



SEBOU WATER FUND
INVEST IN NATURE

Sebou Water Fund Feasibility Study

Sebou River Basin, Morocco

March 2019

FOREWORD

Water Funds are organizations that design and enhance financial and governance mechanisms that unite public, private and civil society stakeholders, around a common goal to contribute to water security through nature-based solutions. To accomplish these goals, they:

1. Contribute with scientific evidence to improve knowledge around water security;
2. Develop a shared and feasible vision of Water Security
3. Convene different stakeholders to generate political will and enable meaningful and positive impact on scale through collective action;
4. Positively influence water-related governance and decision making;
5. Encourage and drive implementation of natural infrastructure and other innovative projects at the basin level
6. Offer an attractive vehicle for pooling resources to invest cost-effectively in source watersheds.

This Study was conducted by WWF in Morocco to compile current information needed to assess the feasibility of developing a Water Fund in the Sebou basin region. The purpose of the Feasibility Phase is to test eligibility by quickly and efficiently determining *if* there are *water security challenges* and *a potential for a Water Fund to help*. If so, then assessing the feasibility (by more deeply understanding the situation) and generally determining *how a Water Fund could positively contribute* to water security within a defined area/region.

The present document compiles the main Deliverables of Feasibility Phase: the Eligibility Screening Checklist which provides a summary-level description of water security challenges in the basin and whether a Water Fund could help address these concerns; the Situation Analysis providing the information for the second part of the feasibility assessment, how a Water Fund could positively contribute; and

finally, the Decision Support Document aiming to inform a decision on going forward with the Water Fund’s design and providing any accompanying recommendations/conditions for moving ahead.

This document includes background, context, and other information to detail the water security challenges in the region. As such, the document provides information for the Feasibility Decision Support Document and supports Phase 1 of the Water Fund’s lifecycle, Feasibility.

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| Eligibility Screening Checklist |

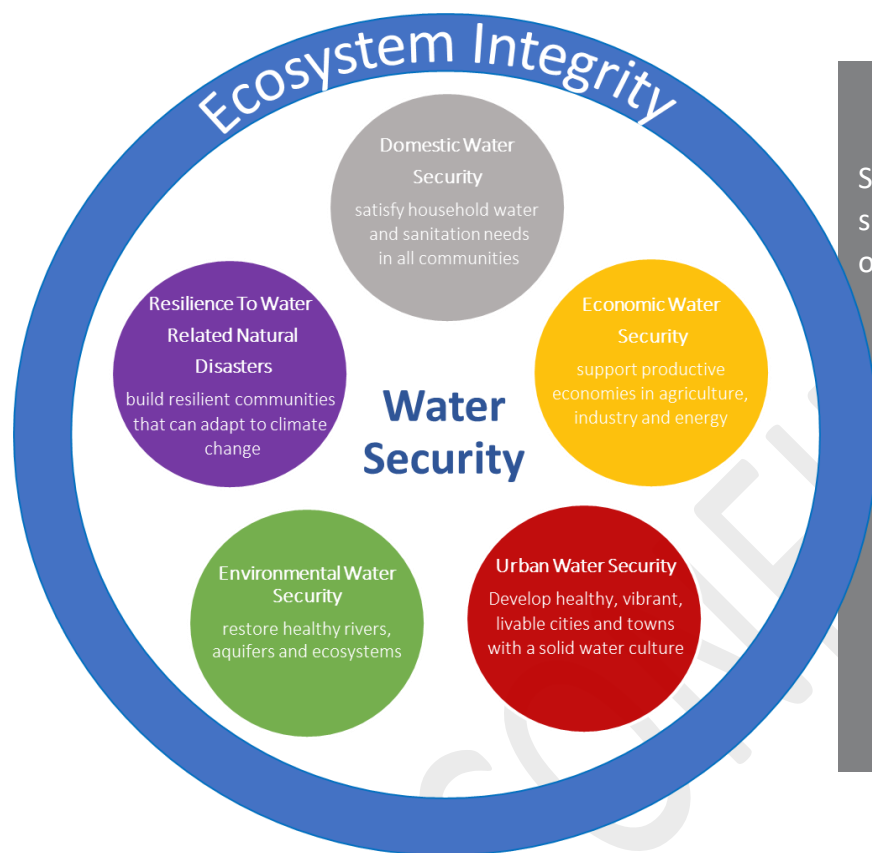
Prelude

The Sebou Water Fund is a sustainable financing mechanism, based on payment for ecosystem services to secure improved water quality and regulate water supply. This is can be done through: Repetition?

1. The use of science to attain and sustain water security through nature-based solutions;
2. The systematization, management and dissemination of knowledge;
3. The capacity building and technical support;
4. The promotion of an inclusive dialogue among key regional stakeholders to create a shared and systemic vision, and to boost collective action;
5. The active participation on water governance, public-policy design and corporate practices so that Water Funds can operate and be strengthened;
6. The leveraging of public and private resources.

The purpose of the Eligibility Checklist is to assist decision making at the very beginning of the life of a Water Fund. The Checklist documents the results of the Eligibility screening and recommends if a Water Fund could help improve water security.

The Checklist is the result of a short and preliminary research effort lasting a maximum of two weeks. The research determines the water security challenges and the potential for a Water Fund to help. Water Security is defined broadly with this description and diagram below.



Societies can enjoy water security when they comprehensively and successfully manage their water resources and services to meet the needs of each dimension of water security:

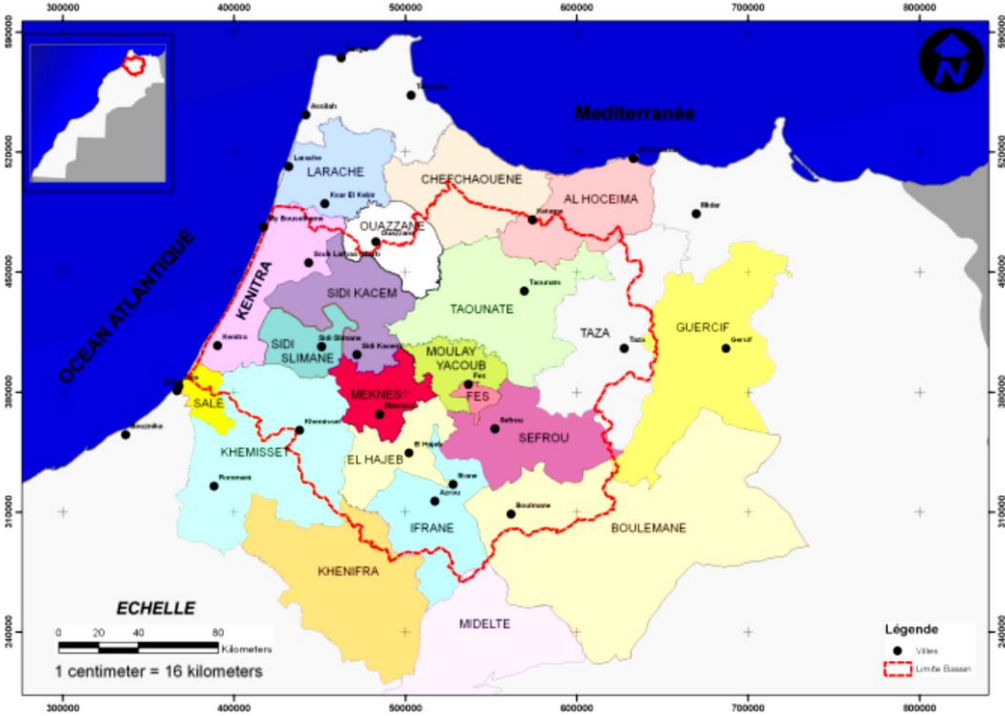
1. Environmental Water Security: restore healthy rivers, aquifers and ecosystems;
2. Domestic Water Security: satisfy household water and sanitation needs in rural and urban communities;
3. Economic Water Security: support productive economies in agriculture, industry, and energy;
4. Urban Water Security: develop healthy, vibrant, liveable water-sensitive cities and towns.
5. Resilience to water related natural disasters: build resilient communities that can adapt to climate change.

Watershed details

Relevant Watershed	Available Information on Geography, Demographics, Hydrology, Hydrogeology and Climatology
Sebou Basin	<p>The Sebou Basin covers an area of 40,000 km² encompassing 4 regions and 17 provinces in Morocco (Figure 1). The streams of Sebou are essential to the livelihood and sector-based activities of over 6.2 million people. The Sebou Basin is divided into 4 operational units, which are Ouergha-Sebou, Upper Sebou and Middle Sebou upstream, Mikkès and Beht.</p> <p>Sebou agricultural and industrial sector outcomes contribute significantly to the national economy. This Basin has a vital socio-economic importance for Morocco, being home to nearly 20% of the population. It holds 30% of the agricultural land and 20% of the country irrigated land potential yet covers only 6% of the national surface area¹.</p> <p>The Sebou Basin is the most important agricultural region of Morocco. It has a relatively well developed social and economic infrastructure, only 25% of its drainage area is covered with natural vegetation. Since the Sebou lower sub-Basin consists of a coastal plain, large scale irrigation schemes have been developed in the Rharb plain. The main crops grown are cereals, vegetables, olive, sugar beet, citrus, and grapes. The upstream part of the Basin supports a large population practicing rainfed agriculture, offering significant opportunities for improved land and water management in agricultural and forest land.</p> <p>Most of the Middle Atlas lakes are located in the Basin. That one is remarkable for the large number of ecosystems containing: 39 important wetlands including 5 areas classified as Ramsar sites, 2 national parks, and 17 sites of biological and ecological interest. Many of these sites are natural habitat of migratory birds and other endemic animal and plant species that are both rare and endangered².</p> <p>The forest represents an important natural wealth in Sebou Basin. It covers a total area of 1,200,000 ha and consists mainly of oaks, cedars, thuja and matorral. In addition, it provides grazing spaces and</p>

¹ ABHS, 2011. Etude d'actualisation du plan directeur d'aménagement intégré des ressources en eau du bassin hydraulique de Sebou : Note de synthèse.

² WWF, 2011. Payment for Ecosystem Services: A new conservation approach for freshwater in Sebou.

Relevant Watershed	Available Information on Geography, Demographics, Hydrology, Hydrogeology and Climatology
	<p data-bbox="600 268 1960 339">fuelwood for riparian populations and contributes significantly to the stabilization of lands and consequently to the reduction of erosion and siltation of dams.</p>  <p data-bbox="1086 1098 1473 1129">Figure 1 : Map of Sebou Basin</p>
<p data-bbox="203 1174 510 1241">Relevant Hydrology and Geology</p>	<p data-bbox="600 1174 1960 1399">The Sebou river begins amongst scattered lakes in the cool oak and cedar forests of Morocco’s Middle Atlas range. The Basin contributes to 30% of the national potential of surface water resources and 20% of the groundwater resources, sometimes this Basin is referred to “Oued Sebou” or “Sebou River”. The river runs north through overgrazed scrub and grasses of the Atlas foothills to meet with the Oued Fez, near the historic city of Fez. From there, it winds through one of the most populated areas of Morocco, supplying water to irrigate fields of rice, wheat and sugar beet as well as supporting olive groves and</p>

Relevant Watershed	Available Information on Geography, Demographics, Hydrology, Hydrogeology and Climatology
	<p>vineyards. This lower course of the river is artificially connected by the Nador canal to one of the most important wetlands of North Africa: the Merja Zerga lagoon. The Basin can be divided into three distinct geomorphic regions: the upper, mid, and lower Sebou: The upper Sebou raises above 2,800 m in the Middle Atlas mountains and is underlain mainly by calcareous rocks³.</p> <p>The mid-Sebou Basin is located in the Rif and pre-Rif mountains, which are characterized by an average altitude of 2,000 m, very steep slopes, and a strong rainfall gradient across the Basin. Ouerrha and Inaouene are the major tributaries of the Sebou draining the Rif and pre-Rif mountains. At its lower part, the Sebou opens into a wide valley where it meanders through a floodplain.</p>
Relevant Climatology	<p>The climate of Sebou Basin is Mediterranean characterized by rainy winters and dry summers. The mean annual rainfall is about 600 mm in the west and 450 mm in the southeast. The average annual temperatures are between 10 and 20°C. Evaporation varies between 1,600 and 2,000 mm per year, its maximum monthly value exceeds 300 mm during July and August.</p>

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³ Mariam ELKHECHAFI et al., 2017. Construction of a Novel Water Quality Classifier: A case study in the Sebou region.

Domestic Water Security

Domestic water security relates to providing all people with reliable, safe water and sanitation services in rural and urban communities. The following provides an overview of domestic water security elements pertinent to the proposed Water Fund, the potential contribution by the Water Fund and a conclusion.

Element	Measurement, proxy and results description
Access to piped water supply	100% in urban area and over 80% in rural area.
Access to improved sanitation (urban)	Access varies from 38% to 97% (depending on city/center) with an average of 72%. Rural areas have very limited access to sanitation.
Hygiene	The entire urban population has basic handwashing facility. The specific areas that are substantially worse (<80% of average) are located in rural areas.
Contribution Water Fund	The Sebou Water Fund can serve as an overarching platform to envision, finance and improve water security in rural areas specifically by convening stakeholders to work collectively on all of these activities in ways that enable meaningful and positive impact on scale. This fund can also encourage and drive implementation of natural infrastructure and other innovative projects for areas with limited access to domestic water.
Conclusions	<p>The constraints and challenges that face Sebou Basin are :</p> <ul style="list-style-type: none"> - Limited collective participation in water and sanitation management. - Improvement of bottom-up participatory approaches and creation of consultation spaces between institutions and users. - Private sector involvement in water resources management. - Reuse of treated wastewater for non-potable purposes. - Treatment and reuse of Industrial effluent. <p>Improved sanitation is needed to improve the hygiene and quality of life of the population, especially in the mountainous area. The majority of rural areas is deprived of collective sanitation services, contaminated water is often discharged into Sebou river and waterborne disease risks are present.</p>

Economic water security

Productive use of water to support productive economies in agriculture, industry, and energy. The following provides an overview of economic water security elements pertinent to the proposed Water Fund, the potential contribution by the Water Fund and a conclusion.

Element	Measurement, proxy and results description
Agricultural water security sub-index	
a) Productivity of irrigated agriculture	<p>The irrigated agricultural area in Sebou Basin represents about 357,000 ha. This area is likely to reach 412,000 ha in 2030 according to national agricultural plans and programs.</p> <p>In 2010, the water demand for irrigation is estimated at 2,875 Mm³, and will increase to 3,232 Mm³ in 2030.</p>
b) Independence from imported water	Inter-Basin transfers are not significant.
Industrial water security sub-index	
a) Value creation at risk	<p>The industrial sector is highly developed in Sebou basin, particularly in the food (oil mill, sugar refinery, etc.), leather and textile industries.</p> <p>-Food industry: There are 200 large oil mills, producing 120,000 t of olive oils and 70,000 t of vegetable oils, which represents more than 65% of the national production. 184 000 t of sugar is produced per year in the Basin, which represents 50% of the national production.</p> <p>-Leather and textile Industries: They are highly developed in the basin, especially in Fez, Meknes and Kenitra, and produce 60% of the national production.</p>
b) Productivity	Many industrial units are located in Sebou basin, the majority of them is located outside the cities or at their immediate periphery. These units are generally fed from drinking water networks, and their consumption is counted as urban consumption.

Element	Measurement, proxy and results description
	Other few industrial units are generally located farther from the cities and supplied with drinking water from their own resources. These isolated industries are heavy consumers of groundwater and surface resources. Their water consumption is estimated at 38 million m ³ / year.
Tourism water security sub-index	
a) Value creation at risk	Tourism potential is important in the imperial cities of Fez and Meknes, mountain areas, hot springs and beaches. Its activity has returned to growth following the introduction of direct flights linking Fez to other European Capitals.
b) Productivity	<p>The Fez-Meknes region has remarkable tourism assets which can play an important role in the economic and social life. This region also has a rich natural, cultural and historical capital representing an effective lever for tourism development. The productivity is concentrated in 3 main areas: Mountain area, traditional spas, traditional towns and historic sites.</p> <p>Tourism in this region has essentially a cultural character, which is distinguished by its historical and architectural heritage of international renown. The region has 335 classified tourist accommodation establishments, with a total capacity of 19,044 beds⁴.</p>
Energy water security sub-index	
a) Ratio of hydropower to total energy supply	<p>The current hydroelectric plants of Idriss I, El Kansera, Al Wahda and Allal El Fassi dams have an installed capacity of 535 MW. Their average production is around 600 GWh / year.</p> <p>Sebou Basin contains other smaller hydropower plants located along the river in Ras El Ma (Taza province), Oued Fez downstream (Fez Prefecture), Oued Aggay (Sefrou province) and Oued Boufekrane (Meknes prefecture).</p>

⁴ Centre Régional d'Investissement, 2016. Tourisme : Infrastructures touristiques dans la région Fès-Meknès.

Element	Measurement, proxy and results description
	5 other plants are planned in Mdez, Ain Timedrine, Ouljet Soltane, Bab Ouender and Asafalou dams, their total capacity is estimated at 300 MWh. The total hydroelectric output of the Sebou Basin is likely to rise to 1,000 GWh / year.
b) Water consumption by power stations	<i>Information not available.</i>
Contribution Water Fund	The most likely contributions of the proposed Water Fund will concern the collective work of Sebou stakeholders on all these activities in order to allow a significant and positive impact on economic water security. This can be achieved by closing important and relevant evidence gaps in agriculture, industry, and energy sectors, and considering the Fund as an overarching platform to envision, finance and improve water security and also positively influence water-related public policy, governance and decision making.
Conclusions	<p>By 2030, the total demand of drinking and industrial water will reach 440 Mm³. The increase in consumption will increase by 69% compared to the actual situation.</p> <p>The main challenges can be presented as follows:</p> <ul style="list-style-type: none"> -Difficulties of implementing the legal and regulatory system. -Low valuation of available water resources due to a weak water-saving awareness and overexploitation of freshwater in agriculture. -Pressure on groundwater threatening water security and environmental balance (especially in Saiss and Mnasra aquifers in the coastal zone of Gharb).

Urban Water security

Creation of better water management and services to develop healthy, vibrant, livable water-sensitive cities and towns. The following provides an overview of urban water security elements pertinent to the proposed Water Fund, the potential contribution by the Water Fund and a conclusion.

Element	Measurement, proxy and results description
Non-revenue water (%)	<i>Information not available.</i>
Wastewater treatment (%)	<p>Fez is the city that poses the most pollution problems, its discharges represent 40% of the total impact in the Sebou Basin.</p> <p>The current pollution treatment rate is about:</p> <ul style="list-style-type: none"> - Domestic pollution: 40% - Industrial pollution: 20%
Local flooding occurrences	<p>The Sebou Basin is subject to intense daily rainfall, particularly on the Rif and Middle Atlas mountain ranges. This situation can lead to significant daily runoff and generate terrible floods.</p> <p>There are 136 high-risk flood sites mainly located in the provinces of Sidi Kacem, Taza, Taounate, Fez and Ifrane.</p>
Contribution Water Fund	<p>The proposed Water Fund can mainly contribute to convince stakeholders to work collectively on all of these issues in ways that enable meaningful and positive impact on water resources quality and also to positively influence water-related public policy, governance and decision making.</p>
Conclusions	<p>The main challenges are related to the supply-side management followed by the Sebou Basin Agency, and to the lack of collective involvement of various stakeholders concerned by the delay in wastewater collection, treatment and reuse.</p>

Environmental Management

This section addresses the progress on restoring healthy rivers, aquifers and ecosystems. The following provides an overview of environmental water security elements pertinent to the proposed Water Fund, the potential contribution by the Water Fund and a conclusion.

Element	Measurement, proxy and results description
Watershed disturbance	<p>The major issues causing the disturbance of Sebou watershed are:</p> <ul style="list-style-type: none"> - Rapid resource scarcity during the last 30 years. - Degradation of Sebou resources quality due to the urban, industrial and agricultural pollution. - Groundwater overexploitation with an alarming drop in the piezometric levels of Saiss and Mnasra resources. - Drying up of Saiss plain sources and Middle Atlas lakes threatening their biodiversity and fragile ecosystems. - Excessive siltation in dams with a loss of 20 Mm³/year. - Overexploitation of forests around lakes (particularly at Awwa and hachlaf), overgrazing and soil erosion. - Excessive harvesting of resources by local populations, particularly with regard to hunting, poaching of birds and their eggs. - Development of rural habitat close to lakes. - Negative impact of Climate Change on the Sebou water resources. - Unsustainable management of irrigation water in farms.
Pollution	<p>The main sources of pollution in Sebou Basin have domestic, industrial and agricultural origins. Water pollution has reached critical levels threatening the economic and social development in the Basin. More than the third of surface resources is poor quality water with high concentration of nitrates.</p> <p>The pollution increases with the demographic, economic and agricultural development in spite of the remediation actions already undertaken. All the activities practiced in the Sebou contribute to the pollution of the Basin:</p>

Element	Measurement, proxy and results description
	<ul style="list-style-type: none"> - Domestic activity: The Sebou cities reject an annual wastewater volume exceeding 102 Mm³, of which 86% is discharged into water streams. The organic pollution is estimated at 63,647 t of BOD5 per year. This concentration represents 25% of the national pollution. - Industrial activity: it generates 3.5 million inhabitant equivalent of organic pollution. Food industry is responsible for 70% of the Sebou industrial pollution. - Agricultural activity: Increasing use of fertilizers and pesticides caused a remarkable chemical contamination of Sebou groundwater. Pesticide use in agriculture is estimated at 2 kg/year/ha, ie over 70 t/year for the entire Basin area. <p>The Sebou Basin is characterized by the proliferation of uncontrolled landfills representing a notable source of diffuse pollution. Leachate presents a high risk of pollution for surface water, especially in the rainy seasons. It also contributes to the rapid spread of diseases and the degradation of landscapes. The pollutant load in total leached BOD5 from Sebou household solid waste is estimated at 29,960 t/year.</p> <p>The current situation of landfills is generally detrimental to the economic development of Sebou, particularly in the tourism and agricultural sectors.</p>
Water resource development	
a) Water balance	<p>The average annual water supply to Sebou watershed is 5,560 Mm³/year. In 2010, the demand for water was 3,638 Mm³, which involved 286 Mm³/year for drinking, industrial and tourist water demand and 2,873 Mm³/year for agriculture.</p> <p>By 2030, the projections of water supply show that its average will not exceed 3,222 Mm³ for a future water demand of 3,638 Mm³. The volume flowing towards the sea will be 2,242 Mm³ and the evaporation loss will reach 502 Mm³.</p>
b) Aquifer stress	<p>The groundwater balance shows a deficit of 157 Mm³/year (-10%) between 1939 and 2002. The deficit in Fez - Meknes region had reached 100 Mm³/year due to the aquifer depletion.</p>

Element	Measurement, proxy and results description
	Various studies shown that coastal aquifers of Mamora, Gharb and Dradere-Souière are experiencing an important Saltwater intrusion due to excessive pumping for agricultural purposes.
Contribution Water Fund	Taking into consideration the current and future situation of water resources, the Water Fund can mainly serve as an overarching platform to envision and improve water security and positively influence water-related public policy, governance and decision making. The integrated water resources management can be reached by convening stakeholders to work collectively on all of these issues in ways that enable a meaningful and positive impact on scale.
Conclusions	The multiple water demands and the pollution sources increase with demographic, economic and agricultural development, despite the curative actions undertaken by the local operator. Many other factors can represent real challenges to the Water Fund: ineffective water management, inadequate hydraulic infrastructure, high demand for irrigation water, socio-economic level of the local population, etc.

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Resilience to water-related disasters

Building of resilient communities that can adapt to change and are able to reduce risk from natural disasters related to water to minimize the impact of future disasters. The following provides an overview of economic water security elements pertinent to the proposed Water Fund, the potential contribution by the Water Fund and a conclusion.

Element	Measurement, proxy and results description
Resilience to drought	<p>Drought was always present in the history of Morocco. Its importance as a structural element of the country climate increased these last decades. Morocco lives the longest dry episode of its contemporary history, characterized by a reduction of the precipitations and a tendency to the rise in temperatures. The characterization of the climatic drought during the period of 1961-2004 showed an increase in the droughts frequency, their severity and their spatial distribution⁵. The Sebou Basin was considerably affected by a long dry period that began in 1980. The differences in rainfall distributions and flow regimes in the northern and southern parts of the basin were very clear in dry periods⁶. The effect of drought was significantly marked on the Sebou water supply.</p>
Resilience to flooding	<p>The Sebou Basin has experienced major floods in the past, particularly in the Gharb plain. The last floods date back to 2008 and 2009. These floods caused enormous damage in the Gharb plain and affected 60,000 ha of cereals and legumes in 2009.</p> <p>16 provinces and prefectures in the basin have 136 zones identified as high-risk flood sites. The flood risks and damage observed at these sites were aggravated by the rapid and uncontrolled urbanization of flood-prone areas, the development of agricultural lands and the development of construction activities on natural waterways, etc.</p>
Climate Change Susceptibility	<p>The climatic fluctuations in Sebou basin are inducing major variations in stream flows and the consequent discharges reaching the dams downstream. These climatic variations, with the</p>

⁵ Stour, L., & Agoumi, A., 2008. Climatic drought in Morocco during the last decades. *Hydroécol. Appl.*, 16, 215-232.

⁶ Haida, S., Fora, A.A., Probst, J.L. and Snoussi, M., 1999. Hydrology and hydroclimatic fluctuations in the Sebou watershed between 1940 and 1994. *Science et changements planétaires/Sécheresse*, 10(3), pp.221-226.

Element	Measurement, proxy and results description
	<p>observed decline in total precipitation, are considered as a trend in response to the global climate change regionally observed.</p> <p>Precipitations and consequent stream flows recorded in 4 sub-basins in the northern part of Sebou watershed showed very important climatic fluctuations with an irregular trend of about 8 to 12 years⁷.</p>
Contribution Water Fund	<p>The proposed Water Fund can serve as an overarching platform to envision and improve water security through risk mitigation and impact minimization of naturel disasters. The water-related public policy, governance and decision making must ensure an adequate management of disaster risks. This Fund can contribute to convince the local stakeholders to work collectively for a better understanding of water-related disasters in Sebou basin and a common establishment of an integrated approach facing drought, flooding and climate change impacts.</p>
Conclusions	<p>The precipitations over the past 50 years shown that dry years are becoming, unfortunately, more frequent than wet or normal years. This trend will definitely be a challenge in early mitigations of stream flows and subsequently on managing surface water resources in a most probable climate change trend. A good knowledge and management of surface water resources relies on both a good understanding of the relationships of previous precipitation fluctuations and their consequent flows, as well as on a sound mitigation of future behaviour based on modelling for probable climatic situations.</p>

⁷ Bouabid, R. and Elalaoui, A.C., 2010. Impact of climate change on water resources in Morocco: The case of Sebou Basin. Séminaires Méditerranéens, 9, pp.57-62.

Conclusions

Recommendation	Proceed with the next Phase (Situation Analysis) to establish a Water Fund for <i>Sebou basin</i> .
Physical Setting and Scope Considerations	The water resource situation associated with Sebou Basin is presented in Situation analysis Report.
Arguments	<p>The Sebou Basin is water-scarce and faces significant challenges in all dimensions of water security. Specifically, the primary challenges identified include:</p> <ul style="list-style-type: none"> - Overexploitation of groundwater resources for agricultural use. - Pollution of the groundwater by solid waste and industrial activities. - Livestock and agricultural activities causing the multiplication of pathogenic microorganisms such as bacteria and waterborne pests. - Use of contaminated water for agricultural purposes (irrigation of riparian fields, livestock watering ...), domestic or other forms constitutes a real danger to the health of local inhabitants and livestock. - Overexploitation of forests around lakes and overgrazing. - Excessive harvesting of resources by local populations, particularly with regard to hunting, poaching of birds and their eggs. - Development of rural habitat close to lakes. - Overexploitation of water resources and groundwater pollution are manifested by a high rate of nitrates with an alarming upward trend. <p>In the long term, this situation will lead to a decrease in freshwater supplies and will have an irreversible effect on the environment and biodiversity.</p> <p>The proposed Water Fund could help improve water security by serving as a complete platform to envision, finance and improve water security in rural areas specifically by convening stakeholders to work collectively on all of these activities in ways that enable meaningful and positive impact on scale. The Fund will provide a better understanding of</p>

water-related disasters in Sebou Basin and a common establishment of an integrated approach facing drought, flooding and climate change impacts.

This Fund can also encourage and drive implementation of natural infrastructure and other innovative projects for areas with limited access to domestic water. This can be achieved by closing important and relevant evidence gaps in agriculture, industry, and energy sectors, and convincing stakeholders to work collectively on all of these issues in ways that enable meaningful and positive impact on water resources quality and also to positively influence water-related public policy, governance and decision making.

Unfortunately, over the past few years there has been a sharp reduction in the surface area of the wetland ecosystems and a deterioration of surrounding areas that has affected their fauna and water quality. The overexploitation of surface and ground waters, overgrazing, deforestation and pollution are the primary causes of the degradation of these natural areas.

This situation is the result of factors including the poverty of local populations, ignorance of the importance of wetland ecosystems, high demand for irrigation water, inadequate hydraulic infrastructure, ineffective water management and the overall difficulty of enforcing laws on water and the environment.

| Situation Analysis Report |

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1.0 EXECUTIVE SUMMARY

This report contains background information on the Sebou basin water situation, an overview of the social, policy/legal and potential finance context, along with an analysis of the five (5) dimensions of water security (i.e., domestic water security, economic water security, urban water security, environmental water management, and resilience to water-related natural disasters), including the challenges that the basin faces in each dimension.

The main area of study associated with this Analysis concerns the region of Ifrane-Azrou, where lakes Awwa, Hachlaf, Ifrah, Aguelmam Afennourir, Aguelmam Tifounassine and Aguelmam Sidi Ali are located. The activities within this area are interrelated and include flows and discharges from other administrative and hydrogeological areas.

In summary, the region of the Sebou basin is water scarce and faces significant challenges in all dimensions of water security. The primary challenges identified include:

- Overexploitation of groundwater resources for agricultural use.
- Pollution of the groundwater by solid waste and industrial activities.
- Livestock and agricultural activities causing the multiplication of pathogenic microorganisms such as bacteria and waterborne pests.
- Use of contaminated water for agricultural purposes (irrigation of riparian fields, livestock watering ...), domestic or other forms constitutes a real danger to the health of local inhabitants and livestock.
- Overexploitation of forests around lakes and overgrazing.
- Excessive harvesting of resources by local populations, particularly with regard to hunting, poaching of birds and their eggs and firewood
- Development of rural habitat close to lakes.
- Overexploitation of water resources and groundwater pollution are manifested by a high rate of nitrates with an alarming upward trend.

In the long term, this situation will lead to a decrease in freshwater supplies and will have an irreversible effect on the environment and biodiversity.

From this analysis, it is clear that Sebou River Basin faces significant water security challenges. These challenges and the Fund’s potential to contribute to improved water security are further detailed in the *Water Fund Strategic Plan*.

2.0 WATER RESOURCES

2.1 Physical Setting

The table below provides information on relevant physical aspects of the Sebou Basin, including available information on geography, demographics, hydrology, hydrogeology, and climatology.

Relevant Watershed	Available Information on Geography, Demographics, Hydrology, Hydrogeology, and Climatology
Sebou Basin	<p>The Sebou Basin covers an area of 40,000 km² encompassing 4 regions and 17 provinces in Morocco. The streams of Sebou are essential to the livelihood and sector based activities of over 6.2 million people. The Sebou Basin is divided into 4 operational units, which are Ouergha-Sebou, Upper Sebou and Middle Sebou upstream, Mikkès and Beht (Figure 1).</p> <p>Sebou agricultural and industrial sector outcomes contribute significantly to the national economy. This Basin has a vital socio-economic importance for Morocco, being home to nearly 20% of the population. It holds 30% of the agricultural land and 20% of the country irrigated land potential yet covers only 6% of the national surface area [1].</p> <p>The Sebou Basin is the most important agricultural region of Morocco. It has a relatively well-developed social and economic infrastructure; only 25% of its drainage area is covered with natural vegetation. Since the Sebou lower sub-Basin consists of a coastal plain, large-scale irrigation schemes have been developed in the Rharb plain. The main crops grown are cereals, vegetables, olive, sugar beet, citrus, and grapes. The upstream part of the Basin supports a large population practicing rainfed agriculture, offering significant opportunities for improved land and water management in agricultural and forestland.</p>

	<p>Most of the Middle Atlas lakes are located in the Basin. The latter is remarkable due to its large number of ecosystems that it contains: 39 important wetlands, including 5 areas classified as Ramsar sites, 2 national parks, and 17 sites of biological and ecological interest. Many of these sites are natural habitat of migratory birds and other endemic animal and plant species that are both rare and endangered [2].</p> <p>The forest represents an important natural wealth in the Sebou Basin. It covers a total area of 1,200,000 ha and consists mainly of oaks, cedars, thuja and matorral. In addition, it provides grazing spaces and fuelwood for riparian populations and contributes significantly to the stabilization of lands and consequently to the reduction of erosion and siltation of dams.</p>
<p>Relevant Geology and Hydrology</p>	<p>The Sebou river begins amongst scattered lakes in the cool oak and cedar forests of Morocco’s Middle Atlas range. The Basin contributes 30% of the national potential of surface water resources and 20% of the groundwater resources. The river runs north through overgrazed scrub and grasses of the Atlas foothills to meet with the Oued Fez, near the historic city of Fez. From there, it winds through one of the most populated areas of Morocco, supplying water to irrigate fields of rice, wheat and sugar beet as well as supporting olive groves and vineyards. This lower course of the river is artificially connected by the Nador canal to one of the most important wetlands of North Africa: the Merja Zerga lagoon. The Basin can be divided into three distinct geomorphic regions: the upper, mid, and lower Sebou: The upper Sebou raises above 2,800 m in the Middle Atlas mountains and is underlined mainly by calcareous rocks [3].</p> <p>The mid-Sebou Basin is located in the Rif and pre-Rif mountains, which are characterized by an average altitude of 2,000 m, very steep slopes, and a strong rainfall gradient across the Basin. Ouerrha and Inaouene are the major tributaries of the Sebou draining the Rif and pre-Rif mountains. At its lower part, the Sebou opens into a wide valley where it meanders through a floodplain.</p>
<p>Relevant Climatology</p>	<p>The climate of the Sebou Basin is Mediterranean characterized by rainy winters and dry summers. The mean annual rainfall is about 600 mm in the west and 450 mm in the southeast. The average annual temperatures are between 10 and 20°C. Evaporation varies between 1,600 and 2,000 mm per year, its maximum monthly value exceeds 300 mm during July and August.</p>

2.2 Land Use

Land use trends within the Sebou Basin are summarized below.

<p>Current Land Use</p>	<p>The Sebou basin is one of the main regions in the country with an agricultural vocation. It has 20% of irrigated utilized agricultural area (i.e. 357,000 ha), and 20% of the utilized agricultural area of Morocco (i.e. 1,800,000 ha). The land use is relatively diversified with a predominant share of grain crops (60%), the remaining being occupied by fruit plants (14.4%), legume plants (6.6%), industrial crops sugar beet and cane (4.2%), oilseed crops (3.6%), vegetable crops (3.1%) and forage (1.7%).</p> <p>Forest covers a total area of 1,200,000 ha. It is primarily composed oak, cedar, thuya and matorrals trees. In addition to its role of grazing land and wood collection for local communities, forest adds significantly to the stabilization of lands and therefore to reduce erosion and silting of reservoirs.</p> <p>The industrial sector is highly developed in the Sebou basin, especially in the agribusiness (oil, sugar), leather and textile i.e water consuming activities. There are 200 major mills producing over 65% of national olive and vegetable oils production. 184,000 tons of sugar is produced annually in the basin, which accounts for half of national production. Leather and textile industry is highly developed in the basin. The region has a large number of tanneries especially in Fez, Meknes and Kenitra cities, and produces 60% of national production. These tanneries are a major cause of pollution of the Sebou river downstream.</p>
<p>Trends and Developments in Land Use</p>	<p>As part of the agricultural development strategy (including PMV Program), irrigated areas are expected to increase. These areas will globally increase from 357,000 ha to more than 412,000 ha in 2030 through the implementation of new collective irrigation schemes. A large part of this future development is intended to fill the gap between the constructed dams (Al Wahda and Idriss I, in particular) and the perimeters equipped downstream. The Ministry of Agriculture launched a resorption program, which covers a total area of 108,440 ha in Al Wahda downstream for the period 2010-2018. The 2nd phase of this program will concern the perimeters of Zrar and Z5 (23,000 ha) in 2019.</p> <p>Statistics on trends and urban/industrial development in the basin are not available, but several industrial parks are planned and zoned in Fez-Meknes Region (aeronautic sector, Agropole, industrial lands, etc.).</p>

<p>Effects of Land Use Change</p>	<p>The consumptive uses are expected to increase following the land use change scenario experienced in the 10 last years. Total uses are estimated at 345 Mm³ in 2019 and will reach 446 Mm³ in 2030, presented as follows:</p> <ul style="list-style-type: none"> ● Urban areas (including the needs of administrations and industry) : 300 Mm³ (+23%); ● Rural areas: 103 Mm³ (+47%); ● Extra-urban industry: 43 Mm³ (+23%). <p>The Irrigation water requirements will increase from 2,873 in 2010 to 3,232 Mm³/year by 2030. In the Gharb plain, irrigation water requirements would be 1,809 Mm³/year with an important increase of 67%.</p>
<p>Ecologically Sensitive Areas</p>	<p>The basin contains 39 important wetlands, including 5 areas classified as Ramsar sites, 2 national parks, 4 key biodiversity areas for freshwater and 17 sites of biological and ecological interest. Among the various types of wetlands of the Sebou basin there are:</p> <ul style="list-style-type: none"> ● Natural lakes, mainly concentrated in the Middle Atlas and reaching, for the biggest one, an area of ca. 300ha and a depth of 40m (Aguelmam Sidi Ali). ● A large number of temporary wetlands are mainly located in semi-arid and sub-humid bio climates (Daya de la subéraie de Maamora, Dayas du Gharb). The impoundment period is between 4 and 11 months, starting usually in the second half of the autumn with first rains, sometimes even later. ● Streams whose mountain chains constitute water towers, the most important being the Middle Atlas, and resulting in three main streams of the country of which the Sebou river. ● Estuaries, the most important in the country being the Sebou river. ● The Merja Zerga lagoon, the coastal lake of Sidi Bou Ghaba, lagoons and famous merjas of the Gharb region almost completely drained. ● Many sources, known for their freshness and stable temperature. These sources are the most abundant in the Middle Atlas and in the Rif. ● Dam lakes and small fish water bodies represent a good proportion of lakes water of the Sebou.

2.3 Water Management

The following describes water management for the region.

<p>Entities Involved</p>	<p>The Sebou Hydraulic Basin Agency (ABHS), a public institution set up under the decree of law 10-95, is responsible for the integrated water resources management at the scale of Sebou watershed in coordination and consultation with the various users of water: public institutions, elected representatives, private actors, associations, researchers, etc.</p> <p>The Agency is administered by a board of directors chaired by the governmental authority in charge of water and made up of the relevant government authorities and public establishments responsible for the production of drinking water, hydroelectric power and irrigation water management.</p> <p>The responsibilities of ABHS are listed below:</p> <ul style="list-style-type: none">● Carry out measurements, investigations and studies necessary to assess the water resources.● Develop and implement the integrated water resources management master plan, the local water management plans and the scarcity management plan.● Manage water resources in an integrated way and control their use.● Issue permits and concessions for use of public hydraulic domain.● Manage, protect and preserve the properties of the public hydraulic domain and aquatic environments.● Provide financial contribution and technical assistance to water conservation projects.● Contribute to the research and development of water techniques (mobilization, rational use and protection of water resources).● Implement actions necessary for the prevention and protection against floods.● Advise on projects that may have an impact on water resources and public hydraulic domain.
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<p>Contact Details</p>	<p>Name: Samira EL HAOUAT, General Director. Address: Rue Abou Al Alae Al Maâri, En face de l'école LAFONTAINE, BP 2101, Fez, Morocco. Phone: (+212) 05 35 64 29 98/97 Email: direction@abhsebou.ma Website: http://www.abhsebou.ma</p>
<p>Water Sources Used</p>	<ul style="list-style-type: none"> ● <i>Surface water: 5,560 Mm³.</i> ● <i>Groundwater: 1,125 Mm³.</i>
	<p>The average annual surface water amounts to 5,560 Mm³/year (average over the period 1939-2002) characterized by temporal and spatial variabilities. Groundwater resources are estimated at 1,125 Mm³, enduring overexploitation due to the effect of drought, development of private irrigation areas and also to pollution. The quality of groundwater in the Sebou basin varies according to each aquifer (Figure 2), as follows:</p> <ul style="list-style-type: none"> ● Good: Aquifers of the Middle Atlas, ● Generally good to moderate: Gharb aquifer, ● Moderate to poor: Mamora aquifer, ● Poor to very poor: Fez-Meknes aquifer, ● Poor for nitrate levels exceeding 50 mg/l: 60% for Fez-Meknes and Gharb aquifers and 45% for Mamora aquifer.
<p>Treatment and Distribution</p>	<p>Water is treated and supplied by ONEE to towns for distribution to the citizens. ONEE (Office National de l'Electricité et de l'Eau Potable) created as alliance between the power company ONE and ONEP, is an electric utility and a bulk water provider that produces 80% of the country's drinking water and sells much of it to the Regies (RADEEF in Fez, RADEM in Meknes and RAK in Kenitra). It also distributes water directly to customers in medium and small towns. ONEE has also taken over sanitation services in many of the Sebou Cities and centers. Furthermore, ONEE provides water through stand posts to one third of the rural population of Morocco that has access to an improved source of water.</p>

<p>Water Use Limitations</p>	<p>The origins of pollution in Sebou basin are domestic, industrial and agricultural. The surface water quality monitoring system, set up by the ABHS, shown that:</p> <ul style="list-style-type: none"> ● 43% points: moderate to good quality; ● 22% points: poor quality; ● 35%: have very poor quality. <p>Regarding groundwater resources, 226 quality control stations of ABHS indicated that: 67% are of good to moderate quality and 34% are of poor to very poor quality, mainly due to nitrate contamination in areas of high agricultural activity (Gharb, Saïss and Mamora).</p> <p>Various studies show that coastal aquifers (Mamora, Gharb, Dradere-Souïère) are facing saline invasion.</p>																																																																															
<p>Water Cost</p>	<p>Information about Water Cost is not available. However, water prices (production and distribution tariffs) in Moroccan cities and centers are given in the table below (March, 2006).</p> <table border="1" data-bbox="573 792 1917 1382"> <thead> <tr> <th rowspan="2">City</th> <th rowspan="2">Production - Water Tariff (DH/m³)</th> <th colspan="7">Distribution - Water Tariff (DH/m³)</th> </tr> <tr> <th>0-6 m³</th> <th>6-20 m³</th> <th>20-40 m³</th> <th>>40 m³</th> <th>Administrative</th> <th>Industrial</th> <th>Touristic</th> </tr> </thead> <tbody> <tr> <td>Tangier</td> <td>2.86</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>El Jadida</td> <td>4.20</td> <td>3.09</td> <td>7.78</td> <td>11.86</td> <td>11.91</td> <td>6.88</td> <td>6.23</td> <td>9.00</td> </tr> <tr> <td>Agadir</td> <td>3.84</td> <td>2.95</td> <td>7.77</td> <td>9.58</td> <td>9.63</td> <td>6.21</td> <td>5.77</td> <td>8.34</td> </tr> <tr> <td>Safi</td> <td>3.96</td> <td>3.32</td> <td>7.88</td> <td>13.12</td> <td>13.17</td> <td>7.82</td> <td>7.14</td> <td>10.87</td> </tr> <tr> <td>Marrakesh</td> <td>3.02</td> <td>1.70</td> <td>6.37</td> <td>9.36</td> <td>9.41</td> <td>5.73</td> <td>5.40</td> <td>8.02</td> </tr> <tr> <td>Oujda</td> <td>3.52</td> <td>3.81</td> <td>10.11</td> <td>14.72</td> <td>14.77</td> <td>9.77</td> <td>10.13</td> <td>12.18</td> </tr> <tr> <td>Fez</td> <td>3.05</td> <td>1.95</td> <td>7.07</td> <td>8.79</td> <td>8.84</td> <td>5.61</td> <td>5.32</td> <td>7.63</td> </tr> </tbody> </table>	City	Production - Water Tariff (DH/m ³)	Distribution - Water Tariff (DH/m ³)							0-6 m ³	6-20 m ³	20-40 m ³	>40 m ³	Administrative	Industrial	Touristic	Tangier	2.86								El Jadida	4.20	3.09	7.78	11.86	11.91	6.88	6.23	9.00	Agadir	3.84	2.95	7.77	9.58	9.63	6.21	5.77	8.34	Safi	3.96	3.32	7.88	13.12	13.17	7.82	7.14	10.87	Marrakesh	3.02	1.70	6.37	9.36	9.41	5.73	5.40	8.02	Oujda	3.52	3.81	10.11	14.72	14.77	9.77	10.13	12.18	Fez	3.05	1.95	7.07	8.79	8.84	5.61	5.32	7.63
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	Nador	3.01	2.13	6.01	8.51	8.56	6.01	5.23	7.05
	Settat	2.19	2.63	6.86	7.53	7.58	5.81	5.56	6.88
	Beni Mellal	2.39	2.61	6.51	10.14	10.19	6.73	7.05	8.56
	Kenitra	4.14	2.32	5.25	6.59	6.64	4.88	4.46	5.82
	Tétouan	2.85							
	Larache	2.96	1.74	5.31	6.06	6.11	3.74	3.57	4.78
	Meknes	2.41	1.30	3.88	4.45	4.51	2.18	2.23	3.71
	Taza	3.07	2.15	6.00	8.92	8.97	5.85	6.07	7.63
	Centers		2.37	7.39	10.98	11.03	7.20	6.68	6.68
	Fixed charges: <ul style="list-style-type: none"> • Domestic use: 72 DH/year. • Administrative, industrial and touristic use: 120 DH/year. 								
Priorities – Sebou Basin	<p>The ABHS priorities are based on the general guidelines of the National Water Sector Strategy, which aim at managing water demand, developing water supply, protecting water resources and fighting against flooding. The priorities concern:</p> <ul style="list-style-type: none"> • Security of drinking water supply in urban cities, particularly in the cities of Fez and Meknes; • Irrigation water saving by the conversion of 239,700 ha to localized irrigation (Gharb area) and small/medium irrigated farms; • Hydro-agricultural equipment of 123,700 ha of agricultural perimeters downstream Idriss I, Al Wahda, Bouhouda and Asfalou dams; • Construction of 9 large dams (total capacity of 2,025 Mm³) and 110 small and medium dams by 2030; • Generalization of access to drinking water in rural areas; • Efficiency Improvement of drinking water, industrial and tourist water distribution networks (target 80%); 								

	<ul style="list-style-type: none"> ● Maintenance of hydraulic infrastructure and interconnection of basin systems; ● Intra-basin transfers to satisfy the drinking water supply of the cities of Fez, Meknès, Sidi Kacem and Kenitra and irrigation needs in the Saïs plain and the Mnasra area; ● Exploration of Saïs and Gharb groundwater and Fez-Taza corridors; ● Rainwater harvesting in urban, peri-urban and rural areas to recover 2.4 M m³/year; ● Reuse of treated wastewater of Fez, Meknes and Kenitra cities (total potential of 147 M m³/year); ● Generalization of aquifer contracts to all the basin; ● Artificial recharge of the Mnasra, Middle Atlas and Saïss aquifers; ● Adoption of a basin remediation program to reduce water pollution to 80% in 2030; ● Implementation of a Flood control program by setting up 75% structural improvements and 25% non-structural measures; ● Preservation of the natural lakes Aoua, Afennourir and Hachlaf and restoration of the springs of Boujaoui, Maarouf and Bittit.
<p>Reputation</p>	<p>In order to ensure an integrated and sustainable development in the Sebou basin, a number of significant challenges still need to be addressed despite the achievements recorded in the water sector in Morocco. The main weaknesses are related to the following factors:</p> <ul style="list-style-type: none"> ● Difficulties implementing the legal and regulatory system; ● Supply-side management of water resources by the ABHS facing overexploitation and scarcity; ● Considerable delay in the collection and treatment of wastewater; ● Low valorization of mobilized water resources (low water saving and large gap between infrastructure and equipments); ● Pressure on groundwater threatening water security and compromising the environmental balance (esp. in the Saïss and Mnasra aquifers). <p>These factors weaken the achievements and require appropriate responses to the shortcomings penalizing the integrated water resources management.</p>

2.4 Water Balance: Sebou Basin

The following provides the water balance for the Sebou Basin based on readily available data.

Actual Renewable Water Resources (Precipitation)	Temporary and spatial variabilities characterize the Sebou water supplies with a ratio of 1 to 20. The average annual precipitation calculated over the period 1973-2008, is about 600 mm (640 mm over the period 1939-2008), with a maximum of 1,000 mm/year on the heights of the Rif and a minimum of 300 mm in the high Sebou and valleys of Beht (Figure 3). The average renewable water amounts to 5,560 Mm ³ /year, or 887 m ³ /inhabitant/year. The national average is estimated to 604 m ³ /inhabitant/year.
Water Transfers	Water transfers from other basins is not significant.
Evapotranspiration	The annual average evapotranspiration is estimated to 502 Mm ³ . It varies between 1,600 mm on the coast and 2,000 mm towards the center. Its monthly maximum of 300mm is noted in July - August and minimum in December-January (less than 50 mm/month). The summer temperatures and the insignificant rainfall explain the high evapotranspiration in the Basin (1,500 mm on the coast and 2,000 mm/year).
Runoff	The total annual average runoff is estimated to 556 Mm ³ . The runoff coefficients vary between 10% in Upper and Middle Sebou, 20% in Inaouène, Lébène, Beht and Bas Sebou, and 40% in Ouergha.
Groundwater outflow	The total annual average groundwater extraction from the aquifers (Moyen Atlas plissé, Couloir Fez-Taza, Taza, Moyen Atlas Tabulaire, Fez-Meknes, Gharb, Maamoura, Dradère-Souiere & Bougba) was 1,737 m ³ (from 1939 to 2002).
Consumption	The total annual average consumption is estimated to 3,395 Mm ³ .

<p>Estimated Water Balance Watershed</p> $\Delta S = P + Q_{ib} - (E_t + Q_{sw} + Q_{gw} + C), \text{ where:}$ <p>ΔS = Change in storage of water in the basin P = Precipitation E_t = Evapotranspiration Q_{sw} = Runoff Q_{gw} = Groundwater outflow Q_{ib} = Flow of inter-basin transfer C = Consumptive uses</p>	P	5560	million m ³ /year
	Q_{ib}	0	million m ³ /year
	E_t	502	million m ³ /year
	Q_{sw}	556	million m ³ /year
	Q_{gw}	1737	million m ³ /year
	C	3395	million m ³ /year
	ΔS	-630	million m ³ /year
<p>Conclusions Water Balance and Verification</p>	<p>As shown in the model below, the water balance has a deficit of 630 Mm³/year, mainly due to private irrigation, which represents 78%. The most impacted aquifers are those of Fez-Meknes, Gharb and Maamoura. This deficit explains the continuous decline in groundwater tables for several years. This drop is alarming in some aquifers (-65m between 1979 and 2004 for the Lias aquifer situated in the south of Meknes plateau).</p> <p>NOTE On Accuracy: This assessment is based on the statistics and the projections presented in the Master Plan of Integrated Development of Sebou water resources by ABHS (2011).</p> <p>Calculating the balance across the aquifers is therefore the best way to check the deficit is correct.</p>		
<p>Water Scarcity Analysis</p>	<p>The available water resources (precipitation minus evapotranspiration) in the Sebou Basin are 5 billion m³/year. The available water for the population of 6.2 million people in area is therefore 815 m³/person/year, well below the 1,700 m³/person/year water stress limit, the 1,000 m³/person/year water scarcity limit and just above the 500 m³ absolute water scarcity limit. Based on these measures, this region can be considered <i>extremely water scarce</i>.</p>		
<p>IWMI Measure of Water Scarcity</p> 	<p>The International Water Management Institute (IWMI) classifies countries that are predicted to be unable to meet their future water demand without investment in water infrastructure and efficiency as economically water scarce; and countries predicted to be unable to meet their future demand, even with such investment, as physically water scarce. Based on this Analysis it is clear that Sebou Basin is economically water scarce and possibly physically water scarce. The latter condition will possibly be reached if the following factors persist:</p>		

	<ul style="list-style-type: none">● Overexploitation of groundwater (esp. Saiss and Mnasra aquifers).● Drought conditions increase due to climate change.● Resource scarcity during the last thirty years.● High degradation of the quality of water resources.● Siltation of the dams.
Water Scarcity Conclusion	<p>The conceptual model shows that:</p> <ol style="list-style-type: none">1. Sebou is severely water scarce.2. Agriculture uses 90% of available water for consumption. Efficient irrigation would improve the water balance.

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3.0 REGIONAL CONTEXT

3.1 Government Agencies, Policies & Regulatory Framework

Government Agencies

Owing to its geographical location, Morocco has considerable climate differences within its territory and variable rainfall depending on the region and season. With a view to supporting its development and streamlining water management, Morocco has, for decades, been committed to managing its water resources by constructing major water infrastructure (dams, efficient water irrigation systems, etc.) to meet its household, industrial, and agricultural consumption needs. The water sector nevertheless continues to grapple with major challenges related to the depletion of water resources, the intensification of extreme climate events (floods and droughts) caused by climate change, and inadequate resources to meet growing needs coupled with overexploitation of groundwater resources.

Below is an inventory of relevant national government agencies

Agencies: National Level	Description
Moroccan Superior Council of Water and Climate	The Moroccan Superior Council of Water and Climate has as its mission to incorporate all administrations involved in the water sector, representatives of the parliament, representation of users and nominated experts that have competencies on water issues. By working with different areas of society and other public entities, the SCWC convenes to address issues of national importance and formulate recommendations on the options of planning, mobilization and management of water resources.
Inter-Ministerial Commission of Water	The Inter-Ministerial commission on Water plays a significant role in the stewardship. It was created under royal instructions to examine and address the problem of the deficit of drinking water and irrigation water in rural and mountainous areas. The Inter-Ministerial commission on Water includes representatives of the Ministries of Interior, Economy, Agriculture, Equipment, Transport, and Water, in addition to the National Office of Electricity and Drinking Water (ONEE). One of the major roles of the commission is to reinforce the governance mechanisms to ensure effectiveness of the mobilization of water resources to guarantee the supply of drinking water and irrigation water.

Policies & Regulatory Framework

Relevant Laws	Overview
Law 36-15	This law provides the regulatory framework for the protection, preservation, restoration, and improvement of the environment, including water. It has introduced reforms with the objective to consolidate and strengthen decentralized, integrated, and participatory management and planning of water resources. Also, to strengthen consultation and coordination bodies and organizations through the establishment of the water basin council, by establishing legal foundations to diversify supply sources through the use of unconventional water resources including desalinated seawater, implementing water-related information systems, strengthening the institutional framework and mechanisms for the protection and conservation of water resources, and strengthening financial instruments for the development of the water sector along the principle: user pays/polluter pays.

3.2 Stakeholders Summary

Stakeholders and relevant organizations identified are listed below.

Stakeholder Category	Organizations
Critical Stakeholders	The selection process and mapping of <i>Sebou Water Fund</i> Champions is still under analysis.
Academic Institutions and Think Tanks	University Sidi Mohamed Ben Abdellah - Fez University of Moulay Ismail - Meknes Policy Center for the New South
Government (all)	National Government Moroccan Superior Council of Water and Climate

	<p>Inter-Ministerial Commission of Water</p> <p>High Commission of Water and Forests and the Fight against Desertification</p> <p>Ministry of Health</p> <p>Ministry of Equipment, Transport, Logistics and Water (Water Department)</p> <p>Ministry of Energy, Mines and Sustainable Development</p> <p>Ministry of Agriculture, Fisheries, Rural Development, Water and Forests</p> <p>Ministry of the Interior (Willaya of Fes and Rabat)</p> <p>Ministry of Finance</p> <p>Agency for Agricultural Development of Morocco (ADA)</p> <p>National Office for Electricity and Potable Water (ONEE)</p> <p>National Human Development Initiative (INDH)</p> <p>Local / Regional Government</p> <p>Sebou Hydraulic Basin Agency</p> <p>Regional Office of Agricultural Development of Gharb</p> <p>Regional Council Fes-Meknes</p> <p>Regional Council Rabat-Salé-Kenitra</p>
<p>Intergovernmental Organizations</p>	<p>Food and Agriculture Organization of the United Nations (FAO)</p> <p>United Nations Development Programme (UNDP)</p> <p>World Health Organization (WHO)</p>
<p>Industry Associations and Professional Organizations</p>	<p>COMADER - Moroccan Confederation of Agriculture and Rural Development</p> <p>INTERPROLIVE - Moroccan Interprofessional Federation of Olive</p>

	MAROC CITRUS - Moroccan Interprofessional Federation of Citrus FEDAM - Moroccan Interprofessional Federation of Fruit Trees. FIMALAIT - Moroccan Interprofessional Federation of Milk.
Companies	Please refer to Appendix C
Civil Societies and Water User Organizations	Local Development associations Local Water Users Associations Mohammed VI Foundation for Environmental Protection

In the Feasibility Phase, a summary stakeholder evaluation has been conducted to address the question: *Who has interest, influence, and is willing to work with the Water Fund to improve water security?*

- A methodical identification and inventory of potential stakeholders along with an assessment of each stakeholder’s interest, influence and willingness to cooperate using standardized questions.

3.3 Existing Initiatives

Below is a summary of significant existing initiatives with relevance for the Water Fund.

Integrated water resources management in Morocco - AGIRE (2008-2011)	<p>The integrated water resources management programme was a partnership between the Moroccan State Secretariat for Water and the Environment, the regional water management agencies of the Sous-Massa-Drâa and Oum Er-Rbia, Tensift basins, represented by GIZ commissioned by German Federal Ministry for Economic Cooperation and Development (BMZ).</p> <p>The programme was designed to enhance and improve the capacity of national institutions in the water sector in order to guarantee an integrated, sustainable management of water resources. The programme was devised over four main issues:</p> <ul style="list-style-type: none"> ● Promoting the reuse of wastewater;
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	<ul style="list-style-type: none"> ● Protecting groundwater resources; ● Improving monitoring and control mechanisms in water management planning; ● Reinforcing participation of stakeholders in order to improve water resources planning and management.
Moroccan Coalition for Water (COALMA)	An initiative uniting the public and private sectors around sustainable management of water resources, particularly in Morocco

The National Forest Funds	<p>National forest fund is a public funding mechanism to support sustainable forest management. The fund was instituted by Dahir in 1949 and partly funded by a tax on forest product levies:</p> <ul style="list-style-type: none"> ● 12% tax on imported wood; ● 20% on the main price of forest products; ● 20% on forest estate revenues and road repair taxes.
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3.4 Transparency and Corruption

The following summarizes transparency and corruption considerations.

Transparency Index	Morocco is ranked <i>81st out of 180</i> countries based on the Transparency International Ranking. Its score – a measure for corruption and inequality – was 40 in 2017, with a 3 point increase from previous score in 2016. The higher the score (to 100) the less corruption/inequality, hence, Morocco has witnessed a fluctuating trend with a slight rise in corruption/inequality in the last five years (Transparency International, 2017).
Corruption	<p>The scourge of corruption remains a prevalent issue in Morocco. Although the existence of a strong political will is paving the way for the country to continue on establishing the foundations of significant legal and institutional agendas, these initiatives remain sporadic. In addition, bad governance is still considered as the major impediment to Morocco’s global position in the fight against corruption. The government has taken a series of important measures to consolidate its commitment to fight corruption.</p> <p>Morocco’s anti-corruption efforts since its independence can be divided into two periods: Pre-Mohammed VI & Post Mohammed VI.</p>

	<p>The first period (1962 – 1999) includes the sporadic campaigns of 1964, 1971 and 1996 led by King Hassan II. Although these campaigns were valuable in that they exposed the magnitude and range of corruption in Morocco, they bore the brunt of a common political and administrative trapping of failed anti-corruption efforts in developing countries. The Second period (1999 – present) has been a political management of the issue translated through Morocco’s active participation in numerous initiatives on an international scale. The ratification of the United Nations Convention against Corruption (UNCAC) in 2007 is a testimony to the government’s responsiveness to the global wave of advocacy and awareness-raising regarding the issue at stake.</p> <p><u>Legal Framework:</u></p> <p>Bribery is governed by Articles 248 to 256 of the Moroccan Criminal Code.</p> <p>The main institutions mandated to prevent and fight corruption practices in Morocco are:</p> <ul style="list-style-type: none"> ● The Central Commission for the Prevention of Corruption (ICPC) ● The Central Body for the Prevention of Corruption; ● The General Prosecution’s office and police; ● The General Inspectorate of Finance; ● The Financial Courts (the Higher Council of Accounts and the Regional Councils of Accounts).
	<p>Relevant examples of corruption include:</p> <ul style="list-style-type: none"> ● In the judicial system bribes and irregular payments are often exchanged in return for favorable court decisions. ● In the police sector bribes are often paid to the road police. ● In public services gifts are sometimes offered in order to obtain public utilities such as an official document or permit. In addition, gifts are also given to officials in favor for a construction permit. ● etc. <p><u>Main anti-corruption initiatives:</u></p> <p>1998 - Creation of the National Integrity Committee.</p> <p>1999- Creation of a National Commission for integrity.</p> <p>2007 - Ratification of the United Nations Convention against Corruption.</p> <p>2007 - Creation of the Central Authority for Corruption (ICPC).</p> <p>2007 - Creation of the Corruption Observatory.</p> <p>2016 - Deployment and adoption of National Anti-corruption Strategy.</p> <p>2017- Establishment of the National Anti-Corruption Commission.</p>

3.5 WF Legal & Financial Considerations

Below is a summary of relevant legal and financial considerations for the Water Fund.

<p>Legal Status</p>	<p>The Sebou Water Fund is hosted by “Living Planet Morocco”, a national environment NGO, and is managed as a project with an independent sub account and financial reports. The team of LPM is coordinating the SWF regarding strategy, finance, administration, communication, field activities...</p>
<p>Water Fund Financing Considerations</p>	<p><u>Current situation :</u></p> <p>Grants from Foundations</p> <ul style="list-style-type: none"> - LPM secured 3 years funding from MAVA Foundation for the implementation of the Sebou Water Fund. All the office costs and activities related to studies, public relations, lobbying, capacity building and communication are covered, in their totality. - MAVA Foundation also donated 100 000 euros as first seed to the Sebou Water Fund to start implementing small projects and activities to showcase some operational examples. <p><u>Other direct sources of financing for LPM in Morocco :</u></p> <p>Public subsidies</p> <p>Under Article 6 of the Law 75-00, registered associations may receive subsidies from public authorities. These grants can come from administrations (state, public and semi-public organizations) or from regional, provincial, local or communal bodies.</p> <p>Every year, nearly 8.8 billion dirhams are paid to all 60,000 associations recognized as of general interest. The pot is obviously not divided equally: nearly 80% of this funding is monopolized by 10% of associations.</p> <p>Private Sector Contributions</p> <p>According to Article 6 of Law 75-00, associations can receive cash or in-kind subsidies from companies.</p> <p>LPM is targeting big national and international companies to contribute to the SWF, starting with industries based in the basin: Olive oil and fruit producers, sugar mills, etc. The other sectors are approached on a principle of national solidarity or based on their CSR strategy.</p>

	<p>Call for proposals</p> <p>LPM participates to national and international calls for proposals and submits projects based in the Sebou basin and related to the activities planned within the Sebou water fund.</p> <p>Other sources</p> <ul style="list-style-type: none">- Private donations- Earned Income activities lotteries, crowd funding, concerts, exhibitions, product sales, promotional items, services, training....
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4.0 WATER SECURITY SITUATION

The following describes relevant aspects of the water security situation for the Water Fund. These aspects are summarized for each of the five dimensions of water security and reflect information and observations as of the date of this Analysis. Conclusions and pertinent water security challenges are provided at the end of each sub-section.

4.1 Domestic Water Security

Domestic water security relates to providing all people with reliable, safe water and sanitation services. The following provides a situational overview of domestic water security elements pertinent to the Water Fund.

Element	Situation
Coverage and Access to Piped Supply	100% in urban area and over 80% in rural area [1].
Access to Improved Sanitation	Access varies from 38% to 97% (depending on city/center) with an average of 72%. Rural areas have very limited access to sanitation.
Hygiene	The entire urban population has basic handwashing facility. The specific areas that are substantially worse (<80% of average) are located in rural centers.
Conclusions	<p>Domestic Water Security Challenges</p> <ul style="list-style-type: none"> ● Use of non-conventional water resources (eg. Rainwater harvesting, treated wastewater reuse). ● Development of solutions and practices related to sustainable water use. ● Improving efficiency of water supply and distribution networks. ● Improvement of sanitation conditions, especially in the mountainous areas. ● Treatment and reuse of Industrial effluent.
	<p>Apparent Drivers</p> <ul style="list-style-type: none"> ● Lack of bottom-up participatory approaches and consultation spaces between institutions and users.

	<ul style="list-style-type: none"> ● Irrational management of domestic, industrial, agricultural and touristic water demands. ● Limited collective participation in water management. ● Private sector involvement in water resources management. <p>Information Gaps</p> <p>These domestic water security challenges are affecting quality of life, productivity and economic development in Sebou basin. It is difficult to assess how much this is the case without further study and monetization of the effects. Such a study could provide valuable elements to define urgency and justify investment from the public and private sectors.</p>
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4.2 Economic Water Security

Productive use of water to sustain economic growth in the food production, industry, and energy sectors of the economy. The following provides a situational overview of economic water security elements pertinent to the Water Fund.

Element	Situation
Broad Economic Development	Water is a key factor affecting the Sebou Basin and the region's economic development. It is needed for agricultural, tourism and industrial activities. It is also a basic need of the population that constitutes the labor force of the Basin. Keeping up with the demand of a growing region requires significant investments in infrastructure and operational projects.

Element	Situation
Water for Agriculture	<p>The irrigated agricultural area in the Sebou Basin represents about 357,000 ha. This area is likely to reach 412,000 ha in 2030 according to national agricultural plans and programs.</p>
Water for Industry	<p>The industrial sector is highly developed in Sebou Basin, particularly in the food (oil mill, sugar refinery, etc.), leather and textile industries.</p> <ul style="list-style-type: none"> ● Food industry: There are 200 large oil mills, producing 120,000 t of olive oils and 70,000 t of vegetable oils, which represents more than 65% of the national production. 184 000 t of sugar is produced per year in the Basin, which represents 50% of the national production. ● Leather and textile Industries: They are highly developed in the Basin, especially in Fez, Meknes and Kenitra, and produce 60% of the national production. <p>Many industrial units are located in the Sebou Basin, The majority of them are located inside the centers or at their immediate periphery. These units are generally fed from drinking water networks, and their consumption is counted as urban consumption. Other few industrial units are generally located farther from the centers and supplied with drinking water from their own resources. These isolated industries are heavy consumers of groundwater and surface resources. Their water consumption is estimated at 38 million m³ / year.</p>
Water for Tourism	<p>Tourism potential is important in the imperial cities of Fez and Meknes, mountain areas, hot springs and beaches. Its activity has returned to growth following the introduction of direct flights linking Fez to other European Capitals. The Fez-Meknes region has remarkable tourism assets, which can play an important role in the economic and social life. This region also has a rich natural, cultural and historical capital representing an effective lever for tourism development. The productivity is concentrated in 3 main areas: Mountain area, traditional spas, traditional towns and historic sites.</p>

	<p>Tourism in this region has essentially a cultural character, which is distinguished by its historical and architectural heritage of international renown. The region has 335 classified tourist accommodation establishments, with a total capacity of 19,044 beds [4].</p>
<p>Water for Energy</p>	<p>The current hydroelectric plants of Idriss I, El Kansera, Al Wahda and Allal El Fassi dams have an installed capacity of 535 MW. Their average production is around 600 GWh / year and will increase to 1077 GWh in 2030. The Sebou Basin contains other smaller hydropower plants located along the river in Ras El Ma (Taza province), Oued Fez downstream (Fez Prefecture), Oued Aggay (Sefrou province) and Oued Boufekrane (Meknes prefecture). Five other plants are planned in Mdez, Ain Timedrine, Ouljet Soltane, Bab Ouender and Asafalou dams. These plants will have a total capacity of 300 MWh. The total hydroelectric output of the Sebou Basin is likely to rise to 1,000 GWh / year.</p>
<p>Current Water Consumption by Sector (Industry, Agriculture, and Energy)</p>	<p>Available data indicates that:</p> <ul style="list-style-type: none"> ● Water demand for irrigation is estimated at 2,875 Mm³ in 2010. ● Total consumption of drinking water (urban, rural & industry) is estimated at 345 Mm³ in 2019.
<p>Expected Demand Trends</p>	<ul style="list-style-type: none"> ● Total water consumption in urban area (including urban industry) and rural area is estimated at 300 Mm³ and 103 Mm³ in 2030, respectively. ● Water consumption by extra-urban industry is estimated at 43 Mm³ in 2030 (+23%) ● Expected trends in demand for Agriculture Sector will increase to 3,232 Mm³ in 2030. ● Estimated water volume necessary to Hydropower generation will be 554 Mm³ in 2030.
<p>Expected Supply Trends</p>	<p>- Expected intra-basin transfers: the main purpose of these transfers is to satisfy drinking water needs in large cities, to relieve groundwater resources in order to preserve them and restore their natural balance:</p> <ul style="list-style-type: none"> ● Transfer from the Idriss I dam to Fez and Meknes to supply drinking water, as compensation for the groundwater withdrawals from the Saiss aquifer; ● Transfer from the Ouljet Soltane dam to Meknes for securing drinking water needs in the medium term;

	<ul style="list-style-type: none"> ● Transfer from the M'Dez dam to the Saïss plain for irrigation purposes as an alternative to water abstraction from the Saïss aquifer; ● Transfer from Ouergha river to Sidi Kacem and Kenitra to supply drinking water supply for urban and rural population. <p>- Expected inter-basin transfer: transfer of a raw water volume of 457 Mm³/year to the southern basins. Another transfer from the Asfalou dam to Moulouya Basin may be planned (detailed studies will explore the feasibility of this transfer).</p>
Supply Sustainability	<p>Fez benefits from a double supply of surface water, from the Sebou River, and groundwater (deep aquifer). However, the need to reduce water table drawdown requires finding new surface resources. Meknes depends on groundwater resources and springs (especially the Bittit spring), subject to sharp decline and high turbidity during floods. Kenitra and Sidi Kacem benefit from Maamora and Gharb aquifers.</p>
Conclusions	<p>Economic Water Security Challenges</p> <ul style="list-style-type: none"> ● Pressure on groundwater threatening water security and environmental balance (especially in Saïss and Mnasra aquifers in the coastal zone of Gharb). ● Water use driven by increased population and public-urban uses in some cities (especially Meknes and Fez city) is higher than the sustainable water supply. ● Pollution of water resources by industrial liquid and solid wastes. <p>Apparent Drivers</p> <ul style="list-style-type: none"> ● Difficulties of implementing the legal and regulatory system. ● Disincentives or lack of incentives to reduce consumption. ● Lack of appropriate platform to address water security issues. ● Low valuation of available water resources due to a weak water-saving awareness and overexploitation of freshwater in agriculture.

Information Gaps

- The economic water security problems listed above affect productivity and economic development in Sebou Basin. It is difficult to assess how much this is the case without further study and monetization of the effects.
- The use of treated wastewater in agricultural activities is necessary to perform additional analysis to assess its economic and environmental impact.
- The industrial/commercial production risks are not well quantified. If a risk is documented and communicated, it could trigger additional action from the water fund.

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4.3 Urban Water Security

Creation of better water management and services to support vibrant and livable water-sensitive cities. The following provides a situational overview of urban water security elements pertinent to the Water Fund.

Element	Situation																									
Urban Water Supply	<p>In 2015, the efficiency of drinking water production and distribution in Morocco was 95.4% and 75.1%, respectively [5]. The consumption statistics established by ONEE define the past and predictable efficiencies of drinking water network below.</p> <table border="1" data-bbox="760 610 1749 867"> <thead> <tr> <th>City</th> <th>2004</th> <th>2010</th> <th>2020</th> <th>2030</th> </tr> </thead> <tbody> <tr> <td>Kenitra</td> <td>80%</td> <td>80%</td> <td>80%</td> <td>80%</td> </tr> <tr> <td>Fez</td> <td>55%</td> <td>70%</td> <td>80%</td> <td>80%</td> </tr> <tr> <td>Meknes</td> <td>66%</td> <td>72%</td> <td>80%</td> <td>80%</td> </tr> <tr> <td>Taza</td> <td>66%</td> <td>75%</td> <td>80%</td> <td>80%</td> </tr> </tbody> </table> <p>Achieving an efficiency of 80% by 2030 will save 52 Mm³/year of water.</p>	City	2004	2010	2020	2030	Kenitra	80%	80%	80%	80%	Fez	55%	70%	80%	80%	Meknes	66%	72%	80%	80%	Taza	66%	75%	80%	80%
City	2004	2010	2020	2030																						
Kenitra	80%	80%	80%	80%																						
Fez	55%	70%	80%	80%																						
Meknes	66%	72%	80%	80%																						
Taza	66%	75%	80%	80%																						
Urban Wastewater Collection	<p>The current pollution treatment rate is about:</p> <ul style="list-style-type: none"> ● Domestic pollution: 40% ● Industrial pollution: 20% <p>Fez is the city that poses the most pollution problems, its discharges represent 40% of the total impact in the Sebou Basin.</p>																									
Flood and Storm Drainage	<p>The Sebou Basin is subject to intense daily rainfall, particularly in the Rif and Middle Atlas mountain ranges. This situation can lead to significant daily runoff and generate terrible floods. There are 136 high-risk flood sites mainly located in the provinces of Sidi Kacem, Taza, Taounate, Fez and Ifrane.</p> <p>The considerable delay in the collection and reuse of stormwater is noteworthy. Its annual volume is estimated at 2.4 Mm³.</p>																									

<p>Urban River Health</p>	<p>Along its course, the Sebou River crosses several cities and urban areas, among which Fez city (1 million inhabitants) is the most important. The main industries in Fez city include tanneries, textile, metal finishing facilities and oils mills. A large amount of pollutants (nutrients, toxic metals and persistent organic compounds), emanating from these industries, are discharged into the Fez River, one of the Sebou tributary, representing a preoccupying threat to the Sebou ecosystem (Figure 4). Leather tanning industry is considered as the primary source of toxic pollution discharging chromium and other toxic substances into the river. Chromium compounds are used principally in tannery activities but also in chrome plating industries, textile dyeing and pigmentation, and manufacturing pulp and paper. Brassware facilities generate a large volume of wastewater with high concentrations of toxic metals (such as Cu and Ni) in addition to cyanides [6].</p> <p>The Sebou River showed a weakly polluted status. Contrarily, high levels of major ions, organic carbon and trace metals were encountered in the Fez River and the Sebou River downstream the Fez inputs, due to the discharge of urban and industrial untreated and hugely polluted wastewaters. Trace metals were especially enriched in particles with levels even exceeding those recorded in surface sediments. The first group of elements (Al, Fe, Mn, Ti, U and V) showed strong inter-relationships, impoverishment in Fez particles/sediments and stable partition coefficient (Kd), linked to their lithogenic origin from Sebou watershed erosion. Conversely, most of the studied trace metals/metalloids, originated from anthropogenic sources, underwent significant changes of Kd and behaved non-conservatively in the Sebou/Fez water mixing [7].</p>
<p>Conclusions</p>	<p>Urban Water Security Challenges</p> <ul style="list-style-type: none"> ▪ Demographic and urban development. ▪ Industrial and touristic pressures. ▪ Pollution of water resources by urban activities. ▪ Lack of effective stormwater and flood infrastructure and management. <p>Apparent Drivers</p> <ul style="list-style-type: none"> ▪ Lack of collective involvement of various stakeholders concerned by the delay in urban water management. ▪ Lack of financial resources and investment in the infrastructure.

	<ul style="list-style-type: none">▪ Limited incentives. <p>Information Gaps</p> <ul style="list-style-type: none">▪ It is difficult to assess how much flood affects environmentally and economically the Sebou Basin without further study.▪ Implementation and development of Stormwater Management Practices are required.
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4.4 Environmental Water Management

This section addresses the progress on restoring rivers and ecosystems to health on a regional scale (e.g., issues with flow regulation, environmental governance, and ecosystem services). The following provides a situational overview of environmental water management elements pertinent to the Water Fund.

Element	Situation
Flow Regulation	<p>The basin encompasses several large reservoirs as well as small ones built over a period of 70 years. Therefore, the Sebou River system is heavily regulated, thereby significantly altering the flow regime. The estimated water discharges before and after the construction of the dams are presented in Figure 5. Between 1940 and 1972, the water discharge of the Sebou River and its tributaries was about 2,550 Mm³. The construction of the Idriss 1er dam on the Inaouene River in 1973 reduced the inflow volume supply by 55%. In 1990 the Allal El Fassi reservoir was built upstream on the Sebou River; the water discharge measured at the Azib Es Soltane station was down 70%. The construction of the Al Wahda dam on the Ouergha River was followed by a decrease of the Ouergha's average flow from 2.93–1.2 Mm³ year⁻¹. Considering all dams, it can be estimated that the water discharge of the Sebou River and its tributaries was reduced by approximately 70% [8].</p> <p>Also, it is estimated that an average of 700,000 m³ of fluvial sediments were deposited annually within the estuary, considerably constricting navigation and necessitating costly dredging operations. Nowadays, due to dams impoundment, the fluvial competence has become very weak and the estuary is not flushed as frequently as before.</p>
Environmental Governance	<p>Environmental governance is not yet considered as an essential part of political ecology and environmental policy for advocating sustainability as the supreme consideration for managing all human activities (political, social and economic) in Sebou Basin.</p>
Ecosystem Services	<p>The Sebou basin and its Middle Atlas lakes particularly, are presenting important biodiversity values provisioning ecosystem services , such as:</p>

	<ul style="list-style-type: none"> ● High level of biodiversity concentrated in lakes and surrounding habitats; ● Wetland ecosystems and springs containing several rare or threatened species. ● Important migration corridors located in the Middle Atlas Lakes (used temporarily by migratory birds for nesting or wintering purposes); ● Several lakes are of international importance to birds: Middle Atlas lakes receive more than 6,000 wintering birds each year, representing about 40 species [9]. ● Areas of international importance for freshwater biodiversity (KBAs) maintaining endemic and/or threatened species <p>Several lakes have been identified as sites of biological and ecological interest and are part of the Ifrane National Park (with the exception of Aguelmame Sidi Ali).</p>
<p>Conclusions</p>	<p>Environmental Water Management Challenges</p> <ul style="list-style-type: none"> ● Groundwater depletion due to over-exploitation. ● Land use changes affect the quality and quantity of groundwater recharge. ● Untreated wastewater discharge to environment. <p>Apparent Drivers</p> <ul style="list-style-type: none"> ● Over-allocation of groundwater resources, demand that exceeds supply. ● Lack of collective involvement of various stakeholders. ● Poor wastewater infrastructure and subsidence damage to drainage systems. <p>Information Gaps</p> <p>The effects of the depletion of the groundwater on the aquifer structure need to be further investigated and quantified through a hydrogeological study, which should include a review of the already existing research. Also, the analysis of the link between the hydrology, the biodiversity and the ecosystem services in the Basin needs to be conducted.</p>

4.5 Resilience to Water-Related Natural Disasters

Building of resilient communities that can adapt to change and are able to reduce risk from natural disasters related to water to minimize the impact of future disasters. The following provides a situational overview of water-related natural disaster elements pertinent to the Water Fund.

Element	Situation
Water-Related Natural Disasters	<p>Morocco has faced 96 big natural disasters between the years 1960 to 2014 in more than 300 cities. The number of disasters increased fourfold between the years 1980 and 2000 and spiked 22-folds during the period between 2000 and 2014. Water scarcity-related disasters caused the most damage to Moroccans, their property and their livelihoods. The kingdom has suffered from several floods and droughts, as well as heat waves and cold waves between the years 1960 to 2014 [10].</p> <p>Drought and floods were always present in Sebou history. Their importance as a structural element of the basin climate increased these last decades. Sebou has experienced the longest dry episode of its contemporary history, characterized by a reduction of the precipitations and a tendency to the rise in temperatures. The characterization of the climatic drought during the period of 1961-2004 showed an increase in the droughts frequency, their severity and their spatial distribution [11].</p> <p>The high precipitations in 1995-96 were intense and caused severe erosion problems and important floods, while the drought of 1994-95 caused severe water shortage with impacts on many activities.</p>
Droughts	<p>The Sebou Basin was considerably affected by a long dry period that began in 1980. The differences in rainfall distributions and flow regimes in the northern and southern parts of the Basin were very clear in dry periods [12]. The effect of drought was significantly marked on the Sebou water supply.</p>
Floods	<p>The Sebou Basin has experienced major floods in the past, particularly in the Gharb plain. The last floods date back to 2008 and 2009. These floods caused enormous damage in the Gharb plain and affected 60,000 ha of cereals and legumes in 2009.</p>

	<p>16 provinces and prefectures in the Basin have 136 zones identified as high-risk flood sites. The flood risks and damage observed at these sites were aggravated by the rapid and uncontrolled urbanization of flood-prone areas, the development of agricultural lands and the development of construction activities on natural waterways, etc.</p>
<p>Climate Change Susceptibility</p>	<p>The climatic fluctuations in Sebou Basin are inducing major variations in stream flows and the consequent discharges reaching the dams downstream. These climatic variations, with the observed decline in total precipitation, are considered as a trend in response to the global Climate Change regionally observed.</p> <p>Precipitations and consequent stream flows recorded in 4 sub-Basins in the northern part of Sebou watershed showed very important climatic fluctuations with an irregular trend of about 8 to 12 years [13].</p>
<p>Effects of Predicted Climate in Watershed</p>	<p>Many studies showed that dry and humid periods are recurrent with a return cycle of about 8 to 12 years. Dry years are becoming more frequent compared to humid or normal years. The recurrence of more dry years, were at some time considered conjectural. However, this recurrence underlines the fact that drought should be considered as a rather factual phenomenon, most probably linked to the climatic changes observed on a larger scale. The linear fit to the observed precipitation shows that, in addition to the fluctuations, there is also a general trend towards a significant decline in total precipitation. Slopes of about -5.5, -4.2, -3.9 and -3.7 are obtained respectively for Ourgha, Inaouen, Upper Sebou and Rdom subwatersheds respectively. This amounts to an average decline in the last 50 years varying from -285 mm in Ourgha to -180 mm in Rdom. Climatic variations are therefore inducing major variations in stream flows and the consequent discharges reaching the dams downstream. These climatic variations, with the observed decline, can certainly be considered as a trend in response to the global climatic change observed regionally and worldwide [14].</p>
<p>Disaster Prevention Strategy</p>	<p>There are several plans that contain information on disaster prevention strategies in Morocco (including Sebou Basin). These include:</p> <ul style="list-style-type: none"> ● National Flood Protection Plan (about 100 floodplains identified in the basin) ● Specific interventions to fight against floods in the Gharb plain. ● 1st Phase of Flood management actions concerned 40 priority sites for the period 2010-2012.

	<ul style="list-style-type: none"> ● 2nd Phase of Flood management actions concern 4 sites / year for the period of 2013-2030.
Mitigation Measures Planned	Mitigation Measures planned by ABHS concern Flood protection and management with 75% structural facilities and 25% non-structural developments (watershed and floods, watercourse maintenance, measurement networks, relief, implementation of Risk Prevention Plans, information, trainings, etc.).
Adequacy of Planned Mitigation	Additional information about mitigation measures and an indication of effectiveness is needed including independent experts opinion validating these plans.
Climate Change Adaptation Actions	Morocco's national plan for combating global warming (PNRC) was drawn up in 2009 to define and consolidate mitigation and adaptation actions carried out by various actors. Therefore, Territorial Plans are being developed to supplement the PNRC according to local specificities. The PNRC commits the country to a policy combating global warming and lists the portfolio of government actions. They mainly concern the energy, transport, industry, waste, agriculture, forestry and construction sectors [15].
Conclusions	<p>Resilience to Water-Related Natural Challenges</p> <p>The precipitations over the past 50 years shown that dry years are becoming, unfortunately, more frequent than wet or normal years. This trend will definitely be a challenge in early mitigations of stream flows and subsequently on managing surface water resources in a most probable climate change trend. A good knowledge and management of surface water resources relies on both a good understanding of the relationships of previous precipitation fluctuations and their consequent flows, as well as on a sound mitigation of future behaviour based on modelling for probable climatic situations.</p>
	<p>Apparent Drivers</p> <ul style="list-style-type: none"> ● Rapid, uncontrolled and often unauthorized urbanization of flood-prone areas; ● Flood risk not considered in urban planning; ● Existence of undersized watercourse crossing structures (eg. bottlenecks); ● Development of sections of watercourses by agricultural diversion works resulting in the uncontrolled raising of the water line; ● Blockage of waterways by construction waste; ● Lack of waterway maintenance.

	<p>Information Gaps</p> <ul style="list-style-type: none">• Data on: climate change projections and impact, disaster prevention strategy, global mitigation measures, and adequacy of planned mitigation.• Assessment of predicted water balance in view of different water needs and climate change scenarios would be crucial for the development of the Water Fund.
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APPENDIX 1: FIGURES

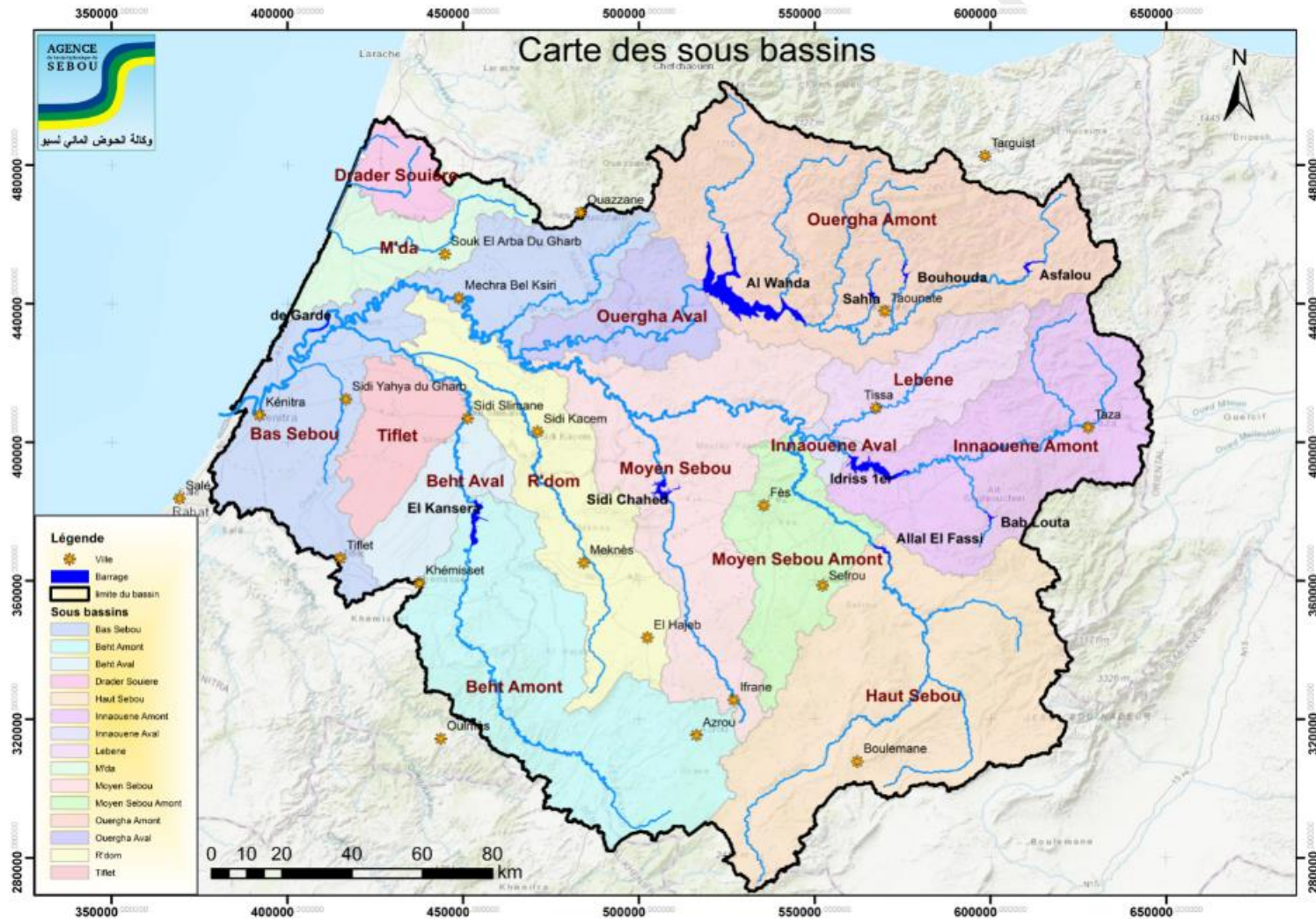


Figure 1: Map of Sebou Sub-basins

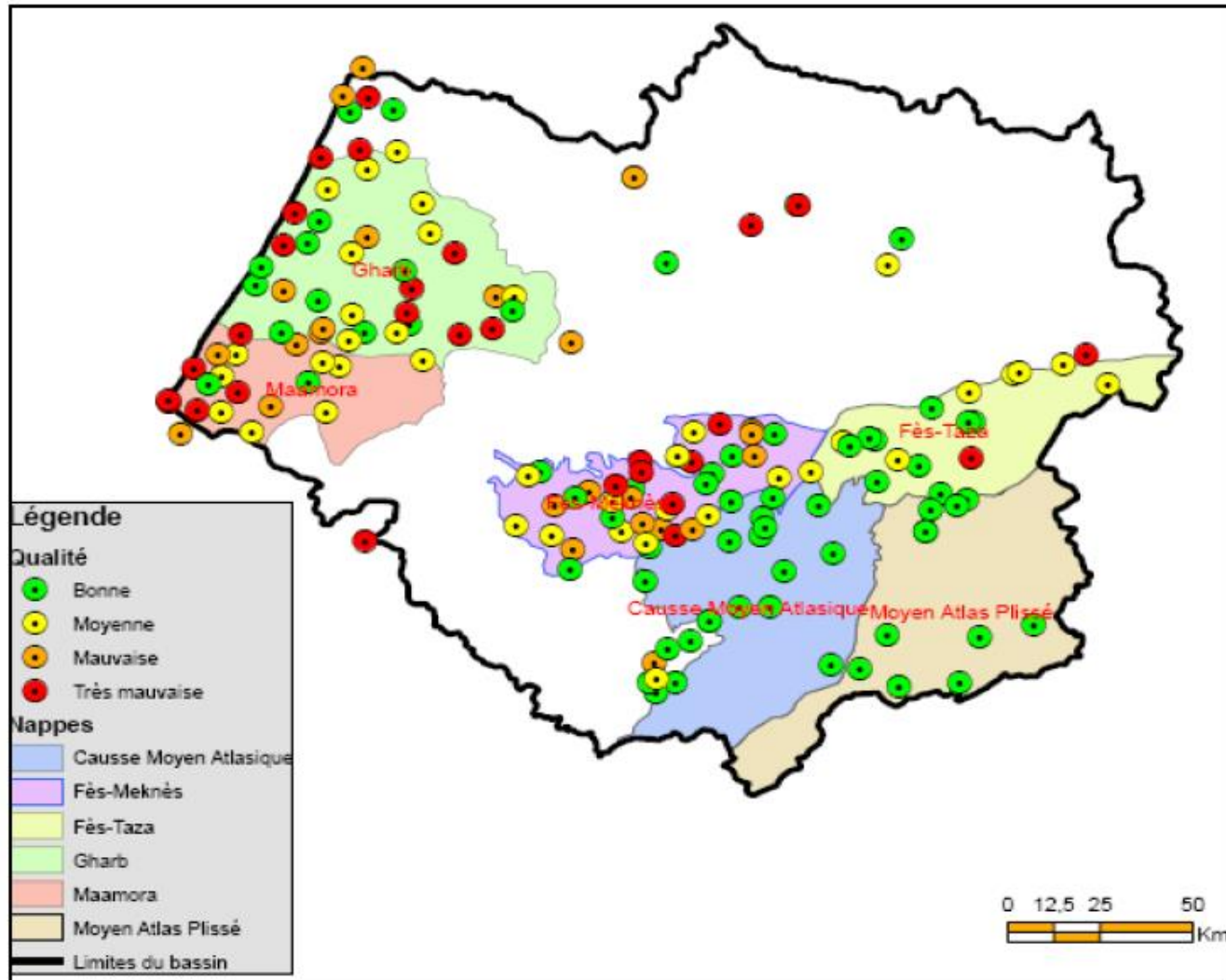


Figure 2: Quality of Sebou water tables (ABHS, 2011)

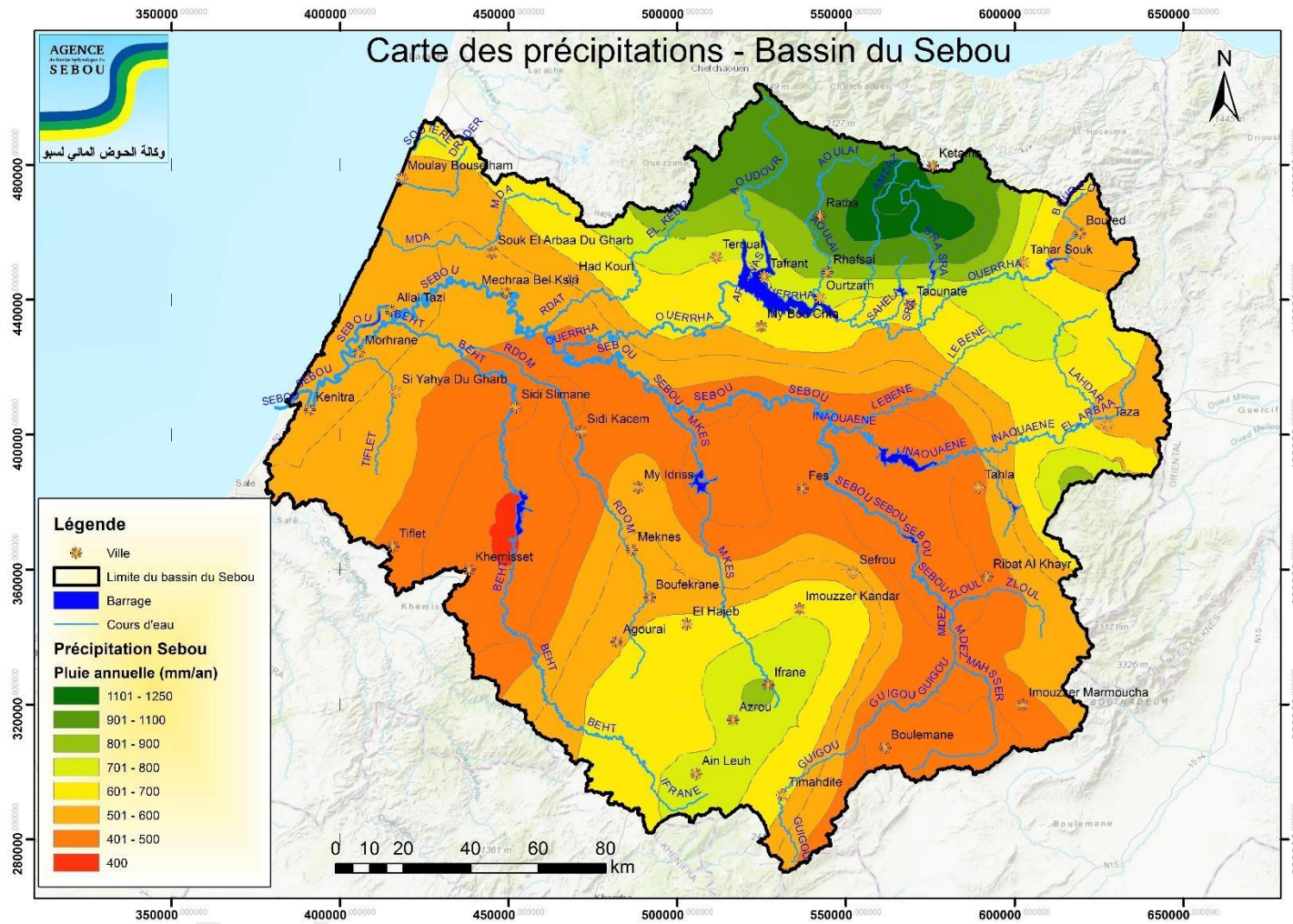


Figure 3: Precipitation Map of Sebou Basin

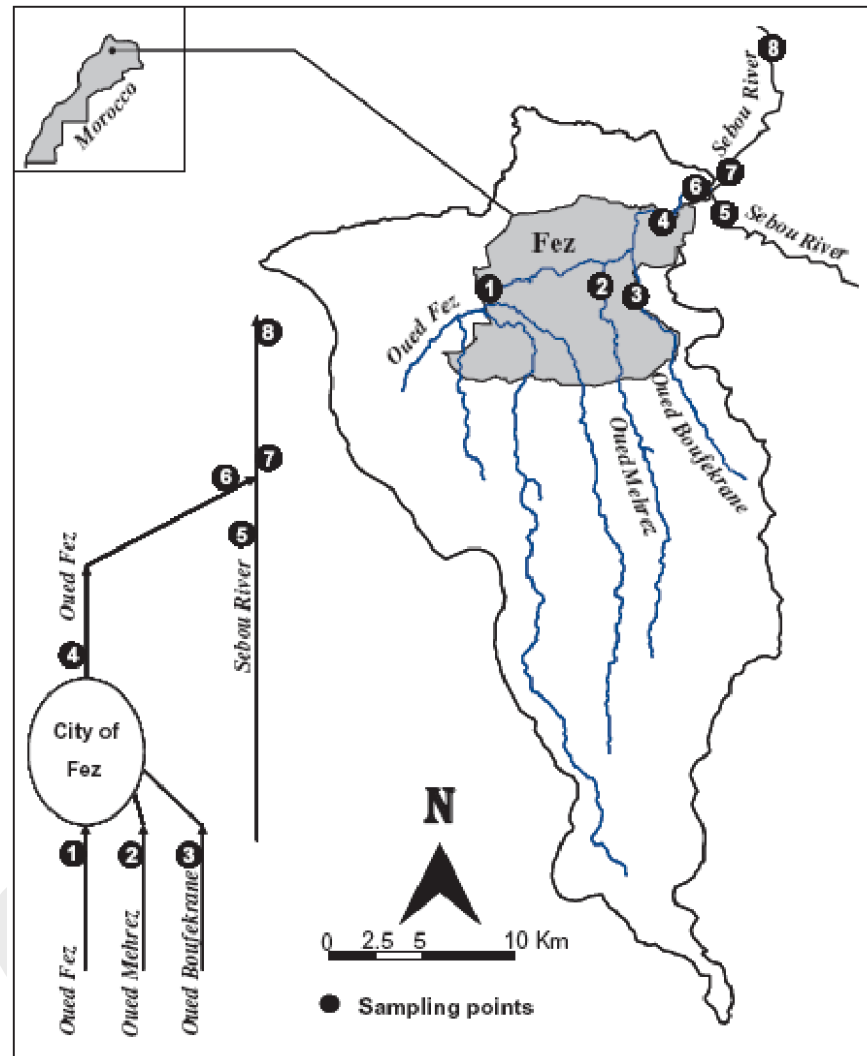


Figure 4: Oued Fez catchment (Perrin et al., 2014) [15]

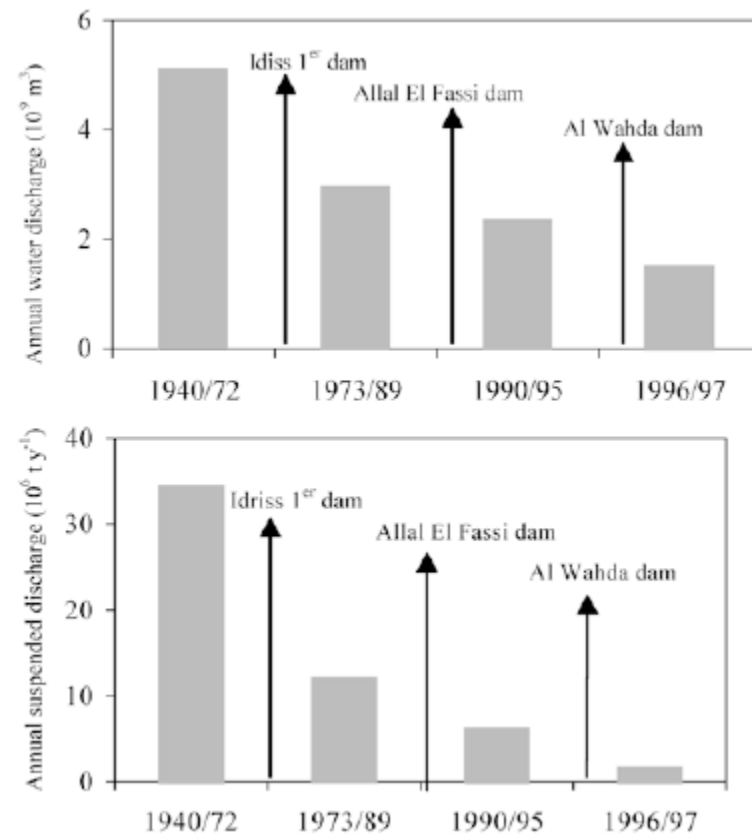


Figure 5: Variation of the annual water (above) and suspended sediment (below) discharges downstream of the Sebou River before and after the construction of dams

APPENDIX 2: STAKEHOLDER MAPPING

Stakeholder	Level	Geography	Category	Power	Urgency	Legitimacy	Interest in water	Influence	Willingness to cooperate with SWF (Perception)
<i>Organization name of your stakeholder</i>	<i>Level of the scope of influence of the organization</i>	<i>Geographical area where the organization has activities/influence/jurisdiction</i>	<i>The category to which the organization belongs: Government, Private Sector, etc.</i>	<i>The degree to which the stakeholder has power (e.g. physical, material, symbolic power) to help make or break your current initiative(s)</i>	<i>The degree to which the stakeholder claims call for immediate attention</i>	<i>How legitimate (e.g. truthful, research-based) are the stakeholder's claims?</i>	<i>See Stakeholder Assessment and Mapping Guide</i>	<i>See Stakeholder Assessment and Mapping Guide</i>	<i>See Stakeholder Assessment and Mapping Guide</i>
				<i>Rank: scores (such as High, Medium, Low)</i>	<i>Rank: scores (such as High, Medium, Low)</i>	<i>Rank: scores (such as High, Medium, Low)</i>	<i>Rank -4 to +4</i>	<i>Rank 1 - 9</i>	<i>Rank 1 - 5</i>
Moroccan Superior Council of Water and Climate	National	National	Government	High	High	High	4	9	4
Inter-Ministerial Comission of Water	National	National	Government	High	High	High	4	9	4
High Comission of Water and Forests and the Fight against Desertification	National	National	Government	High	High	High	3	8	5
Ministry of Health	National	National	Government	Low	Low	High	2	8	4
Ministry of Equipment, Transport, Logistics	National	National	Government	High	High	High	3	8	5

Stakeholder	Level	Geography	Category	Power	Urgency	Legitimacy	Interest in water	Influence	Willingness to cooperate with SWF (Perception)
and Water (Water Department)									
Ministry of Energy, Mines and Sustainable Development	National	National	Government	High	High	High	2	8	4
Ministry of Agriculture, Fisheries, Rural Development, Water and Forests	National	National	Government	High	High	High	2	8	4
Ministry of the Interior (Wilayah of Fes and Rabat)	National	National	Government	High	High	High	1	8	4
Ministry of Finance	National	National	Government	Low	Low	High	1	8	3
Sebou Hydraulic Basin Agency	National	Regional	Government	High	High	High	4	9	5
Regional Office of Agricultural Development of Gharb	National	Regional	Government	Medium	Medium	High	1	7	4
Agency for Agricultural Development of Morocco (ADA)	National	National	Government	Medium	Medium	Medium	1	7	4
National Office for Electricity and Potable Water (ONEE)	National	National	Government	Medium	Medium	Medium	3	8	4

Stakeholder	Level	Geography	Category	Power	Urgency	Legitimacy	Interest in water	Influence	Willingness to cooperate with SWF (Perception)
Regional Council Fes-Meknes	National	Regional	Government	High	High	High	1	8	4
Regional Council Rabat-Salé-Kenitra	National	Regional	Government	Low	Low	High	1	8	4
National Human Development Initiative (INDH)	National	National	Government	Low	Low	High	1	6	4
Mohamed VI Foundation for Environmental Protection	National	National	National Foundations	High	Medium	High	2	7	4
National Fund for Environment and Sustainable Development	National	National	National Funds	Medium	Medium	Medium	2	4	3
Agricultural Development Fund (FDA)	National	National	National Funds	Medium	Medium	Medium	1	2	3
Industrial Pollution Control Fund (FODEP)	National	National	National Funds	Medium	Low	Medium	1	4	3
COMADER	National	National	Inter-professional Associations	High	High	Medium	-1	4	3
INTERPROLIVE	National	National	Inter-professional Associations	Medium	Low	Low	-1	4	3
MAROC CITRUS	National	National	Inter-professional Associations	Medium	Medium	Low	-1	4	3

Stakeholder	Level	Geography	Category	Power	Urgency	Legitimacy	Interest in water	Influence	Willingness to cooperate with SWF (Perception)
FEDAM	National	National	Inter-professional Associations	Medium	Medium	Low	-1	4	3
FIMALAIT	National	National	Inter-professional Associations	Medium	Medium	Low	-1	4	3
Local Development associations	National	Local	Civil Society	Medium	Medium	Low	-1	4	3
Local Water Users Associations	National	Local	Civil Society	Medium	Medium	Low	-1	4	3
Food and Agriculture Organization of the United Nations (FAO)	International	International	Intergovernmental Organizations	Low	Low	High	2	2	4
United Nations Development Programme (UNDP)	International	International	Intergovernmental Organizations	Low	Low	High	2	2	4
World Health Organization (WHO)	International	International	Intergovernmental Organizations	Low	Low	High	2	2	4

| Decision Support Document |



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1.0 EXECUTIVE SUMMARY

Based on Sebou's identified water security problems and the potential for a Water Fund to mitigate and resolve the problems, the recommendation is to proceed with the design of a Water Fund. A Sebou Water Fund can have a positive impact on all Water Security Dimensions by generating the necessary interest from stakeholders, influencing public policy and water governance, and ultimately, unlocking the potential to create significant impacts.

In a general sense, a Water Fund can contribute by:

- Contributing with scientific evidence to improve knowledge around water security;
- Developing a shared and feasible vision of Water Security;
- Convening different stakeholders to generate political will and enable meaningful and positive impact on scale through collective action;
- Positively influencing water-related governance and decision making;
- Encouraging and driving implementation of natural infrastructure and other innovative projects at the basin level;
- Offering an attractive vehicle for pooling resources to invest cost-effectively in source watersheds.

2.0 Go/No-Go Recommendation

2.1 Recommendation

Recommendation	Proceed with the next Phase (Design) to establish a Water Fund for Sebou Basin.
Physical Setting and Scope Considerations	<p>The Sebou Basin covers an area of 40,000 km² encompassing 4 regions and 17 provinces in Morocco. The streams of Sebou are essential to the livelihood and sector based activities of over 6.2 million people. Its agricultural and industrial sector outcomes contribute significantly to the national economy. This Basin has a vital socio-economic importance for Morocco, being home to nearly 20% of the population. It holds 30% of the agricultural land and 20% of the country irrigated land potential yet covers only 6% of the national surface area.</p> <p>The Sebou Basin is the most important agricultural region of Morocco. It has a relatively well-developed social and economic infrastructure; only 25% of its drainage area is covered with natural vegetation. Since the Sebou lower sub-Basin consists of a coastal plain, large-scale irrigation schemes have been developed in the Rharb plain. The main crops grown are cereals, vegetables, olive, sugar beet, citrus, and grapes. The upstream part of the Basin supports a large population practicing rainfed agriculture, offering significant opportunities for improved land and water management in agricultural and forestland. Most of the Middle Atlas lakes are located in the Basin. The latter is remarkable due to its large number of ecosystems that it contains: 39 important wetlands, including 5 areas classified as Ramsar sites, 2 national parks, 4 key biodiversity areas for freshwater and 17 sites of biological and ecological interest. Many of these sites are natural habitat of migratory birds and other endemic animal and plant species that are both rare and endangered. The forest represents an important natural wealth in the Sebou Basin. It covers a total area of 1,200,000 ha and consists mainly of oaks, cedars, thuja and matorral. In addition, it provides grazing spaces and fuelwood for riparian populations and contributes significantly to the stabilization of lands and consequently to the reduction of erosion and siltation of dams.</p>

	<p>See Section 2.1 of the Situation Analysis for more information about each hydrologic area and Appendix 1. See Section 2.4 of the Situation Analysis for the detailed Water Balance.</p>
<p>Arguments</p>	<p>The Sebou Basin is extremely water-scarce and faces significant challenges in all dimensions of water security. The primary drivers identified include:</p> <p>Domestic Water Security Drivers</p> <ul style="list-style-type: none"> ● Lack of bottom-up participatory approaches and consultation spaces between institutions and users. ● Supply-side management of water resources. ● Irrational management of domestic, industrial, agricultural and touristic water demands. ● Limited collective participation in water management. ● Private sector involvement in water resources management. ● Lack of an action plan to promote water conservation. <p>Economic Water Security Drivers</p> <ul style="list-style-type: none"> ● Difficulties of implementing the legal and regulatory system. ● Disincentives or lack of incentives to reduce consumption. ● Lack of appropriate platform to address water security issues. ● Low valuation of available water resources due to a weak water-saving awareness and overexploitation of freshwater in agriculture. <p>Urban Water Security Drivers</p> <ul style="list-style-type: none"> ● Supply-side management of water resources. ● Lack of collective involvement of various stakeholders concerned by the delay in urban water management. ● Lack of financial resources and investment in the infrastructure. ● Lack of insight and evidence of economic impact. ● Failing oversight and limited incentives. <p>Environmental Water Management Drivers</p> <ul style="list-style-type: none"> ● Over-allocation of groundwater resources, demand that exceeds supply.

- Lack of collective involvement of various stakeholders.
- Poor wastewater infrastructure and subsidence damage to drainage systems.

Resilience to Water-Related Natural Drivers

- Rapid, uncontrolled and often unauthorized urbanization of flood-prone areas.
- Flood risk not considered in urban planning.
- Existence of undersized watercourse crossing structures (eg. bottlenecks).
- Development of sections of watercourses by agricultural diversion works resulting in the uncontrolled raising of the water line.
- Blockage of waterways by construction waste.
- Lack of waterway maintenance.

The precipitations over the past 50 years shown that dry years are becoming, unfortunately, more frequent than wet or normal years. This trend will definitely be a challenge in early mitigations of stream flows and subsequently on managing surface water resources in a most probable climate change trend. A good knowledge and management of surface water resources relies on both a good understanding of the relationships of previous precipitation fluctuations and their consequent flows, as well as on a sound mitigation of future behaviour based on modelling for probable climatic situations.

See Section 3.0 below for data and details about the magnitude of these water security problems and potential Water Fund contributions/interventions to mitigate their negative impacts.

2.2 SWOT Analysis

Strengths

- Solid WWF presence in the basin with a long lasting relationship with the Sebou Hydraulic Basin Agency
- Common vision on IWRM developed with the Sebou Basin Agency
- MoU with the HCEFLCD (Forest Service)
- Baseline of information related to Sebou Basin
- Knowledge of i) the civil society ii) the scientific world iii) local and national authorities
- On-going dialogue with the public and private sector exploiting water resources of the Basin
- Legal representation of WWF in Morocco and in the Region
- WWF as the host of Sebou Water Fund set-up operational Team.

Opportunities

1. Water quantity

- One of the most important river basins in the country with a total area of 40,000 km².
- It contributes with 30% of the national potential of surface water resources and 20% of the groundwater resources.
- Water resources potential of 5.6 billions of cubic meters representing 28% of the national potential.
- Several large and small dams built in the 70s which are a major source for irrigation, drinking water and industrial water.

2. Ecosystems

- 39 wetlands including 5 Ramsar Sites
- 2 national parks
- 4 key biodiversity areas for freshwater
- 17 sites of biological and ecological interest (SIBE) that constitute a natural habitat for migratory birds and other rare and endangered endemic animal and plant species.
- Lakes located on migration corridors and used temporarily by migratory birds for nesting or wintering. The lakes of the Middle Atlas receive more than 6000 wintering birds each year representing about forty species.
- Results of the inventory of animal species of local, national or international importance:
- 198 species and subspecies divided into 12 classes, 72 families and 145 genera. The most representative classes in terms of specific wealth are: the class of insects with 76 species, the class of birds with 47 species and the class of

	<p>fishes with 17 species, the majority of which are introduced species.</p> <p>3. Governance: In its Intended Nationally Determined Contribution, Morocco has set ambitious targets for adaptation in the water sector by putting in place actions to conserve water resources and for economic sectors and domestic needs by 2030 under the following instruments:</p> <ul style="list-style-type: none"> • National Water Strategy • National Water Plan • Plan Maroc Vert • Drought management • Guidelines for the integrated management of water resources • National flood protection plan • National Liquid Sanitation Program • National Rural Sanitation Program • National Plan for reuse of wastewater. <p>4. Socioeconomics</p> <ul style="list-style-type: none"> • Most important agricultural region of Morocco with a total agricultural area of 1.8 million hectares, 357,000 of which irrigated. • One of the most populated areas of Morocco, supplying water to irrigate wheat, sugar beet and rice fields as well as supporting olive groves and vineyards. • Large number of rainfed farms upstream offering significant opportunities for improved green water management practices.
<p><u>Weaknesses</u></p> <ul style="list-style-type: none"> • Access to information 	<p><u>Threats</u></p> <p>1. <u>Water quantity</u></p>

- Difficulty in accessing the decision makers in public sector
- Management of inter-institutional conflicts
- Limited engagement of Civil Society actors in the Region

- Overconsumption of mobilized water in irrigation.
- Overexploitation of groundwater for agriculture
- Poor irrigation system with water losses reaching sometimes 50%, mainly due to:
 - Poor water-use practices at the farm level;
 - Degradation of irrigation systems;
 - Lack of operational capacities for network management.

2. Water quality

- Diffuse pollution from agricultural percolating in the water tables
- Industrial pollution from small and medium enterprises (olive, leather, etc.)
- lack of wastewater treatment plants

3. Ecosystems

- Water overexploitation depleting wetlands, riverine and riparian ecosystems
- Massive deforestation and associated land degradation causing siltation of dams, loss of arable land, and flooding (particularly relevant in the high mountain areas of the Middle Atlas and the Piedmont area).
- Failure to meet environmental water demands.
- Climate change causing:
 - Localized, intense precipitation, especially in summer or fall causing erosion
 - Prolonged floods also occur, affecting downstream areas. These harmful events have most likely become more frequent in recent years due to the continuing land use changes in the mountain areas.
- Lack of ecosystem connectivity as consequence of infrastructures

	<p>4. <u>Governance:</u></p> <ul style="list-style-type: none">• Lack of integration among sectors. <p>5. <u>Socioeconomics</u></p> <ul style="list-style-type: none">• 6.2 million people living in the basin (23% of Morocco's population), and relying on its water resources• Population growth• Land use and management changes altering the overall water balance, leading to an increase in runoff, peak flows, soil erosion and sedimentation of downstream reservoirs.• High pressure to secure the growing demands for water for domestic consumption, industry and agriculture• Irregular precipitation and flooding events are limiting the socio-economic development of the basin.
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2.3 Conditions

To address the aforementioned weaknesses and threats the Water Fund’s Design Phase needs to consider the conditions below to ensure the Water Fund remains feasible and sustainable.

<p>Conditions</p>	<ol style="list-style-type: none"> 1. Continuing stakeholder engagement program to ensure the various stakeholders remain aligned with the Water Fund’s mission, goals, and objectives. 2. The Water Fund needs to have a sound anti-corruption policy to maintain credibility and effectiveness. 3. Upon the creation of the Water Fund, sustainable sources of funding must be sought to ensure the long-term success of the Fund. 4. Some of the assumptions in this analysis will need to be verified to withstand scrutiny by experts and academia. Such verification should only be done if and when necessary (e.g., when decisions are required, for publication or dissemination). We recommend the following studies per category <ul style="list-style-type: none"> • Link between hydrology, biodiversity and ecological functioning <ul style="list-style-type: none"> ○ Hydrological report incl. water requirements of ecosystems ○ Mapping of biodiversity hotspots • Socio-economics, land-use & policies <ul style="list-style-type: none"> ○ Analysis of the impact of PMV ○ Analysis of trends and current land-use & socio-economics ○ Analysis of ecosystem services and description of most valuable ecosystems & related business opportunities ○ Study on climate change scenarios ○ Assessment of predicted water balance in view of various human water needs and climate change scenarios 5. Stakeholder Engagement – from very early on – with the critical stakeholders will be vitally important to ensure an issue does not become an obstacle to other solutions.
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SEBOU WATER FUND

INVEST IN NATURE



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