etc.), which are some-

times full of hazards and generalized chemicals, causes reduction in yields and damages the fertility of their lands. May be it is because of this the use of chemical fertilizers per hectare has increased four times more than it was used in 1960s (Ghariani, 2005).

During discussing with researchers on the water conflicts, some of them pointed that due to irregularities of fresh water the farmers in Cap Bon are feeding their citrus farms with brackish water, which has seriously threatened this industry. In facts this citrus forest has always been at the forefront in agriculture and is still the source of income for thousands

of families (Sethom, 1977); but the public authorities are seemed no more active to preserve this industry (Hammami, 2010). Beside the agriculture, the tourism sector is being focused by public authorities for regional development in Cap Bon. This sector consumes less water than agriculture but every year it needs extra 30 percent of water to satisfy needs of tourists (Gafsi and Ben-Haj, 2009). While there is no proper study regarding the opportunity cost of this sector in terms of other sectors has been conducted, in order to justify the use of water resource to ensure economic viability in long terms.

However, water is largely being consumes for domestic use also but still lower then tourism and irrigation; According to the latest statistics, over past year, the consumption of water for domestic use has been increased about 6 percent (Gafsi and Ben-Haj, 2009). It is also estimated that the population of the city of Hammamet (largest tourist destination in Cap Bon), will reach about almost double in 2020, which need basic amenities including water almost double or may be more. Obviously it will leave reduced area of irrigated farmland and might leave a question mark on food sustainability.

This increasing demand of water shows that the Cap Bon will significantly face a huge water crises in near future (see Figure 5), if suitable management practices have not been followed. This lake of management practices poses the problem at the national level for the optimal allocation of this scarce resource (Gafsi and Ben-Haj, 2009). In this regard the main questions might be faced by concerned institutions are: what activities needed to ensure the sufficient water supply to each sector; may give priority to economic efficient sectors; or how bear the cost of desalination treatment processes?

### 3.2.2 Governance: management practices and strategies

Given relatively high vulnerability of water resources in Tunisia and especially at the eastern edge of Cap Bon, several water management policies and strategies have been implemented. Whereas main national policies run after the key points like; to reserve access volume in rainy season for dry season, to treat waste water for reuse, to protect water against pollution and overexploitation, to monitor the quality of water etc. This all seems unfruitful, may be because the political system for water management changes over time. At current, besides the ministry of agriculture and the ministry of environment, the government has emerged young institution named national water committee supposed to work jointly. Therefore, autonomous public companies are responsible for provision of drinking water (SONEDE), operating channel (SEC-ADENORD), which works under ministry of agriculture, where organization responsible for the management and operation of wastewater (ONAS) which works also under ministry of environment (Treyler, 2000). In 1989, the office of agricultural development has been established, which is the example of decentralization. The current policy is oriented towards more involvement of end-users under an umbrella of the association for collective interests (AIC) over the issues of rural drinking water supply, irrigation and groundwater overexploitation. These AICs were supervised by the National Committee on Water (Al-Atiri, 2006; Romagny and Cudennec, 2006; Treyler, 2000).

Among water distribution and management, like the Pakistan, the drinking water is designated as a priority, particularly for the purpose of equity between rural areas, to ensure basic amenities in Tunisia. In this regard three strategies have been implemented. First strategy was ten-year plan to mobilize water resources (1990-2000). This plan was developed and implemented to provide integrated control of potential water sources and to in-

crease water storage and supply, which has not been successfully achieved. The second strategy is complementary strategy (2001-2011). This strategy attempts to achieve long-term goals to ensure sustainable balance of demand from available water to be collected from dry and wet seasons. This plan was also extended over soil conservation from salinity as well as aquifer recharges, but the plan has not significantly met its objectives. The third strategy is the long-term strategy (2030), which mainly relies on water management plans, aims to ensure the sustainable management of water resource in long term (Al-Atiri, 2006; Treyer, 2000).

#### **4. DISCUSSION AND RECOMMENDATION**

In this section of the article we go through a comparative discussion of both case studies and come-up with a proposed model for water governance and its sustainability.

##### **4.1 Comparative analyses**

As we see from our case studies, we notice that socioeconomic, political, environmental characteristics and the climatic conditions are quite different, but in both countries, agriculture is the main water consumer (80 percent in Tunisia and more than 80 percent in Pakistan). Moreover, we find differences in the other sectors regarding their governance system and strategies, e.g., in Pakistan, industrial sector is second largest water consumer, after domestic and tourism sector; for Tunisia, we find that tourism sector is second largest water consumer, followed by industrial sector and domestic uses. In Tunisia, tourism and industrial sectors are considered as a major focus of development policy and land use planning. Those two sectors are reaffirmed as major activities, for which water use should not be limited. It is for this reason that man-

agement strategies aimed at rationalizing the use of natural resources especially the agriculture which consumes a lot of water. On the other hand, in the Pakistan, despite of existence of numerous natural and ecological potential, we find that there is no proper policy and strategy to encourage the tourism sector. Unfortunately, the development of dams in upper stream led negative impacts on ecosystem especially degradation of mangroves, depletion of fish stock and decline in agriculture because, which is reflecting inefficient governance and mismanagement of the resource. As results, majority of the population move to other areas and even changed their lifestyle, since the degradation of delta has began.

In Tunisia, during survey the majority of farmers have recognized that they are suffering from sufficient potable water especially people resided between lagoon and urban surroundings, which has lowered economic earning of local population, because unavailability of sufficient water discourage tourists to rent the loges. A local person has reported that there is a failure in storage system that was designed to ensure water supply from shallow wells. The state interventions (establishment of protection perimeter, groundwater recharge, financial incentives...) failed to solve the problem of farmers who complain about pollution (discharge of sewage in the lagoon), the position of adjacent lagoons and of persons who are operating in these areas without ownership certificate. This lack of information, dialogue and communication between farmers and the government led to the creation of many conflicts that have prevented the sustainable management of water resource. Therefore, both countries suffer from weak governance. Since 1970s in Tunisian government has opted policy of major hydraulic works aiming to store maximum water by building dams and distribute water from north of the country to deficit areas and to achieve a

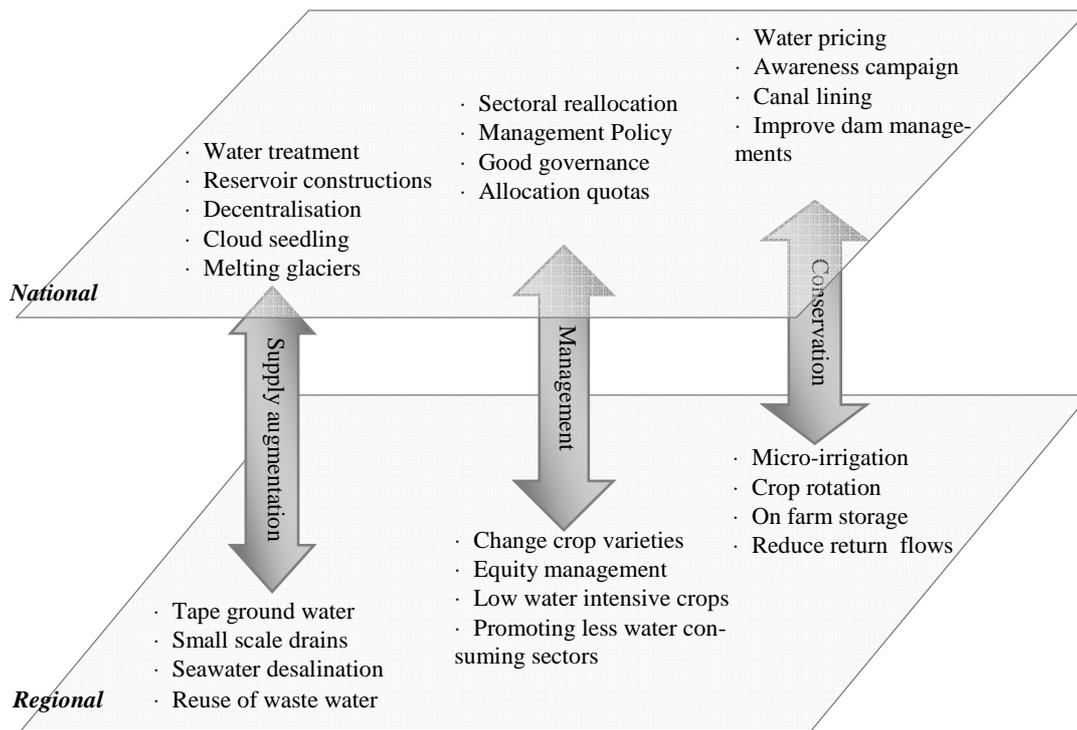
real interconnection at the national level. However, this policy has many shortcomings, e.g., state had acted for more than two decades without participation and aspirations of benefits. This has led to many failures in the management and use of water and its recycling (waste of large amount of water) as well as lower participatory management (due to low levels of education, lack of awareness of technical aspects...) causes opposition of these development projects (Al-Atiri, 2006).

On the other hands, Indus delta the economic contribution and landscape attractions are being suffered from current water supply management practices. Thus in general, water shortage is affecting economic activities and in particular bellow recommended escape has allowed seawater intrusion. Therefore it is recommended that in case of Pakistan any further upstream development of storage (water reservoir) must be preceded by a full economic and environmental assessment, otherwise the country will suffer from manmade draught like situations. In parallel, we find the biodiversity in the region is at risk as biotic potential of many species is starting to be diminished and many of them may be lost forever. Similarly in the Cap Bon, due to management failure the local population is using brackish water to their farm lands; resultantly the regional soil is becoming more saline. That is why literature suggests the Tunisian policy makers that if the management and planning authorities failed to augment the water supply, they have to bring a large quantity of water from northern regions to overcome the regional deficit (Chaibi et al., 2004), and this may not be economical. However, other water consuming sectors like tourisms should be promoted along with the coasts of Cap Bon and Indus delta. In general the coastal zones with contemporary and patrimonial landscapes might not only generate employment opportunities, but also contribute in national economy. Through this comparative analysis,

we find that poor management is closely related to the conflicts between local population and public authorities. These conflicts are result of lack of dialogues, awareness and information before implementation of any infrastructural project (Magsi and Torre, 2013).

#### **4.2 Recommendations for sustainable management**

It is highly recommended that the public authorities needed to reformulate their governance structure at regional to national scales as well as to make aware the local population about economic viability of the region with all economic activities. In this regard the pursuit of a single strategy might be difficult due to the increase in capital costs, competition between water users and worsening environmental problems. Thus, pursuing the mobilization of available water resource (not only in the case study zones but also in the developing countries which are facing similar fates), we have formulated a new management strategy, which comprised on three key pillars: supply augmentation, management and conservation of the water resource (see Figure 6). This model has extremely analytical tools for water management. It can help policy designers in their decision support capabilities how to maintain economic development while avoiding the conflict of water use and to meet the increasing demands as well as it can also help to value this liquid resource at farm-gate level. It is also proposed that to aware farmers for on-farm small scale water storages, which might be helpful during draught seasons. Additionally, for long term solutions of water conflicts, it is suggested that to motivate indigenous population for crop rotations from high to low water intense crops and to considerable reuse of sewerage water for farm irrigation, urban green spaces and tourist units (Gafsi and Ben-Haj, 2009), where government has to provide extension services, in



**Figure 6** Water management mechanism

order to avoid negative impacts of wastewater on the health of farm households (Alebel et al., 2011).

The water resource has high importance in terms of economic contribution, environmental protection and landscape management, where its value can be determined from its scarcity (Fisher and Huber-Lee, 2005; Nardelli et al., 2011; Qiuqiong et al., 2010; Scudder, 2005). The demand for water resource management is then a principal axis of the water policy in the future to control consumption in various sectors, especially the agriculture, a major water consumer, and delay as long as possible due to the use of non-conventional water resources (treatment of desalinated and wastewater). The preservation and sustainability of water infrastructures are now a primary concern in the developing countries (Fisher and Huber-Lee, 2005). Such countries have initiated the services based on public-private partnership in association with the World Bank to implement a delegated management of water resource at large-scale.

However, their efforts on supply management are reaching limits both physically and economically, as we see from our case studies from Pakistan and Tunisia. Although both the economies have different water management practices and mechanisms for their precious natural resource, but are similarly lumping along the pace of development with governance failures.

## CONCLUSIONS

In developing countries like Pakistan and Tunisia, the conservation of water resource and environment has become a major concern in recent years. However, their efforts to manage water supplies have reached limits in terms of quality (environmental degradation, landscape disfigurement, pollution, etc.) and quantity (improper uses and distribution between different economic sectors). Although for both the countries many strategies for water management have been developed, but there are still many failures in their governance

system (role of institutions in water sustainable management), which are hindering to formulate those strategies properly. Through this system, we advocate for decentralized resource management by associated water users with autonomy, financial and technical responsibility. Through the examples of Tunisia and Pakistan, we have seen that these conditions are far from being met. We must think about setting up a more effective policy framework, a more organized social and political climate and more favorable economic conditions for water supply and management in a sustainable manner, as we have suggested in our model (see Figure 6). The implementation of economic and environmental assessment is policy concern issue and will require a framework of integrated water management in which future development will have to consider the environment as stakeholder and it should be key factor during key strategy decision and actions. In this regard a strong geopolitical force for implementation of the new water management practices may bring back the livelihood of the indigenous population in the similar parts of Pakistan and Tunisia.

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## REFERENCES

- Al-Atiri, R. (2006). *Evolution institutionnelle et réglementaire de la gestion de l'eau en Tunisie Vers une participation accrue des usagers de l'eau*. ACT of Seminar Wademed, Cahors, France, 6-7 November, Cirad, Montpellier, France
- Alebel, B.W., Boelee, E., Drechsel, P. and Dabbert, S. (2011). Wastewater use in crop production in peri-urban areas of Addis Ababa: impacts on health in farm households. *Environment and Development Economics*, 16(01), 25-49.
- Amjad, A.S., Kasawani, I. and Kamaruzaman, J. (2007). Degradation of Indus Delta Mangroves in Pakistan. *International Journal of Geology*, 3(1), 27-34.
- APAL. (2003). *Plan de gestion des sites d'Oued Laâbid et de Dar Chichou, Analyse des potentialités et des contraintes et proposition de scénarios de gestion*. GOIDD report February 2003, pp. 26.
- Atif, S. (2012). *The Lower Indus Basin: An anthropogenically modified system under the influence of extreme events*. PhD. Thesis department of geography, Université Paris 7, Diderot, France.
- Baccar, L., Moussa, M. and Ben-Hamza, C. (2001). *Conservation des Zones Humides Littorales et des Ecosystèmes côtiers du Cap-Bon*. Hydraulic report on wetlands of Maamoura Tazarka and Korba, Ministry of environmental and territorial planning, Tunisia, pp. 62.
- Baxamoosa, S. (2007). *Where the river runs dry: an analysis of the Ecological and socio-economic Impacts of Large Dams on the Indus Delta*. Senior Thesis, School of Social Sciences, Hampshire College, US, pp 27.
- Benalaya, A., Chkirbene, A., Jallali, S., Harbaoui, K. and Tarhouni, J. (2009). *Evaluation de la qualité des eaux de la nappe de la côte orientale du Cap Bon en Tunisie*. International symposium on sustainable agriculture in Mediterranean regions (AGDUMED), 14-16, Mai 2009, Rabat, Marrakesh.
- Bied-Charreton, M., Petit, O., Makkaoui, R., Requier-Desjardins, M. (2004). *La gouvernance des ressources en eau dans les pays en développement*. Université de Versailles St-Quentin-en-Yvelines, Cahiers du C3ED n° 04-01.
- Chaibi, T., Chenini, F., Epp, C. and Tondi, G. (2004). *Une approche intégrée pour la gestion durable des ressources en eau dans le bassin*

- méditerranéen. Available at <http://www.franco-phonie-durable.org/documents/colloque-ouaga-a3-chaibi.pdf> (Accessed on 16 September, 2012).
- Colombi, S.B. and Robert, W.B. (2003). Geopolitics, water and development in South Asia: cooperative development in the Ganges-Brahmaputra delta. *The Geographical Journal*, 169(1), 43-64.
- Courcier, R., Venot, J.P. and Molle, F. (2005). *Historical Transformations of the Lower Jordan River Basin (in Jordan): Changes in Water Use and Projections (1950–2025)*. Comprehensive Assessment of Water Management in Agriculture, Research Report No.9, pp. 29-32.
- Fisher, F.M. and Huber-Lee, A. (2005). *Liquid Assets: An economic approach for Water Management and Conflict Resolution in the Middle East and Beyond*. RFF Press, Washington, USA, pp. 19.
- Gafsi, H. and Ben-Haj, S. (2009). *Destinations-Développement de stratégies pour un tourisme durable dans les nations méditerranéennes*. Diagnostic Report Project destination European Commission, pp.18.
- Ghariani, F. (2005). *CAR/PAP: Gestion des zones côtières en Tunisie*. Centre d'Activités Régionales pour le Programme d'Actions Prioritaires, Split, p.13, 16.
- Government of Pakistan. (2012). *Economic Survey of Pakistan 2011-12*. Economic advisory wing, Ministry of finance, Islamabad.
- Hammami, S. (2010). *Territoires de projets et agriculture multifonctionnelle sur le littoral Tunisien, le cas de la façade orientale du Cap Bon*. PhD thesis of agronomy, Institut Supérieur Agronomique de Chott-Mériem. Sousse, Tunisia.
- Inam, A., Clift, P., Giosan, L., Tabrez, A., Tahir, A., Rabbani, M. and Danish M. (2007). The geographic, geological and oceanographic setting of the Indus River. In Gupta, A.J.(eds.) *Large rivers: geomorphology and management*, Wiley & Sons Ltd.
- IUCN. (2007). *Sindh Strategy for Sustainable Development*. Planning and Development department Government of Pakistan, Islamabad.
- Kazi, A.M. (2004). *Overview of Water Resources in Pakistan*. National Seminar, University of Sindh, 15-16 January 2004, Jamshoro, Pakistan.
- Lannerstad, M. (2002). *Consumptive Water Use Feeds the World and Makes Rivers Run Dry*. M.Sc. Thesis, Royal Institute of Technology (KTH), Stockholm, Sweden.
- Magsi, H. and Atif, S. (2012). Water Management, Impacts and Conflicts: Case of Indus water distribution in Sindh, Pakistan. *International Journal of Rural Studies*, 19(2), 3-7.
- Magsi, H. and Torre, A. (2013). Approaches to understand land use conflicts in the developing countries. *The Macrotheme Review*, 2(1), 119-136.
- Mekki, H. (2006). *État, défis majeurs et axes stratégiques du secteur de l'eau en Tunisie*. Ministry of Agriculture and Environment, Tunisia.
- Memon, A.A. (2004). *Evaluation of Impacts on the Lower Indus River Basin Due to Upstream Water Storage and Diversion*. WWER Congress, 27 June–July 1 2004, Salt Lake City, Utah.
- Molle, F. (2003). *Development trajectories of river basins: A conceptual Framework*. Research report, No.72, International water management institute, Sri Lanka.
- Mustafa, D. (2001). Colonial law, contemporary water issues in Pakistan. *Journal of Political Geography*, 20(7), 817-837.
- Nardelli, P., Battistoni, E.M., Eusebi, A.L. and Battistoni, P. (2011). Best Management Practices in Wastewater Treatment in Italian Country: the Territorial Approach of the Autonomous Province of Trento. *Journal of Water Sustainability*, 1(1), 23-32.
- OMERE. (2010). *Le dispositif d'observation sur le bassin versant de Kamech, Cap Bon, Tunisie*. [http://www.umr-lisah.fr/omere/download.php? f=2010\\_11 KAMECH](http://www.umr-lisah.fr/omere/download.php?f=2010_11_KAMECH) (Accessed on 25 August 2012).

- Polgreen, L. and Sabrina, T. (2010). *Water Dispute Increases India-Pakistan Tension*. The New York Times, published on 20 July 2010 (accessed on 10 May 2011).
- Qiuqiong, H., Rozelle, S., Howitt, R., Wang, J. and Huang, J. (2010). Irrigation water demand and implications for water pricing policy in rural China. *Environment and Development Economics*, 15(3), 293-319.
- Rajput, M.I. (2006). *Managing Shared Water Resources in Pakistan and South Asia*. SPRIDER Project, February 2006.
- Rinaudo, J.D. (2001). Corruption and water allocation: the case of public irrigation in Pakistan. *Water Policy*, 4, 405-422.
- Romagny, B. and Cudennec, C. (2006). Gestion de l'eau en milieu aride: considérations physiques et sociales pour l'identification des territoires pertinents dans le Sud-Est tunisien. *Développement durable et territoires*, 6, 2-19.
- SAP (2001). *Water Crisis in Pakistan: News Clippings, Reports and Articles*. A South Asia Partnership Report, May 4.
- Scudder, T. (2005). *The Future of Large Dams: Dealing with Social, Environmental, Institutional and Political Costs*. Earthscan, London.
- Sethom, H. (1977). *L'agriculture de la presqu'île du Cap Bon (Tunisie) structures sociales et économie rurale*. Publication de l'Université de Tunis, Tunisie, volume V, p.73-113-114.
- Treyer, S. (2000). *Analyse des stratégies et perspectives de l'eau en Tunisie*. Report Plan Blue, [http://www.planbleu.org/publications/rapTreyer\\_eauTUN](http://www.planbleu.org/publications/rapTreyer_eauTUN) le 22 (Accessed on 10 August 2012).
- UNEP. (2004). *Dams and Development Project: Addressing Existing Dams*. Issue based workshop 14-15 June 2004, United Nations Office, Nairobi, Kenya.
- WAPDA. (1990). *Water Sector Investment Planning Study (WSIPS) 5 vols*. Lahore Federal Planning Cell, Pakistan.
- WAPDA. (2008). *Water and power development authority Pakistan, Ongoing Projects*. <http://www.wapda.gov.pk/htmls/ongoing-index.html> (Accessed on 9 July 2012).
- Weber, G. (2009). *The Indus Valley civilization*. <http://www.andaman.org/BOOK/F1-IndusCivilization/indus.htm#leastknown> (Accessed on 5 November 2011).
- World Bank. (2005). *Pakistan's water economy: Running dry*. The World Bank in Pakistan, Islamabad, Pakistan.
- Zghibi, A. (2007). *Evolution de l'état de l'aquifère plio-quaternaire de la côte orientale du Cap-Bon de la Tunisie (Etude hydrodynamique et Modélisation numérique)*. Master Thesis Hydraulic Agriculture and Rural planning, Institut National Agronomique of Tunisia, pp. 28-33.