

## The impact of climate change on the choice of irrigation technology in the region of Mostaganem (Algeria)

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**Abstract:** In Algeria, climate change and drought in recent years have meant that the rains have become erratic and water resources become increasingly scarce thus creating an imbalance between needs and available resources. There is then a decline in rainfall but also the economic and social life of the population. The province of Mostaganem with a semi-arid climate has so far limited water resources. In the province agriculture uses near 74% of water use with an old irrigation techniques resulting in a remarkable waste of resources. Water resources used for irrigation comes exclusively from books of PMH (Small and medium hydraulics) above wells which unfortunately are not controlled. The demand for water in agriculture is mainly provided by groundwater. So the modest goals of this work are a general diagnosis and promote irrigation or are the anomaly that we draw to prevent the necessary remedies. There is then a groundwater overexploitation causing the drawdown has reached a dangerous threshold for the future of the wilaya. However, with the projects identified and the implementation of various policies for the rational use of water, the services of the hydraulic hope meet different demands of the wilaya.

**Key words:** *Water resources; Irrigation; Climate; Mostaganem; Algeria*

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### 1. Introduction

The relationship between (Mamechebbek, 2011) agriculture and water resources is a key factor in Mostaganem, given the climatic conditions of this region, water resources are increasingly a strategic element in the process of socio-economic development of the wilaya. Water resources are (Arrus, 1985) considered a decisive factor in increasing agricultural production, so irrigation is absolutely necessary for all crops especially summer, it greatly improves yields for winter crops.

According to recent data collected from the DSA and the DHW, using this data to determine how to manage water resources (Perennial, 1990) for the benefit of irrigation in the region of Mostaganem.

### 2. Methods and materials

According to recent data collected from the DSA (Division of Agricultural Services) (DSA, 2012) and DHW (Department of (Hydraulics of the wilaya) DWH; 2012, using this data to determine how to manage water resources for the benefit of irrigation in the region of Mostaganem.

#### 2.1. Water management in agriculture

The water management in agriculture (Ferrah and Yahiaoui, 2004) amounts to know ultimately if

water is used by irrigators in a rational way and if the infrastructure maintenance is done at the fairs last as long as possible.

At the wilaya level, most farmers use well water for the benefit of irrigation and therefore groundwater (Boualem and Ahmed, 2000) is most used in this sector.

### 3. Irrigated areas

The province of Mostaganem has a total agricultural area SAT (Total irrigated area) of about 144 778 ha or 63.81% of the total area of the wilaya. As for the agricultural area SIU surface irrigation useful), it occupies an area of 132,268 ha.

#### 3.1 The major irrigation (GPI)

The province of Mostaganem does not have any large irrigation scheme (GPI). Irrigation is provided only by the small (AIM Jensen; 1983 and Stern, P.H; (1979) and medium hydraulics (PMH). Note that there is a draft GPI below the dam on the foothills of Kramis Dahra. (Inventory of PMH, Mostaganem October (2009)).

#### 3.2. Early and medium hydraulics (PMH)

Small-scale irrigation in the wilaya occupies an area of 31,800 ha is the total irrigated area today, which represents 24% of the UAA.

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Water needs are provided by wells, boreholes, springs, small dams and reservoirs (Withers and Vipond, 1974).

The classification of engineering mobilization of water resources for the PMH shows that (document DHW, Mostaganem):

- 96.6% of the area is irrigated from underground water resources from wells, boreholes and springs;
- Only 5.4% are from surface water mobilized by dams or taken over water.

But a new direction is given to investments by the state in terms of PMH. Development a project of PMH was essentially focused on the use of groundwater is much more oriented towards the exploitation of surface water resources through construction of small dams and reservoirs.

Most books of PMH are for individual use which is managed privately. For books for public use, they are limited in the wilaya.

It should be noted that the major constraint on development generally meets these facilities for collective use of PMH. This constraint is the difficulty to implement appropriate management structures, designed to maintain and renew equipment, properly manage and protect water resources mobilized.

#### 4. The existing irrigation systems in the province

Irrigation systems in the wilaya of Mostaganem are: surface irrigation, sprinkler and drip. The surface irrigation (Booher, 1974; Kay, 1986) is the most widely used technique in the province; water is brought through pipes from the basin to the plot or

the tank in the plot. By this method 70-80% of water is lost.

The spraying is primarily used for field crops; it is mostly practiced in the shelf area. But the method is practiced evil which causes a water loss of about 20 to 30%.

The third method of irrigation is drip or trickle irrigation is practiced too little and badly. As the spray is at the plateau it is most practiced. It must be said that farmers are struggling to accept micro-irrigation techniques (sprinkler and localized). And there is some suspicion on the part of farmers.

However, in the framework of NADP (National Agricultural Development Project), the state began to encourage farmers by increasing the cost of well construction in the province of Mostaganem.

## 5. Results and discussions

### 5.1. Evolution of irrigated areas on the province of Mostaganem

The table below shows the area irrigated by different kinds of water resources of the study area (see Table 1).

Regions of the foothills and mountains of Dahra have a density of wells is also quite large, although the hydro geological formation of these regions does not lend itself to a truly operating the underground resource. There are many small shallow pockets that receive inputs from the Mountains of Dahra and operated locally.

**Table 1:** Distribution of irrigated area by different kinds of water resources

agricultural areas irrigated areas (ha)	Mountains of Dahra	foothills of the Dahra	Plain of the Habra	Plateau de Mostaganem
From drilling	63	19	15	41
From wells	1 502,5	2 011	3 018	26 655
From the water intake	52	274	00	10
For other (spring catchment)	82	67	00	06

Source : DSA, Mostaganem 2012

As indicated in Fig. 1 a very high density of drilling wells and especially on the set of Mostaganem and the plain of the Habra, reflecting the very overexploitation of groundwater resources in these two regions.

### 5.2. Irrigated area by irrigation system

Although micro-irrigation will lead to increased yields, their use remains limited. The following table shows the irrigated area by the three types of irrigation (see Table 2).

From Fig. 2, we find that the most commonly used system is the gravity system with a very high percentage is 71.3%, although this system is traditional and does not allow changes in agriculture. The use of new systems such as drip and sprinkler

covers only a percentage of 28.7% of the area irrigated.

According to the Table 3, gravity irrigation is largely dominant in all agricultural regions against the use of more advanced methods of irrigation (sprinkler, drip) remains limited (see Table 3).

Fig. 3 shows that surface irrigation is by far the method of irrigation as practiced in the province. It remains near 73.61% of all irrigation methods paradoxically it is proportionally much practiced on the set of Mostaganem.

Localized irrigation is a relatively limited impact. It is found on the set of logically

Mostaganem Dahra and foothills. Sprinkler irrigation (Kay, 1983; Vermeiren and Jobling, 1980) is practiced heavily on the set of Mostaganem, whereas it is virtually absent in other regions.

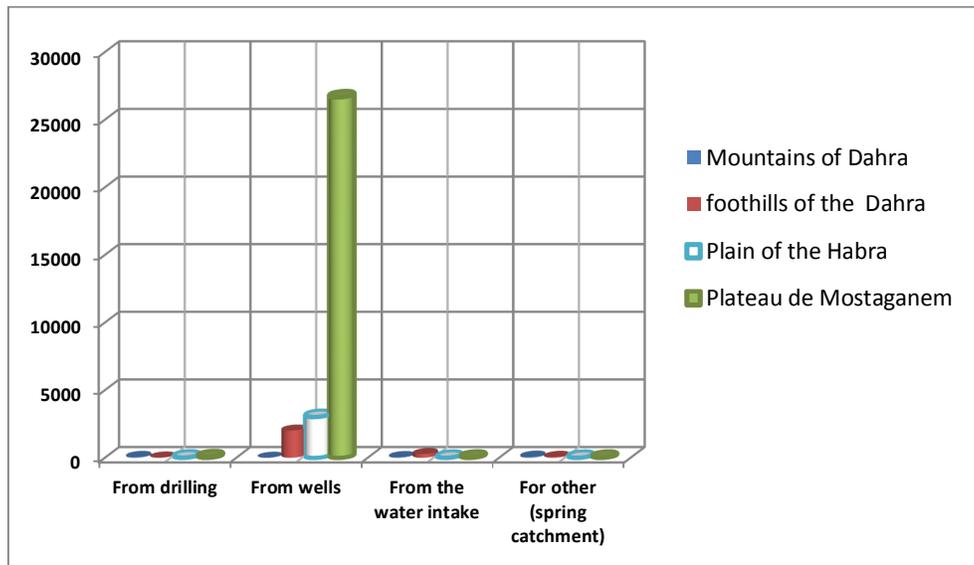


Fig. 1: The area irrigated by different kinds of water resource

Table 2: irrigated area by irrigation system (ha)

Irrigation systems	Irrigated area (ha)	percentage
Gravity	22 664	71,3
Sprinkling	6 312	19,8
Located	2 824	8,9
Total	31 800	100

Source : DSA, Mostaganem 2012

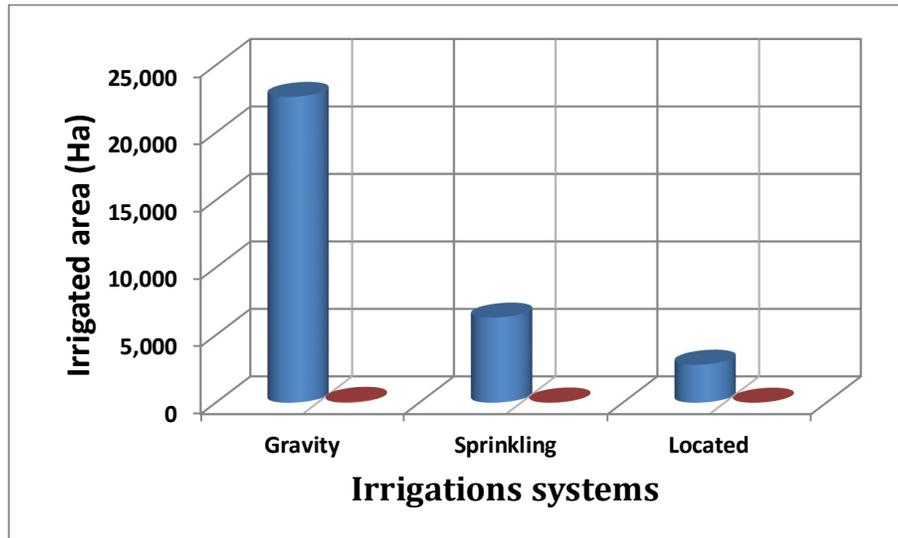


Fig. 2: The irrigated area by irrigation systems

Table 3: Distribution of irrigation by agricultural region

Regions agricultural irrigated by system (ha)	Mountains of Dahra	foothills of the Dahra	Plain of the Habra	Plateau de Mostaganem
Gravity	1 480,4	1 798	2 472	17 658
Sprinkling	119	43	245	3 444
Located	127	530	316	2 380,5

Source : DSA, Mostaganem 2012

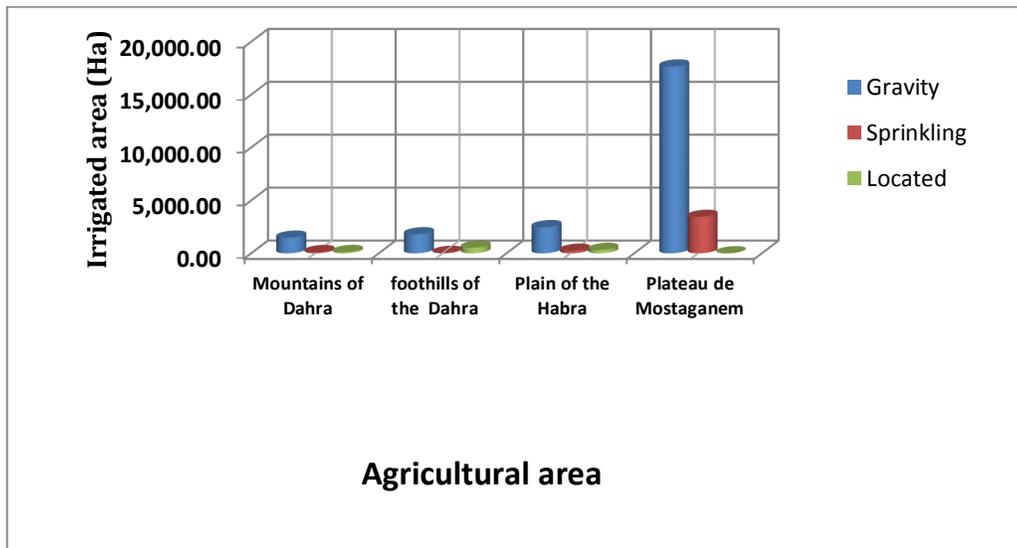


Fig. 3: The area irrigated by irrigation system

**5.3. The irrigated area by crop type**

Irrigation schemes (31.800 ha) in the region of Mostaganem used to grow six crops, which are summarized in the following (see Table 4).

Table 4: irrigated area by crop type (ha)

Type de culture	Area in crop type (ha)	Percentage
cereals	22	0,06
Forage Crops	116	0,36
Vegetable crops	20 143	63,34
Tree crops	11 261	35,41
Industrial crops	204	0,64
Other cultures	54	0,17
<b>Total</b>	<b>31 800</b>	<b>100</b>

Source: DSA, Mostaganem 2012

Fig. 4 shows as vegetables and fruit with 31 404 ha or 98.75% are the total irrigated area the largest in the region of Mostaganem.

There is evidence that farmers in the region prefer vegetable crops and fruit. What is forcing farmers to dig a lot of wells and boreholes causing the lowering of water tables and deep?

**5.3.1. The irrigated area by crop type and irrigation systems**

From Fig. 5, we notice that the vegetable crops are the most dominant in the gravity irrigation system, as well as the region of Mostaganem a purely agricultural in arboriculture and market gardening (Nakayoma and Bucks, (1986).

**5.3.2 The irrigated area by type of works**

Mobilization of water resources are normally controlled by six types of resources: boreholes, wells, dams and impounding reservoirs, springs, pumping over and spreading flood (see Table. 6). The table shows that 99% of the total agricultural area under irrigation is carried from the wells, which are built by the farmers themselves, this shows that the water use in agriculture because the costs far use of well water has a very high cost due to:

- High cost of construction of a well;
- Body of water in gradual decline;
- High cost of pumps that requires spare parts of diesel, electricity and maintenance.

The figure 6 wells that are located in the province that do irrigate 320 ha with a very low percentage of irrigated area is 1%. The real problem of agriculture in irrigation is the lack of exploitation of the waters of dams throughout the territory of the province of Mostaganem profile of irrigation.

For the companion 2011 the number of irrigation and irrigated area by spreading is unknown. Finally, for such a situation we propose the use of resources of dams for irrigation, in the wilaya to increase agricultural production and cover the cost of construction of wells for farmers is that the state supports a number of operations within the NADP program.

Most agricultural land in the wilaya are irrigated by wells, this is confirmed by Fig. 6.

**6. Conclusion**

As we have said so well above the water resources in Algeria are extremely low and mostly unevenly distributed.

Algeria suffers in recent years an unprecedented shortage of water. Persistent climatic hazards, lined with a high population growth in urban centers have contributed to the current lack of available resources for basic needs of the country.

Public policies of these twenty (20) years have not been to the stakes, both of delays in construction programs of dams or the thinness of resources

allocated to the ongoing maintenance of networks of water supply or sanitation.

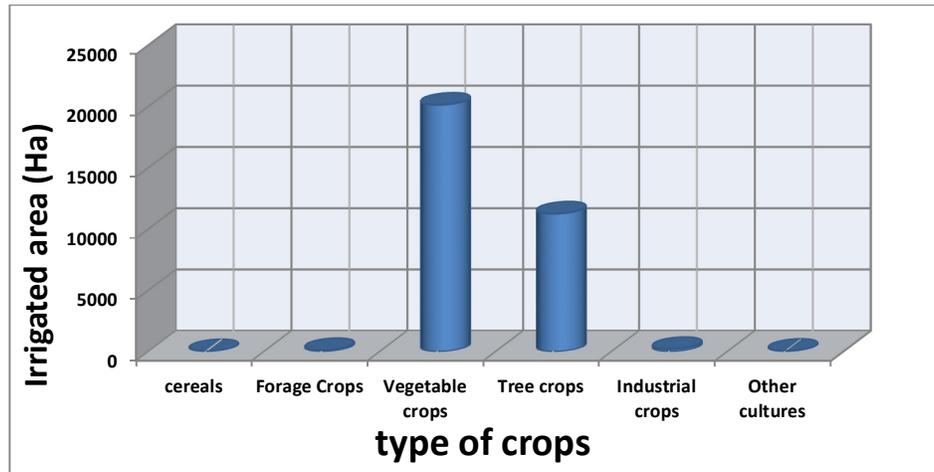


Fig. 4: The irrigated area by crop type

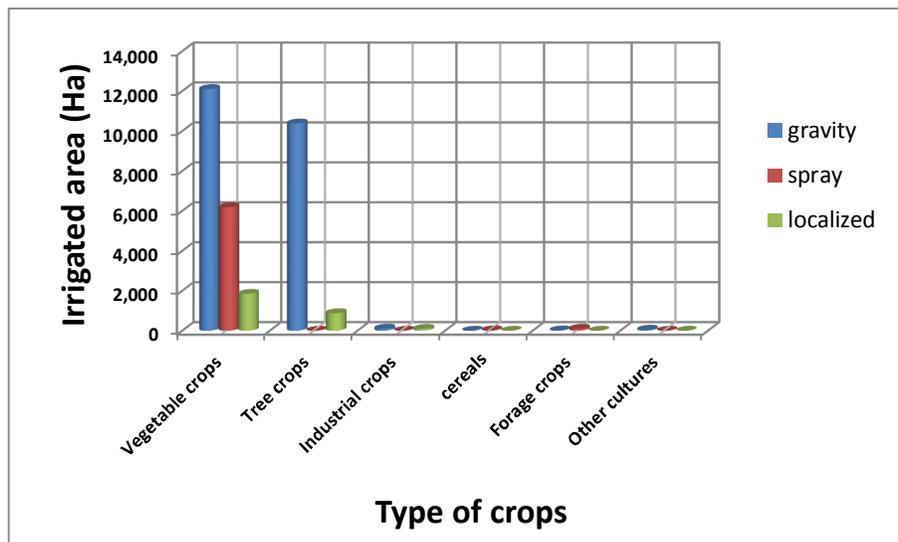


Fig. 5: The irrigated area by crop type and irrigation system

Table 5: Distribution of irrigated area by crop type and irrigation system (ha)

Type of crop	irrigation systems			total
	gravity	spray	localized	
Vegetable crops	12 105	6 190	1 848	19 055
Tree crops	10 380	0	881	11 229
Industrial crops	109	0	95	184
cereals	0	22	0	22
Forage crops	16	100	0	116
Other cultures	54	0	0	54
<b>Total</b>	<b>22 664</b>	<b>6 312</b>	<b>2 824</b>	<b>31 800</b>

Source : DSA, Mostaganem 2012

Cost situation becomes even more difficult with increasing costs of raising water, poor management,

especially in irrigation due to losses in networks and plots largely due to the use of doses irrigation well in excess of plant requirements and lack of maintenance equipment and maintenance. But with the new policy of hydraulics, the state intervenes in the water supply to serve different users. Under the economic stimulus plan initiated in April 2001 by the Government, the water sector is an important part of the expenditure budget. In this sense, "the Algerian government has arrested in May 2002 two (02) decisions to correct deficiencies in water: water importation and desalination of sea water."

The province of Mostaganem, with a population of 731.000 inhabitants is a typical rural character wilaya whose economy relies particularly on agricultural development.

The wilaya, where the climate is Mediterranean, with rainfall less than 393.96 mm per year, has so far

limited water resources derived exclusively from groundwater on which the water demand for irrigation is strongly challenged by the drinking water supply.

In this situation, additional water must be supplied by irrigation methods. The irrigated area is estimated at 31 800 ha in 2011, representing 24% of

the UAA of the wilaya, the majority is concentrated in the shelf area. This is causing the excessive use of groundwater in this area for the surface waters are not mobilized.

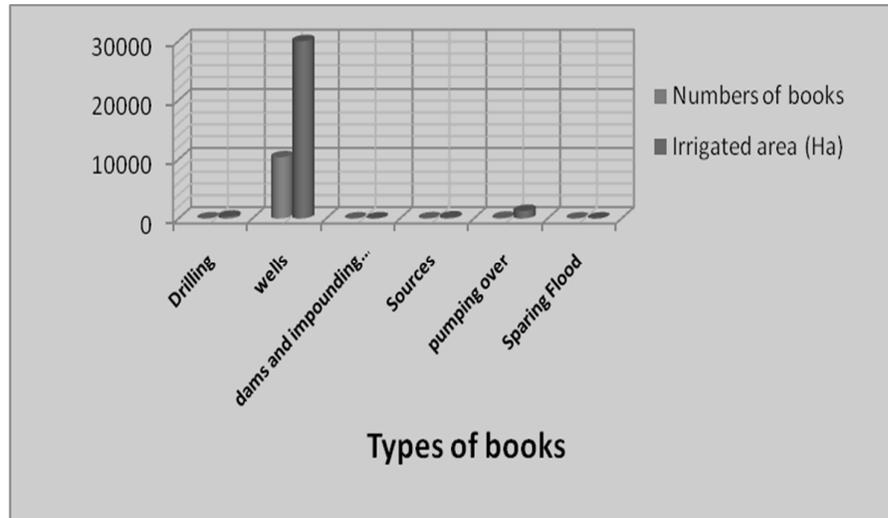


Fig. 6: Irrigated by Type of Work

Agricultural services have an important role for farmers. They should popularize the new irrigation techniques and encourage farmers to adopt a positive attitude vis-à-vis the use of water.

The assessment of water resources being mobilized and mobilizable water resources from projects already identified, that is to say, the transfer system of MAO (Mostaganem-Arzew-Oran) and the desalination of Water Sea, will enable the province of Mostaganem to receive a total volume of 178.7 m<sup>3</sup>.

These sources should enable, in future, enough to meet the different demands in water and thus open up good prospects for economic and social development of the wilaya.

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