

A HISTORICAL OVERVIEW OF EVOLUTION OF THE IRRIGATED AGRICULTURE SECTOR IN MOROCCO

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Abstract. *Purpose and aim of the study: The paper aim is to analyse scientific and other relevant literature on the sustainable development of the irrigated agricultural sector in Morocco.*

Design / Methodology / Approach: The method of data collection is literature review. Literature review was chosen, as it is the basis for further research. The obtained data are presented in accordance with the identified historical periods. A summary of results is delivered.

Main Findings: In light of scarce water resources, the technical, legal and institutional levels in the agricultural sector are permanently updated by the public authorities in order to mitigate the impact of climate change and adapt the management of water resources.

Originality: Sustainability is regarded as gradual and sequential growth and development. Sustainability means the consideration of all the stakeholders' interests in the decision-making process.

Implications: Concerted efforts of the public authorities, companies and other stakeholders in the improvement in the efficiency of water use in agriculture through the development of localized irrigation technology and modernization of collective or private water supply networks in large irrigated areas would be beneficial for all. Innovative irrigation systems that allow the exploitation of unconventional, largely unused water resources must be developed. Low cost solutions with natural and locally available materials (Low Technology, Low Energy, Low cost, Easy to Use) should be used.

Keywords: *agricultural sector, damn, efficiency, irrigation, water demand, water resources, water supply.*

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Introduction

In the contemporary conditions of the negative impact of climate change on water availability, agriculture and food security, scarce water

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resources are to be used in an efficient and ecologically correct way in order to guarantee the sustainable supply of water and food. Water resources in the agricultural sector for food security are of great importance.

Agriculture in Morocco, as in many other developing countries, plays a key role in the national economy. The agricultural sector generates between 13 to 20% of the national Gross Domestic Product (GDP) (Adghough, 2018). This sector employs about 40% of the active population. The agricultural sector is undoubtedly the leading employer in Morocco. The total area of Morocco is 71 million hectares; the areas used in agriculture occupy 13% or 8.7 million hectares (FAO, 2001). 55% of the 1.2 million hectares under irrigation belong to the public authorities, 30% to owners and communities, 15% are irrigated by underground water from private pumping (FAO, 2001). Water is a scarce natural resource in agricultural production. Water resources depend on climate change. Among other factors, water is decisive for the productivity and yield of crops. A dose and frequency of irrigation are of paramount importance for the plant and its productive optimum. In Morocco, water resources are on increasingly high demand. Several factors influence this. Among those factors, the three key factors are (Boukhari, Nami, Chikhaoui, Raclot, Sabir, 2019): climate change that results in recurrent droughts and lower levels of precipitation; demographics, since the population is significantly growing; and economies due to the development of the agricultural, tourist and industrial sectors. Population growth, changing consumer behaviour and climate change have serious effects on the availability of fresh water. This scarcity of water resources requires to improve the efficiency of water use in agriculture, and to develop localized irrigation technology.

The aim of the paper is to analyse scientific and other relevant literature on the sustainable development of the irrigated agricultural sector in Morocco. The present research is based on the approach of sustainable development. Our research originality is revealed by our understanding of sustainability as gradual and sequential growth and development. Sustainability means the consideration of all the stakeholders' interests in the decision-making process (Ahrens, Zascierinska, & Aleksejeva, 2021). The method of data collection is literature review. Literature review was chosen because literature review is the basis for the development of further research work (Snyder, 2019). Particularly, a historical overview of the process allows identifying tendencies and trends for further development. The obtained data will be presented in accordance with the determined historical periods. A summary of results will be shown. The novelty of the research is revealed in the directions of future research.

Research results and discussion

The Green Morocco Plan (GMP) (Ministry of Agriculture, 2008) and Morocco Generation Green 2020-2030 (Naji, 2020) served as the basis for the analysis of the development of the irrigated agricultural sector in Morocco in different historical periods.

Four key stages in the development of the irrigated agricultural sector in Morocco are identified as shown in Figure 1.

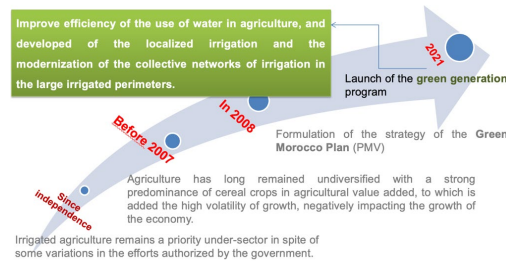


Fig.1 Four key stages in the development of the irrigated agricultural sector in Morocco (Wahid, 2022)

Figure 2 illustrated the key methods for the development of the irrigated agricultural sector in Morocco in different historical periods.

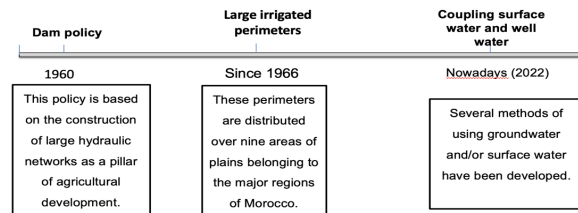


Fig.2 Key methods for the development of the irrigated agricultural sector in Morocco in different historical periods (Wahid, 2022)

Since 1956 when Morocco officially gained independence, irrigated agriculture remains a priority sector for the government efforts. The irrigated land occupies only 15% of the cultivated area of the national acreages (Maazouz, 2016). It contributes to a total value of 45% on average of the agricultural added value and intervenes for 75% of agricultural exports (Global Yield Cap Atlas, 2022). However, before 2007, despite of the important contribution of the agricultural sector to the national GDP, its share in the budget of public investment remained limited (Ministry of Agriculture, 2008). This deficit of the public investment, associated with a deficit of the private investment, partly due to limited participation of the banking structure to the finance of the agricultural sector, had placed

agriculture in a spiral of low productivity, low incomes and poverty. In addition, for a long time the sector was not properly diversified. Cereal crops in the agricultural added value prevailed. Also, the agricultural sector obtained a strong volatility of growth that negatively impacted the growth of the whole economy, too. The sector was also weakened by the lack of human resources (Naji, 2020). Agricultural professional organizations were poorly organized and structured. Another identified problem was that these structures could not meet the new requirements set to modern agricultural problems (Ministry of Agriculture, 2008). In addition to these structural deficiencies, the sector environment can be characterized by the climatic change that threatens the durability of the systems of production, in particular the modes of sustainable use of water; the instability and volatility of the world markets of the basic commodities that resulted in the rise of the inducing price, for example, food crises in 2007-2008; changes in the world competing landscape (specialization, modes of marketing, the modern distribution implying the in-depth transformations in the chains of value, etc); increasing requirements to the product quality traceability by the customers.

In 2008, Moroccan agriculture had to choose a direction between stagnation and potential to mobilize and rehabilitate in order to solve the faced challenges. In this context, the Department of Agriculture gave an impetus by formulating the strategy of the Green Morocco Plan (PMV) in 2008. This strategy focused on the objective to make agriculture an engine of economic and social development by the transformation of the agricultural sector into a modern, competitive and inclusive sector. The programmes of subsidy and reorganization through the specialized structures of the Regional Offices of Agricultural Development (ORMVA) were initiated by the State. They supported the reorientation of agriculture towards new techniques and farming methods, the promotion of the improved and adapted crop varieties, and the development of irrigation techniques to save water. 10 years after its launch, the Green Morocco Plan (PMV) repositioned the agriculture sector to become an engine of the economic growth as disclosed in Figure 3.

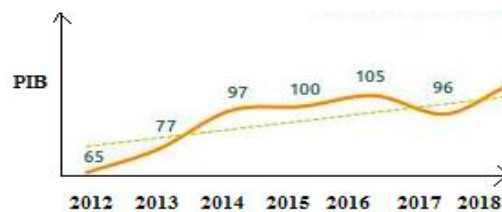


Fig.3 Evolution of the GDP in billions of Moroccan dirhams (MMDH) (chained prices) (HCP, 2020)

The value of 65 billion dirhams (measured in terms of GDP), created before the PMV, doubled to 125 billion dirhams in 2018. During this period, the average annual growth rate was + 5.25%, as illustrated in Figure 3. This evolution was two times faster if compared with the decade former to the PMV (1997-2007) during which the annual growth rate average of the GDP was only 2.5% (Ministry of Agriculture, 2008). This change testifies to the new productive dynamics generated by the Green Morocco Plan within which the conditions of production were systematically transformed so as to significantly impel the profits of 10% of productivity as shown in Figure 4.

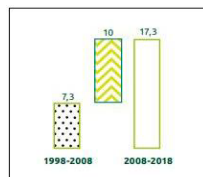


Fig.4 Contribution of agriculture to the points of national economic growth (%) (Ministry of Agriculture, 2008)

This value creation was ensured by improved effectiveness of the organization of the production process. In comparison with other countries, the growth rate of the production in the agricultural sector in Morocco had the highest growth rate during the period 2008-2014 as shown in Table 1. Hence, agriculture appears to be the most productive sector of the national economy in Morocco exceeding industry and the services.

Table 1 Growth rate based on the improved organization and production processes in some countries
(Direction de la Stratégie et des Statistiques, 2020)

Pays	Agriculture			Industrie			Services		
	1990-2014	1990-2007	2008-2014	1990-2014	1990-2007	2008-2014	1990-2014	1990-2007	2008-2014
Espagne	2,9	4,0	0,0	-0,2	0,1	-1,1	-1,1	-0,6	-2,4
France	2,5	2,6	2,2	0,7	1,2	-0,6	0,0	0,2	-0,7
Italie	1,8	2,4	0,2	-0,2	0,4	-1,9	-0,5	0,0	-1,7
Portugal	1,9	1,4	3,0	0,4	0,5	0,0	-0,3	0,0	-1,3
Egypte	1,5	1,0	2,9	-1,5	-1,2	-2,3	-0,5	-0,4	-0,8
Maroc	3,0	2,1	3,3	-0,1	0,3	-1,0	0,2	0,5	-0,6
Tunisie	3,3	3,9	1,8	0,3	0,6	-0,6	1,4	1,8	0,6
Turquie	1,1	1,0	1,4	-0,8	-0,6	-1,4	-0,4	-0,3	-0,6

To balance the supply of hydrous resources and demand of irrigated agriculture, the Green Morocco Plan adopted the policy of control and management of the water articulated around four structuring programmes as depicted in Figure 5:

- National Programme of Saving Irrigation Water (PNEEI): to mitigate the effects of the rarefaction of the water resources and to improve efficiency of their use in agriculture through the development of localized irrigation and modernization of collective networks of irrigation in the large irrigated perimeters (Direction de la Stratégie et des Statistiques, 2020);
- Programme of Extension of Irrigation (PEI): the downstream of dams for the creation of new perimeters and the reinforcement of the irrigation of the existing perimeters dominated by the dams;
- Programme of the Rehabilitation and Safeguard of the Perimeters of Small and Average Hydraulics (PMH): to improve the efficiency and the availability of water and to ensure the small agriculture irrigated in the fragile zones perennially;
- Programme of Promotion of the Public-Private Partnership (PPP): to improve technical, economic and financial management of water for irrigation and development of nonconventional water resources.

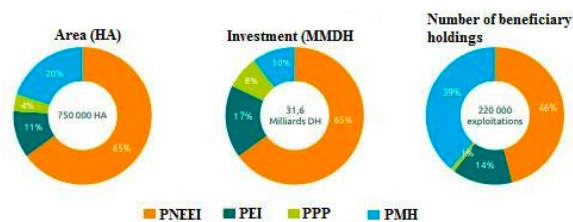


Fig.5 Summary of achievements of irrigation programmes at the end of 2018 (Direction de la Stratégie et des Statistiques, 2020)

Water is managed on the basis of agreements and rules which allow the distribution of water between the various users and sites in an organized way, adequate to the farming systems of irrigation and climate conditions. In Morocco, hydraulics covers nearly 683.000 ha (Kweld, 2006; Saad, 2014). Hydraulics is the pillar in the agriculture development to support the irrigation of million hectares (Benjelloun, 2001; Saâd, 2012).

At the end of the 1960s, the Moroccan government decided to enhance water management through “the policy of dams”. This policy was based on the construction of large hydraulic networks (Benjelloun, 2001). In these hydraulic zones, all the crop, fodder and cereal plots, and fruit plantations were served from the dam lakes via a dense network of irrigation canals. It was generally composed of main canals and secondary canals to ensure the distribution of water to the entire irrigated territory. The strategic choice of the dam policy was defined by the climate context of the country but also by a proactive policy of control and enhancement of water resources including development of efficient and sustainable irrigated agriculture.

Since 1966, nine large irrigated areas have been created in Morocco under the direction of the Regional Offices for Agricultural Development (ORMVA) as depicted in Figure 6.

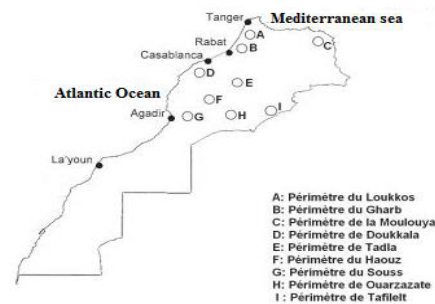


Fig.6 Geographical location of 9 major irrigated perimeters of Morocco (Saâd, 2012)

These perimeters are distributed over nine plain areas belonging to the major regions of Morocco as described in Figure 6 and Table 2.

Table 2 Importance of crops (in ha) in nine major irrigated perimeters of Morocco (Saâd, 2012)

	Cereals	Plantations Fruit trees	Forages	Cultures Industrial	Vegetables	Total
Doukkala	52343	500	16849	19700	3683	93075
Gharb	52425	19844	25307	23138	6955	127668
Haouz	51109	70443	11593	1639	3856	138640
Loukkos	4240	1705	5960	11317	9701	32928
Moulouya	9060	26106	4878	6201	7613	53858
Ouarzazate	14070	-	3560	-	565	18195
Souss-Massa	4084	3795	1832	-	6742	16453
Tadla	36800	28095	29192	8389	-	102476
Tafilelt	26340	-	8117	-	652	35109

The perimeters are distributed over a large area of the national territory, in the North, known as the perimeter of Loukkos (30,300 ha) (A, Figure 6), in the South - the perimeters of Souss-Massa (39,900 ha) (G, Figure 6); Ouarzazate (37,650 ha) (H, Figure 6) and Tafilelt (27,900 ha) (I, Figure 6), to the West - the perimeters of Gharb (113,350 ha) (B, Figure 6) and Doukkala (104,600 ha) (D, Figure 6), in the East - the perimeter of Moulouya (77,280 ha) (C, Figure 6), in the centre - the perimeters of Haouz (142,620 ha) (F, Figure 6) and Tadla (109,000 ha) (E, Figure 6). This coverage also affects three bioclimatic levels: the arid (Souss-Massa, Ouarzazate and Tafilelt and Haouz), the semi-arid (Tadla, Doukkala and Moulouya) and the sub-humid (Gharb and Loukkos). This geoclimatic combination is a real advantage for crop diversity and agricultural production, and biodiversity (Saad, 2014). Irrigation was recognized by public authorities as an inescapable recourse. The government, through the ORMVATs, has set up an irrigation water distribution network supplied to the plot. The years of abundant surface water marked by the development

of irrigation were followed by a period of drought characterized by restrictions in the use of surface water for irrigation as shown in Figure 7.

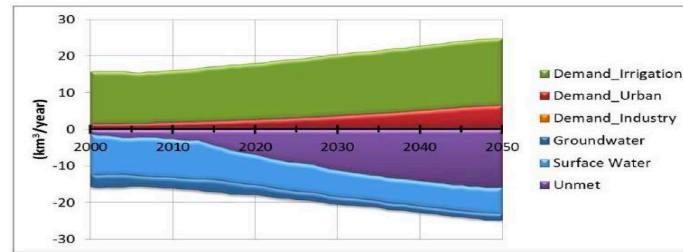


Fig.7 Climate scenario for water demand and supply in the MENA region (Immerzeel, et al, 2011)

The same climate scenario for water demand and supply are in the MENA (Middle East and North Africa) region (Middle-East and Northern Africa) (Immerzeel, Droogers, Terink, Hoogeveen, Hellegers, Bierkens, Van Beek, 2011). The continuity and regularity of surface water supplied to the plot is not always obvious, and the exploration of other alternative water resources has become essential. Restrictions on the use of mains water were becoming more and more frequent. Alongside major hydro-agricultural investment efforts by the public authorities, at farm level, farmers have developed their own initiatives to deal with water scarcity: digging wells, boreholes and/or or their deepening. This is the reason of the increase in the number of private pumping over time. In this perspective, groundwater abstraction and its use for irrigation require more technical means and methods (Benjelloun, 2001; Kweld, 2006). The difficulty of using groundwater justifies the multiple strategies developed by farmers to irrigate their plots. The variability of cultivated areas, the specificity of crop needs and the location of the farm in relation to the irrigation network are all parameters that justify the development of “private pumping” (Kweld, 2006; Dugu, Lejars, Ameer, Amichi, Braiki, Burte, Kuper, 2014; Kuper, Faysse, Hammani, Hartani, Marlet, Hamamouche, Ameer, 2016). Other socio-economic factors are not least in this justification: the diversification of crops, the improvement of incomes, the availability of financing from immigration. “Private pumping” aims in particular to make up for the lack of water supplied by the network and to manage periods of low water marked by the scarcity of water resources and low flows. The distribution of individual pumping over the entire perimeter does not obey any rule (Kweld, 2006). The depths of wells in Morocco vary from one locality to another; and in the same locality, this variability in depth can be observed from one exploitation to another. As “private pumping” develops, access to groundwater has become an alternative and an imperative. As the main idea is to compensate for the mediocrity of precipitation and the lack of

water in the network, several methods of using groundwater and/or surface water have been developed.

Conclusions and suggestions

The literature analysis allowed for identifying a fact that the agricultural sector in Morocco and, consequently, irrigation, remain the key areas for the country's sustainable development. In light of scarce water resources, technical, legal and institutional levels in the agricultural sector are permanently updated in order to mitigate the impact of climate change and management of water resources. The present research is limited by the theoretical analysis of scientific and other relevant literature. Concerted efforts of the public authorities, companies and other stakeholders in the improvement in the efficiency of water use in agriculture through the development of localized irrigation technology and modernization of collective or private water supply networks in large irrigated areas would be beneficial for all. Active engagement of small-holder farmers into the implementation of the Green Generation programme could help strengthen water supply networks. Innovative irrigation systems that allow the exploitation of unconventional, largely unused water resources must be developed. Low cost solutions with natural and locally available materials (Low Technology, Low Energy, Low cost, Easy to Use) are proposed. Further research tends to focus on the comparative analysis of irrigation in the agricultural sector in terms of type of crops, water management regulations, labour force availability, financial sustainability, and economic perspective in the same climate conditions in other Mediterranean countries. This will help to search for efficient key irrigation technologies for agriculture in Morocco in order to support sustainable economic growth and social development in the country.

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