Chapter 6
Integrated Water Resources Management in Morocco

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Abstract In Morocco security of water supply has always been an important consideration in the economic and social development of the country. The consequence of population and economic growth, accentuated by an increased variability and scarcity of water resources, is the growth of requirements for the quantity and quality of water, their more intensive and comprehensive use. The emphasis in Moroccan development planning has been for the last five decades on maximizing the capture of the country's surface water resources and providing for their optimal use in irrigated agriculture, potable water supplies, industrialisation and energy generation on a sustainable basis. Enormous capital resources have been invested in the essential infrastructure to control surface water flows. To meet the challenges posed by the growing water scarcity, the rising costs of supplying additional water and more direct and intense competition among different kind of water users and uses, emphasis has shifted to the more sophisticated and difficult task of ensuring socially and technically efficient allocation of the existing water resources among competing consumer groups on a sustainable basis. An integrated approach to water resources management is adopted through mutually reinforcing policy and institutional reforms as well as the development of a long term investment program mobilizing innovative financing mechanisms including public-private-partnerships.

6.1 Introduction

Morocco is a water-scarce country, and securing an uninterrupted supply of water for the nation's sustainable socio-economic development has been a constant concern. The success of Moroccan water policy can be associated with a number of

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achievements. These include a long-term planning policy launched in the early 1960s, and a 'state-of-the-art' institutional framework and legal arsenal, most prominently Law 10–95, enacted in 1995 (and updated in 2016), which consolidated integrated, participatory, and decentralised water resources management through, in particular, the creation of river basin agencies. These policies endowed the country with 140 large dams, an area equipped for irrigation of approximately 1.5 million hectares, the satisfaction of domestic, industrial, and tourism water needs, the development of hydropower production, and the improvement of drought alleviation and flood protection.

In spite of these achievements, Morocco's water sector is facing growing challenges. Indeed, water scarcity is becoming a serious challenge and affecting development in the country. A changing climate, decreasing precipitation and higher frequency of droughts, population growth, and urbanisation are increasing the pressure on the resources. The present water use patterns and withdrawals are not sustainable (CESE 2014).

Driven by these challenges, Morocco has embarked on reforming its water sector. A change in thinking and action in water management has taken place through embracing a holistic water sector approach that is economically, socially, and environmentally sustainable.

The National Water Plan (NWP) was launched in 2010 as the vehicle of the National Water Strategy, combined with the regional water master plans. It is based on an optimal mix of both a vigorous demand management strategy, involving comprehensive reforms and actions to make better use of existing supplies, and a supply management strategy, involving highly selective development and exploitation of new water supplies (conventional or non-conventional such as desalination and reuse of sewerage water). Moreover, the NWP pays more attention than in the past to the protection of water resources and the natural environment, as well as adaptation to climate change.

6.2 The Geographic and Hydro-Climatic Contexts

Located on the extreme north-west of the African continent, Morocco's territory covers an area of over 700,000 km^2. Its coastline on the Atlantic Ocean and the Mediterranean totals 3500 km.

Four rugged mountain chains dominate Morocco's topography and divide the country into three geographic regions: the mountainous interior, including plateaus and fertile valleys; the Atlantic coastal lowlands; and the semi-arid and arid area of eastern and southern Morocco, where the mountains descend gradually into the Sahara Desert. In the north, the Rif mountain range runs parallel to the Mediterranean. South of the Rif range, a series of three Atlas ranges somewhat overlap one another as they slant across the country on a generally north-east/south-west axis.

The Rif and Atlas ranges divide Morocco into two climatic zones: one that receives westerly winds from the Atlantic and one that is influenced by the proximity of the Sahara Desert. Western and northern Morocco have a Mediterranean (subtropical) climate, with mild winters and hot, dry summers. The pre-Saharan and Saharan south have semi-arid and arid climates. Rainfall varies from moderate in the north-west to scanty in the south and east (Fig. 6.1). Morocco has the most extensive river system in North Africa. It is managed by ten river basin agencies (Fig. 6.2). The country is also endowed with groundwater resources. Some 32 deep aquifers and more than 46 shallow ones scattered all over the country have been inventoried (Fig. 6.3).

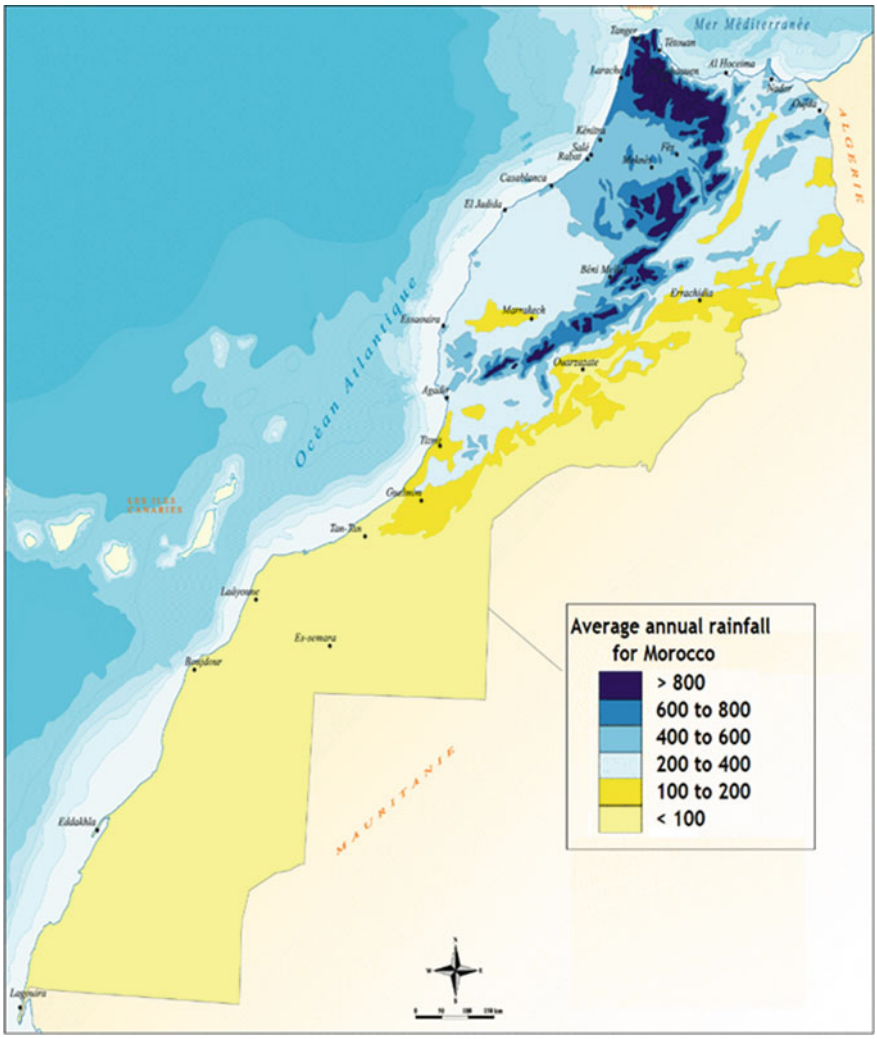

Fig. 6.1 Spatial distribution of precipitation

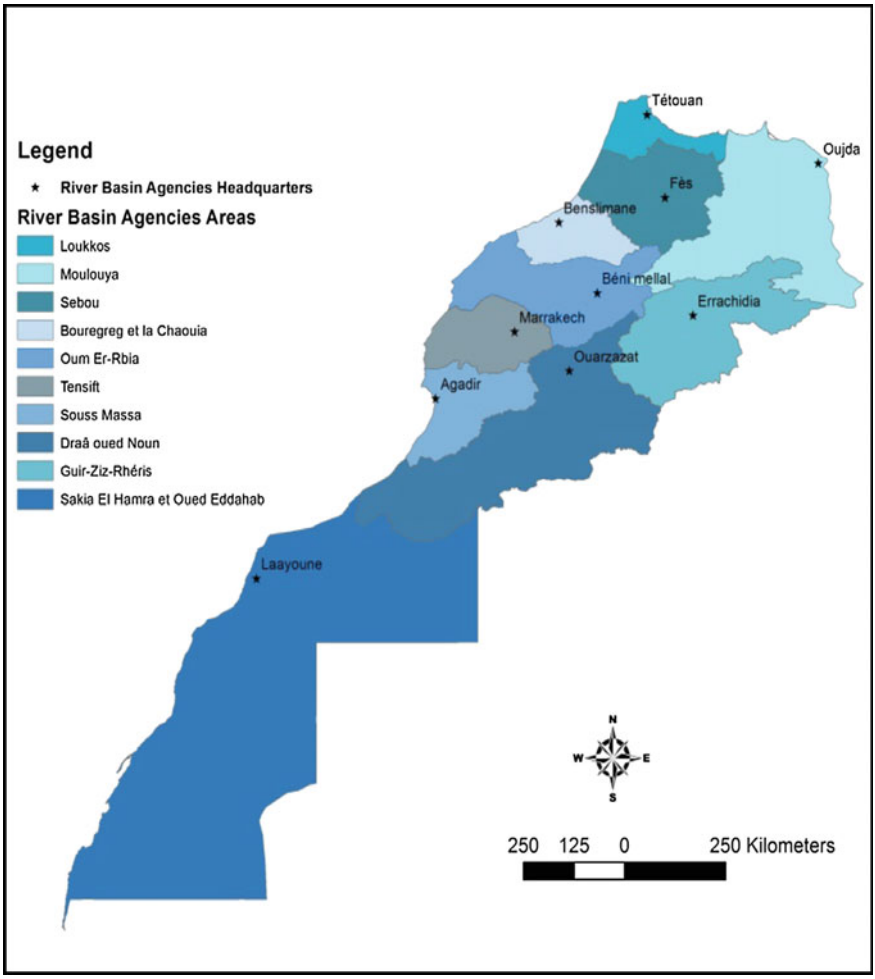

Fig. 6.2 River basin agencies in Morocco

The mean annual rainfall throughout Morocco under average seasonal conditions is estimated at 140 billion cubic metres (BCM). However, the renewable water resources do not exceed 22 BCM: 18 BCM from surface water and 4 BCM from groundwater. More than half of these resources are concentrated in the northern basins and the Sebou Basin, which together cover a mere 7% of the country's surface area (Fig. 6.2). Moreover, water supply is very irregular over time: the ratio between the wettest and the driest year can vary from 1 to 9. The spatial variability is also very high: the water supply per capita can vary in the proportion of 1 to 8 between the different drainage areas. Because of its inconsistent rainfall, Morocco is subject to periodic droughts, which take a considerable toll on agriculture and the economy.

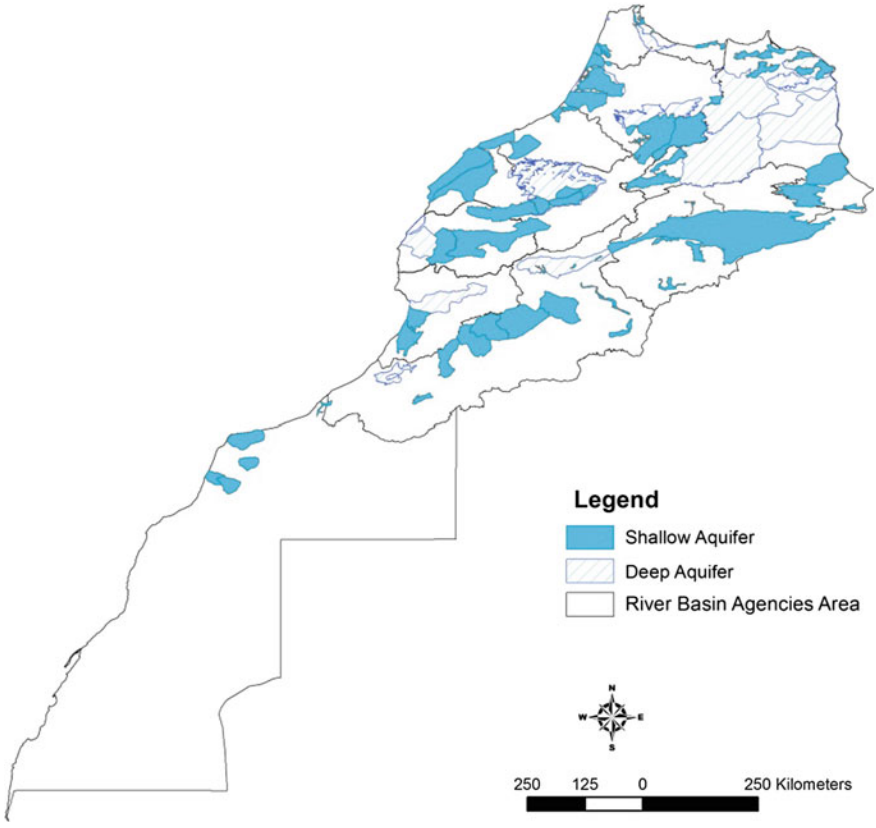

Fig. 6.3 Groundwater in Morocco

The population has more than tripled since 1956, rising from 10.5 million in that year to 33.8 million according to the 2014 census (Fig. 6.4). Morocco has seen rapid urbanisation in recent decades, with its urban population rising from 29% in 1956 to 60% today. The consequence of a rapidly growing population, accentuated by a progressive shift from rural to urban living, is the growth of requirements for the quantity and quality of water resources, as well as their more intensive and comprehensive use.

Morocco's economy is well diversified. The economy is dominated by the service sector, with a 56% share of GDP in 2016, against 24% for industry and 20% for agriculture and agro-industry. On the other hand, agriculture employs 40% of the active population of the country. Morocco is proceeding with a core economic growth path with critical development activities in industry (Plan Emergence), agriculture (Plan Maroc Vert), tourism (Plan Azure), and energy. The demands of these sectors will have to be met against the backdrop of shrinking water resources and amidst rapidly growing competition for water use.

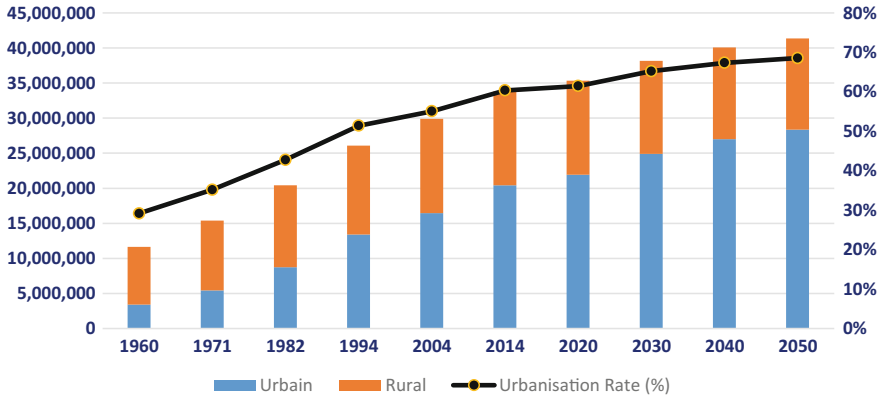

Fig. 6.4 Moroccan population, 1960–2050

6.3 Water Resources Development and Uses

For the last five decades, the emphasis in Moroccan development planning has been on maximising the capture of the country's surface water resources and providing for their optimal use in irrigated agriculture, potable water supplies, industrialisation, and energy generation on a sustainable basis.

Enormous capital resources have been invested in the essential infrastructure to control surface water flows. The number of large dams increased from 16 in 1967 to 140 in 2016, and led to a nine-fold increase in water storage capacity (Fig. 6.5) to 17.6 BCM, equivalent to 530 m^3 per capita (Ziyad 2017b). In addition, Morocco has 13 inter-basin water transfer systems. A number of major infrastructure projects are in advanced stages of planning and/or construction to capture most of the remaining surface runoff by the year 2020. Most of the major hydraulic infrastructure is multipurpose, integrating in its design and operation the water-agriculture-energy nexus.

Groundwater mobilisation efforts have resulted in an extensive development of wells and boreholes. This strategic resource contributes about one-third of drinking water production across the country, but up to 90% in rural areas. In addition, 40% of the currently irrigated area, mostly growing high-value export crops, depends on groundwater. Groundwater also plays the role of a strategic water reservoir in drought years.

The bulk of Morocco's water resources is used by agriculture. Irrigation accounts for 85% of the water use, compared to 10% for domestic use and 5% for industry. Irrigated agriculture has a high priority in Morocco, to meet the needs of its rapidly growing population and to expand export of both commodities and processed agricultural products. In 1967 the government committed itself to the provision of irrigation to a million hectares of land by the year 2000. Thanks to considerable investments over the period, this goal was achieved by 1997, and as of

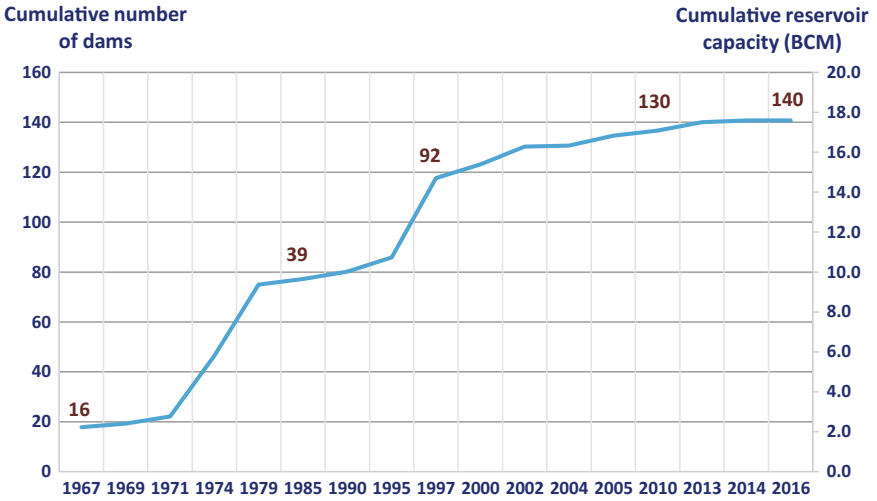

Fig. 6.5 Reservoir number and capacity since 1967

2016 the area was 1.5 million hectares. Morocco has made modern, large-scale irrigation projects the centrepiece of its irrigated agricultural development. They represent new investments in major civil works for water regulation, conveyance, and distribution systems (including on farm) using modern technologies. Nine irrigation perimeters have been developed in the major river basins of the country. Each one is developed and managed by a regional irrigation and agricultural development agency, or ORMVA (*office régional de mise en valeur agricole*). The ORMVAs are responsible for the design, construction, operation, and maintenance of the irrigation networks. They integrate all the productive services required by farmers under one management structure. They provide assistance to rainfed farmers, and those dependent on traditional irrigation, in their jurisdictions. ORMVAs are semi-autonomous organisations overseen by the Ministry of Agriculture, Fishery, Rural Development and Forestry.

The whole irrigation subsector currently contributes 45% of the agricultural value added and 75% of agricultural-export earnings. In addition to boosting food production, irrigation development has also increased rural employment, promoted agroindustry, and helped stabilise domestic production. It has also raised productivity and incomes significantly by bringing modern agriculture to small farm families, and in several areas it has reversed the flow of people from rural to urban areas, while contributing to natural resources conservation by relieving the pressure on areas with fragile ecology.

Concerning the drinking water sector, production has been multiplied by 5 in the last three decades, reaching more than 1.2 BCM in 2015. Currently, 100% of the urban population and 94% of the rural population (against 14% only in 1994) have access to an improved water supply.

Morocco lacks the large oil or gas reserves that some other North African countries boast; it is a net energy importer. Thus, hydropower production plays an important role in meeting the country's energy needs and reducing the energy imports bill. The current installed capacity is 1770 MW. In a typical hydrological year, hydropower provides 10% of the energy produced.

6.4 Issues and Constraints

Despite all its efforts and remarkable achievements, Morocco faces a growing challenge and many constraints in the water sector, which if not properly managed may hinder the growth of the country. These constraints can be summarised as follows (Ait Kadi 1998b).

6.4.1 Decline in Available Water Resources and Increase of Extreme Events

Morocco is highly exposed to climate change, resulting in hotter and drier climate. The warming trend of climate in Morocco is clearly shown by observations. An increase of the total annual number of warm days was seen in 1961–2016 at both national and local levels, along with a decrease in the number of cold days. Heat waves are following the same kind of evolution towards more high-temperature events. Moreover, this warming is accompanied by a decrease in total rainfall and a positive trend in the maximum number of consecutive dry days (slightly more persistent drought). These changes are illustrated in Figs. 6.6, 6.7, 6.8, 6.9, 6.10 and 6.11.

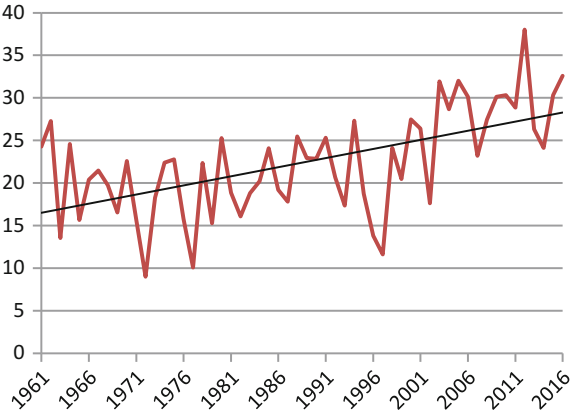

Fig. 6.6 Annual number of warm days, 1961–2016

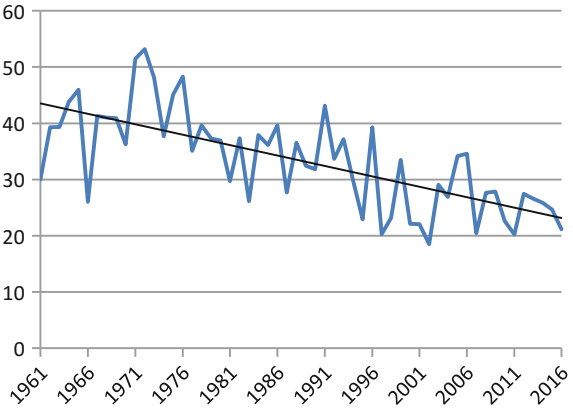

Fig. 6.7 Annual number of cold days, 1961–2016

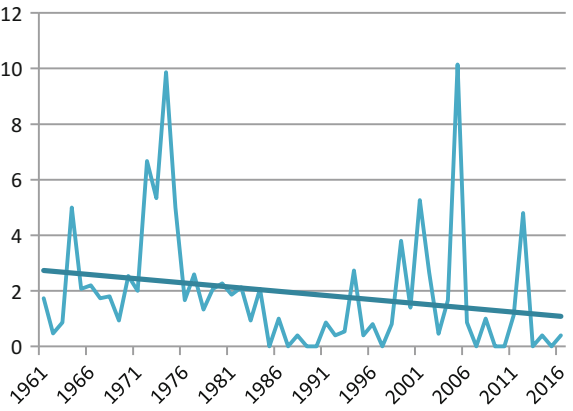

Fig. 6.8 Cold spell duration index, 1961–2016

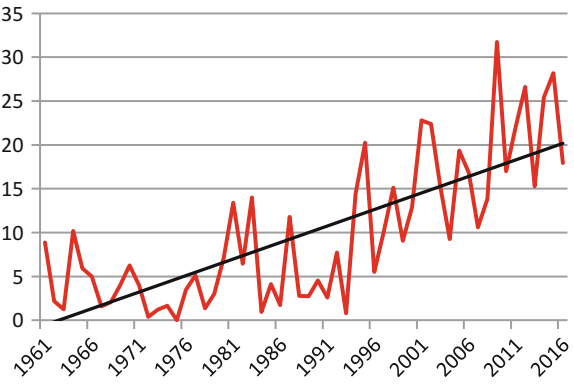

Fig. 6.9 Warm spell duration index, 1961–2016

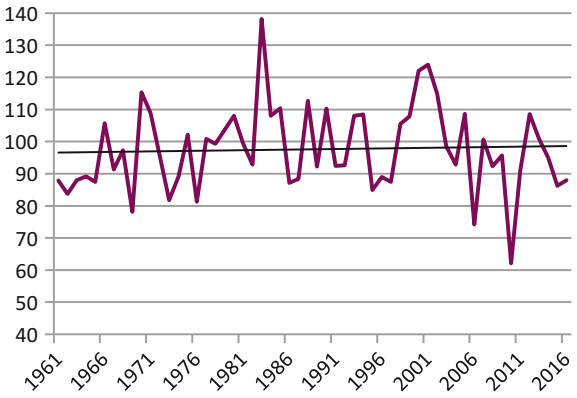

Fig. 6.10 Maximum number of consecutive dry days, 1961–2016

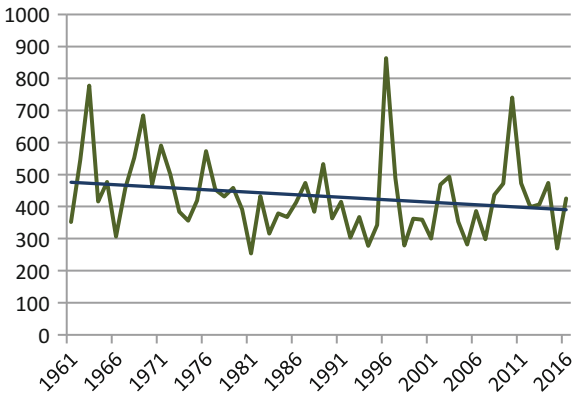

Fig. 6.11 Annual rainfall (mm), 1961–2016

A change in hydrological regimes is already observed, with lower average runoff and low flows, and higher frequency and intensity of flash floods. These changes add a layer of complexity to the operation of dams and flood control. Hydroelectric generation has also been affected, sometimes falling by more than 50% due to low water reserves in the dams. As an example, Fig. 6.12 illustrates the deviation from the normal and the temporal variability of flows at the Allal El Fassi Dam.

Drought is a recurrent natural phenomenon of Morocco's climate, and experience over the years has allowed the gradual establishment of an integrated drought management system (Box 6.1). However, current climate change projections suggest an increase in the frequency, intensity, and duration of droughts, with substantial impacts in the food, water, energy, and health sectors.

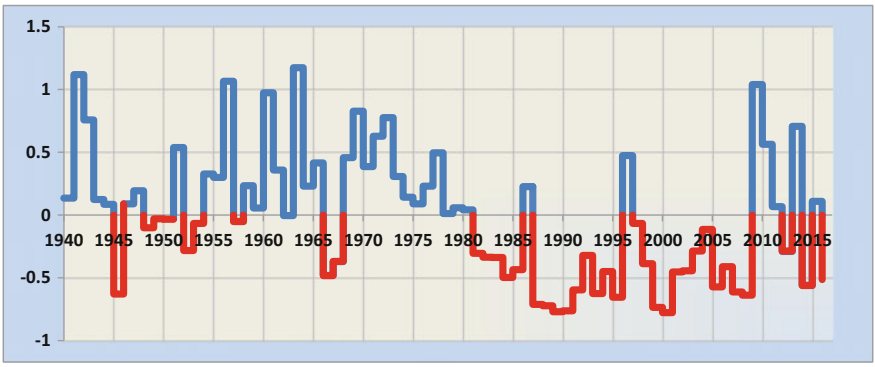

Fig. 6.12 Deviation from the average of the inflow at the Allal El Fassi Dam, 1940–2015

Box 6.1 Integrated drought management in Morocco

Drought is a recurrent natural phenomenon of Morocco's climate. A dendrochronological study undertaken in the early 1980s helped reconstruct the history of drought in the last millennium (1000–1984). It showed over 89 droughts of one to six years' duration, at an average interval of about 11 years. The average duration of a drought is around 1.6 years. The twentieth century was one of the driest in the last nine centuries (Fig. 6.13).

Morocco's experience over the years has allowed it to gradually establish an integrated drought management system structured around three essential elements:

A monitoring and early warning system. Morocco has developed national institutional and technical capacities, particularly in the areas of climate modelling, remote sensing, and crop forecasting. A national Drought Observatory was established in 2000 to improve forecasting, assess impacts, and develop strategies and tools for decision support and drought preparedness.

Emergency operational plans to alleviate the impacts of drought. Morocco has much experience in the development and implementation of programmes to alleviate the impacts of drought. These programmes are based on interventions aimed at (1) securing safe drinking water for rural populations in particular, (2) preserving livestock through feed distribution, (3) implementing income- and job-creating activities (maintenance of rural roads and irrigation infrastructure), and (4) conserving forests and natural resources.

A long-term strategy to reduce vulnerability to drought. This strategy is based on a risk management approach that reduces the vulnerability to drought of the national economy as a whole and of agriculture and the rural economy in particular. It involves a diverse and multidimensional array of policies that takes drought risk into account in its geographical diversity and economic and social implications, as well as in its long-term recurrence.

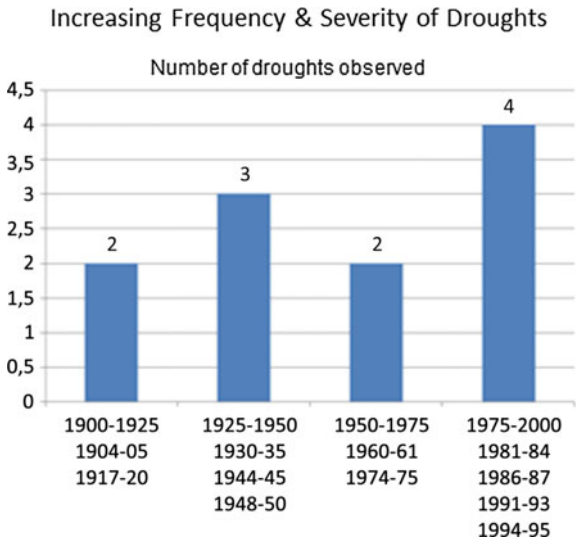

Fig. 6.13 Increasing frequency and severity of droughts in the twentieth century

Morocco is also facing more pronounced hydrometeorological extremes, with locally more intense rainfall and higher frequency of intense floods, causing significant economic losses and asset damage. A National Flood Protection Plan was developed in 2002 and updated in 2011. The aim of the plan is to treat flooding in a comprehensive and integrated way. The plan includes structural and non-structural measures. The structural measures cover all kinds of methods for controlling and preventing floods with tangible facilities. The non-structural measures include the establishment of a flood monitoring system and flood information and vulnerability maps, as well as improving legislation and institutional frameworks.

6.4.2 Overexploitation of Groundwater Resources

Depletion of groundwater resources is of particular concern. According to estimates, about 5 BCM of water are abstracted annually, against a renewable potential of 4 BCM.

This overexploitation has resulted in falling piezometric levels, reduced flows (or even drying up) of sources, and degradation of the quality of groundwater in some coastal areas due to salt intrusion. Monitoring of the evolution of water levels in almost all of the country's aquifers shows a continuous decline, sometimes reaching alarming values that may exceed two metres per year. The examples presented in Fig. 6.14 showcase the difficulties of a command-and-control approach based solely on the enforcement of the 1995 law. A more holistic approach is being used to reverse groundwater depletion trends in the Souss Aquifer. The aim is to reduce

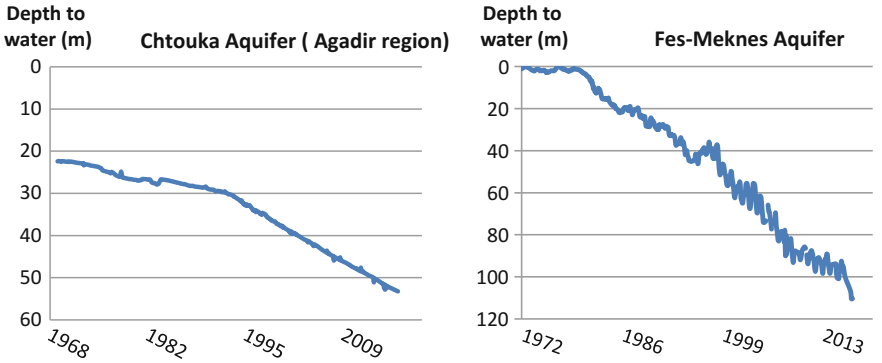

Fig. 6.14 Evolution of piezometric level in the Chtouka and Fes-Meknes Aquifers

abstractions while ensuring the socio-economic viability of agriculture, which is heavily dependent on groundwater in the region (Box 6.2).

Box 6.2 A holistic approach to groundwater management in agriculture: The Souss Aquifer contract in Morocco

The unsustainable abstraction of groundwater and the depletion of groundwater aquifers is a major problem. Rapid declines of groundwater levels reached alarming values, mainly in the Souss region (Fig. 6.15).

The Souss region, in the south-west of Morocco, has a semi-arid climate, with average annual rainfall not exceeding 250 mm. The region ranks first in production and export of citrus fruits and fresh vegetables. Irrigated agriculture covers nearly 120,000 ha, relying mostly on groundwater (72%). Because of a succession of droughts the region has been experiencing since 1985, the annual recharge of the aquifer does not exceed 40 million m^3, compared to 650 million m^3 withdrawn annually. The decline of the water table has consequently been dramatic: two to three metres per year. This situation has forced many farmers to uproot their citrus orchards, especially in the Elguerdane area (3750 ha, representing 38% of the total citrus area). The imposition of more restrictive legislation did not correct this tragic situation, and so the state and the regional authorities have developed a comprehensive programme for the development and management of water resources in the Souss region. This programme is based on two major pillars.

Conjunctive use of groundwater and surface water. This is made possible by the development of the Elguerdane large-scale collective irrigation project. It is a pioneering public–private partnership for irrigation development and management in Morocco in the form of a 30-year build-operate-transfer contract. Its main objective is to supply an additional 45 million m^3 of surface water to preserve citrus orchards threatened by rapidly sinking groundwater

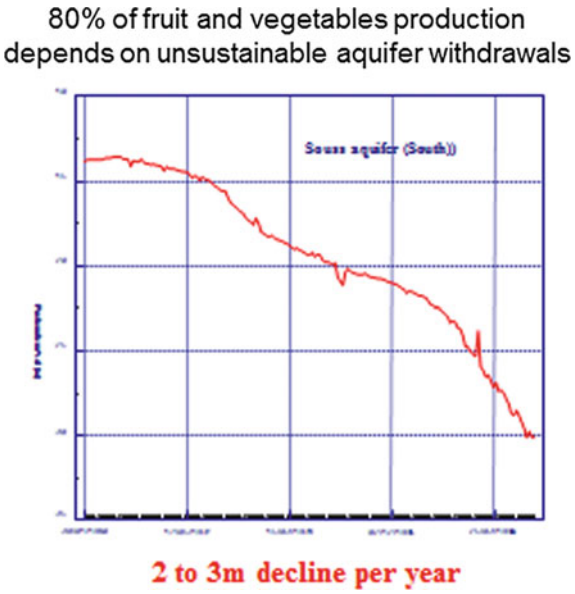

Fig. 6.15 Eighty percent of fruit and vegetable production depends on unsustainable aquifer withdrawals

levels in the Elguerdane area (10,000 ha). It consists of a reservoir and piped conveyance and distribution systems supplying a portion (50–70%) of the irrigation water requirements to farms, to be used conjunctively with groundwater. Citrus farmers have subscribed to the project on the basis of their agreement to use exclusively drip irrigation, contribute 40% of the investment cost, and pay a volumetric water fee, as defined in the public–private partnership contract.

An ambitious action plan to improve governance and water productivity. A convention for the preservation and development of water resources in the Souss region was established in the form of an 'aquifer management contract'. It was the result of a process of intensive consultations with all the stakeholders: government and local authorities, water users' associations, farmers' organisations, and credit institutions. The action plan under this contract covers control on the digging of wells and boreholes, control on the expansion of orchards and irrigated areas, adopting water-saving technologies (drip irrigation coupled with irrigation scheduling services), and awareness-raising of farmers and the general public in the region on issues of saving water and preventing pollution. A commission was formed by representatives of all the stakeholders to enforce the implementation of the aquifer contract.

To date, more than 50 water users' associations in agriculture, covering an area of 12,300 ha, have benefited from the programme. The commission has played a key role in the development and adoption of legislative amendments to adjust the fees paid by farmers for the use of irrigation water.

The originality of the approach stems from:

- Coupling aquifer governance to the development of a surface water project for conjunctive use as well as the introduction of more virtuous practices in the use of water resources;
- Shifting from a system of policing that was purely authoritarian but ineffective, to a system of voluntary commitments by users;
- Offering a comprehensive agricultural and water management package through the combination of many regional initiatives inspired by a collective action to solve the many water challenges the region faces.

6.4.3 Degradation of Water Quality

Water resources are increasingly threatened by pollution. The main pollution sources are agriculture, industry, and households. Water quality is deteriorating further as a consequence of the variability of the hydrological regimes, with lower flows during the summer dry season. Sanitation and wastewater treatment infrastructure has not kept pace with drinking water supply, and urban effluent is currently the major contributor to pollution of surface, coastal, and groundwater. Therefore, if the Moroccan economy proceeds along its growth path, water quality requirements will grow faster than quantity requirements. Hence, a National Plan for Water Quality Improvements has been formulated. The plan calls for (1) diagnosis of the quality of water resources, (2) analysis of the sources of pollution and their impact on water quality, and (3) preparation of a water quality protection plan for the major rivers (Sebou and Oum er Rbia) and the country in general, including the formulation of remedial measures against pollution.

6.4.4 Soil Erosion and Dam Siltation

Soil erosion affects all parts of the country, with various intensities. The annual cumulative land erosion contributes to the loss of nearly 75 million m^3 of available storage capacity per year, plus eutrophication and degradation of water quality. Moreover, it sharply increases the cost of operation and maintenance of downstream infrastructure and the cost of production of drinking water (Fig. 6.16).

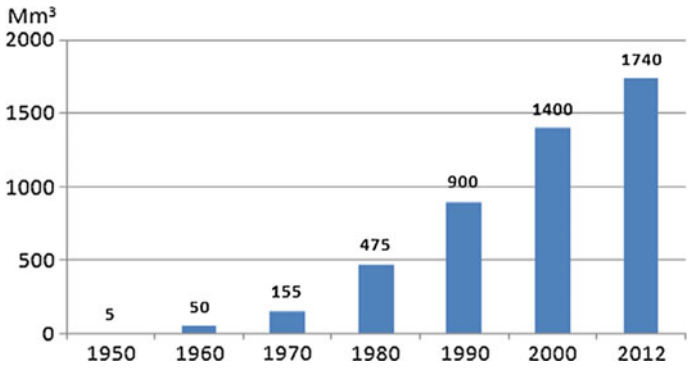

Fig. 6.16 Evolution of cumulative annual losses of dam reservoirs due to siltation

6.4.5 Low Water-use Efficiency

Morocco's water economy is now characterised by sharply rising costs to supply additional water and more direct and intense competition among different kinds of water users and uses. This has fostered a substantial change in attitudes to water conservation. Water shortages in general, and problems of groundwater overexploitation in particular, have spurred calls for improved efficiency in all sectors.

6.5 Holistic Water-sector Reform

The successive droughts of the 1990s, coupled with the challenges posed by the growing water scarcity, moved the management of water resources, already high on the national development agenda, even further up. Morocco opted to face up to these thorny problems (which were constraining the benefits of its prolonged efforts to secure its water supply) by adopting an integrated approach to water resources management through mutually reinforcing policy, legal, and institutional reforms, and developing a long-term investment programme (Ait Kadi 2014a, b).

6.5.1 The Strategic Framework

The major policy reforms are:

- Adopting a long-term strategy for integrated water resources management. The NWP is the vehicle for strategy implementation and serves as the framework for investment programmes until the year 2030;
- Developing a new legal and institutional framework to promote decentralised management and increase stakeholder participation;

- Introducing economic incentives in water allocation decisions through rational tariffs and cost recovery;
- Taking capacity-enhancing measures to meet institutional challenges for the management of water resources; and
- Establishing effective monitoring and control of water quality to reduce environmental degradation.

6.5.2 The Legal and Institutional Frameworks

The Water Law 10–95 was enacted in 1995 and updated in 2016 to consolidate integrated, participatory, and decentralised water resources management (SGG 2016). Its major features are:

- Stipulates that water resources are public property;
- Provides for the establishment of river basin agencies in individual or grouped river catchments. It clarifies the mandates, functions, and responsibilities of the institutions involved in water management. In particular, the status and the role of the High Water and Climate Council has been enhanced as the higher advisory body and a forum on national water policies and programmes. All the stakeholders from the public and private sectors, including water users' associations, sit on this council;
- Provides for the elaboration of the NWP and river basin master plans;
- Establishes a mechanism for the recovery of costs through charges for water abstraction and the introduction of a water pollution tax based on the principles of 'user pays' and 'polluter pays';
- Reinforces water quality protection by defining environmental mandates, sanctions, and penalties.

Concerning the institutional set-up, the major change was the establishment of river basin agencies empowered to manage individual or grouped river basins. The three principal responsibilities of these agencies are development of water resources, allocation of water as defined by the master plan, and control of water quality. The agencies reinforce the network of existing institutions in charge of the different water management functions (World Bank 1995).

6.5.3 The National Water Plan

To consolidate past successes and overcome the aforementioned challenges, a new impetus for the reinforcement of the water policy was triggered and exposed through the NWP based on the National Water Strategy and regional water master plans. This plan, which defines the priority actions to be engaged by 2030, aims to

provide sufficient water resources to support the economic and social development of the country, ensure integrated and sustainable water resources management, and reinforce convergence and integration with other sectorial plans and strategies (Interministerial Commission 2015).

The main guidelines of this plan consist of consolidating past successes through additional water supply, facing new challenges relating to climate change, and proposing funding mechanisms adapted to the needs of the various projects and water uses (public–private partnership, Ziyad 2017a). The NWP is structured around three pillars:

6.5.3.1 Water Demand Management

Managing water demand and water valorisation through new technical, regulatory, and financial tools are priorities of the NWP. In the field of drinking water, in addition to the supply security objectives, the plan aims to improve the efficiency of distribution networks to reach a national average efficiency of 80% by 2025. It invites the tourism and industry sectors to adopt water-saving practices including reducing water use and maximising water reuse and recycling. In agriculture, a national irrigation-water-saving programme has been developed. It is based on a massive conversion of surface irrigation to drip irrigation over an area of 500,000 ha by 2020.

The NWP also envisages the development of hydroelectric power production, which is a clean and renewable form of energy. In effect, the expectations of the water and energy sectors are that development of hydropower will accelerate in the future. The energy strategy aims to increase the contribution of renewable energies to electricity production in the kingdom to 42% in 2020 and to 52% in 2030, of which a third is to be hydroelectric power.

6.5.3.2 Supply Management and Development

Morocco has invested great efforts in water resource mobilisation, and these efforts must be continued in two ways:

- The pursuit of surface water mobilisation by large, medium, and small dams, through the construction of three dams per year, to expand storage capacity from 17.6 BCM at present to 25 BCM by 2030. There is also the possibility of transferring water from water-surplus basins in the north-west to the central-west basins experiencing deficit.
- Non-conventional water resources mobilisation, through seawater desalination and treated wastewater reuse, mainly in agriculture and green-space watering. Desalination contributes about 1% of drinking water production today. By 2030, through the realisation of large-scale projects, desalination will cover nearly 16% of drinking, industry, and tourism demand.

6.5.3.3 Water Resources Preservation, Natural Environment Protection, and Climate Change Adaptation

As part of sustainable development promotion, the NWP offers a battery of activities:

- Preservation of water resources quality, fighting pollution by strengthening water quality monitoring, acceleration of the implementation of a National Programme of Sanitation and Wastewater Treatment, development of a National Sanitation Programme in Rural Environment, and the fight against water pollution, especially domestic and industrial pollution;
- Preservation of groundwater through the implementation of a new governance mode for sustainable and participatory management of this strategic resource, within a contractual framework (groundwater contracts), artificial recharge of deficit aquifers, and preserving groundwater quality;
- Watershed management and protection against water erosion;
- Safeguarding and preservation of sensitive areas through the implementation of specific action plans for wetlands and oasis areas; and
- Proposed measures to protect against flooding and drought effects (see above).

6.5.4 Financing

There are various sources of funding for water in Morocco. The national budget is currently the major funder of investment. Cash flow from water revenues covers recurrent costs (operation and maintenance) but only rarely contributes to investment funding, though Morocco has a well-established cost recovery system in both the irrigation sector and the water supply and sanitation sector.

In irrigation, the Agricultural Investment Code provides a legal and institutional framework for the significant recovery of both investment and operating costs. It calls for the full recovery of operations and maintenance costs and up to 40% of the initial investment costs (Ait Kadi 1998a). Similar principles apply to potable water pricing. In this sector the tariffs are differentiated between production and distribution, between cities, and between different categories of users in a progressive pricing structure. A solidarity tax paid by urban users has been established to support investment in improving access to potable water in the rural areas.

Morocco has granted a series of concessions to private international companies for the development and management of the water supply and sanitation systems in some major cities (Casablanca, Rabat, Tangier-Tetouan). A public–private partnership in the form of a BOT (build, operate, transfer) agreement has been pioneered for the development and management of the Elguerdane Irrigation Perimeter (Box 6.2). Other public–private partnerships are being launched in the field of irrigation and drinking water production through the mobilisation of surface water and the use of desalinated seawater. Two examples are (1) a project to save and

develop irrigation in the areas of Bir Jdid, Saiss (Fes Meknes), Loukkos (linked to Dar Khrofa Dam), and Guir (associated with Kadoussa Dam); and (2) a project to strengthen the drinking water supply of Agadir City and safeguard irrigation in the Chtouka region through seawater desalination.

6.6 Conclusion

Morocco is continuing its efforts towards the completion of integrated water resources reforms. A holistic approach is being adopted based on:

- Developing an enabling environment in terms of adequate policies and institutions (including regulations and organisations);
- Mobilising the necessary financial resources both for selective development and exploitation of new water supplies and more vigorous demand management, with comprehensive reforms and actions to make better use of existing supplies; and
- Fostering greater cooperation between the various water subsectors.

Morocco's water reform experience offers a range of useful features, covering mainly the new institutional arrangements governing the water sector, with the reinforced role of the High Water and Climate Council as an apex body for national water policy and programmes, and the creation of river basin agencies. At the sub-sectorial level, the Moroccan irrigation agencies are unique, as they integrate the provision of production services to farmers with water supply, an approach that is crucial for enhancing water productivity and farm output.

This experience emphasises the need for major shifts in conceptual approaches to water governance to reach a more desirable future and limit calamities that can otherwise be foreseen. This is particularly relevant as many societies are currently facing socio-economic transformations which need to be reflected in changes in the respective governance systems (Ait Kadi and Arriens 2012; Ait Kadi 2015b). But putting effective water governance into practice is a very large and complex agenda (Ait Kadi 2015a). Tackling this agenda must start with new institutional mindsets and mechanisms that can develop a more coordinated approach to the challenge of water resources development and management, reflecting stronger interconnectedness among water systems. It calls for the creation of an enabling environment based on an adequate set of mutually supportive policies and a comprehensive legal framework, with a coherent set of incentives and regulatory measures to support these policies. Yet, policies and regulations, though necessary, are not sufficient. Putting effective water governance into practice also means strengthening and/or creating institutions and mechanisms that can transcend the boundaries between sectors.

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