

Assessment of irrigation water requirements by survey in Oualidia Area, Morocco

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Abstract: In the coastal basin of Oualidia, groundwater is the only freshwater resource, and beyond, facing a significant anthropogenic pressure and massive agricultural activity depends mainly on irrigation. The objective of this work is to bring an investigation, primarily intended to raise the type of cultures, a descriptive of the wells and its uses in irrigation and the irrigation schemes, in order to detect conditions that may affect the safety of these groundwater resources and the benefits of use of the system drip irrigation. The results revealed that 38.8 per cent of the wells surveyed by the questionnaire are proven non-covered, and even the wells covered are not totally immune to the external pollutants. The pumping of water from wells is automated with the predominance of gas engines of butane (55.1 %) follow-up of engines to diesel (42.9 %). The surveyed population is aware of the importance that provides the wetland, because 91% have introduced the mode drip irrigation. Agriculture in the foreshore of the Oualidia do not differ from the sahelian agriculture international, with a predominance of truck farming, low concentration of cereal crops and absence of the arboriculture. The results have highlighted the need to adopt an agriculture less consumer of water and to ensure a better protection of wells.

Keywords - Oualidia, groundwater, Drip irrigation, Agriculture sahelian, Truck farming

I. Introduction

The area of Oualidia is part of the region of Doukala-Abda, whose agriculture is an important economic activity. It occupies in most of the forest and fishing 59% of the regional labor force aged 15 years and more, and owes its development to a natural morphology varied and to the wealth of the soil (HCP, 2010). The region has a flourishing agriculture especially in the Sahel, with shallow groundwater allowing the installation of a market gardening of good level, and in the vast plains of Doukala-Abda favorable for grain farming. The irrigated area by private pumping in the region is of the order of 3500 hectares (Oulaaross, 2009). Groundwaters in the area are increasingly saline, lack of the introduction marine in the coastal zone and the stresses applied to the aquifer (pumps, etc. ..) (Choukr-Allah, 2004).

According the Regional Office of Agricultural Development of Doukkala (ORMVAD, 2013) several wells located in the coastal zone of Oualidia were used for irrigation of land under cultivation and the study revealed that 76.92 % of wells analyzed display values of higher electrical conductivity than 3mS/cm in agriculture. Groundwaters are considered to be salted and require restrictions on their use for irrigation in order to avoid the sterilization of soils in the long term and the fall of crop yields sensitive.

Moreover, this degradation of the quality of the irrigation water that threatens the economic balance of holdings in the region of the Sahel of the Doukkala, is made in parallel to two factors: the intensification of cultivation, and population growth. The changes of agricultural production systems under the influence of the demographic pressure in several regions of Morocco, insisting on a conversion more or less gradual of extensive farming to intensive agriculture (Jamal, 2000).

This work aims to bring investigation in Oualidia area, intended primarily to raise the type of crops and a descriptive of the wells and its uses in irrigation, in order to detect conditions that may affect the safety of these groundwater resources. Also the questionnaire will give an overall idea on the application of the system of drip irrigation by the farmers of the region, the benefits and the problems related to the use of this method. The respondents are the owners of these wells included in this study.

II. Materials And Methods

Study Area: The lagoon of the Oualidia is located on the Atlantic Ocean (fig.1). This lagoon has 7 km long, on average of 0.5 km wide, which gives a total area of 3.5 km². The exchange of water with the ocean is insured by an important arm on 150 m wide. The hydrological regime of the lagoon is linked to the rhythm of the tides, and the renewal of the waters is assured by the contribution of seawater that pervades the whole of the lagoon at high tide (Orbi A. et al. 1995) (Hilmi et al., 2005). The region is primarily agricultural and pastoral.

The important gardening activity using only the groundwater has developed for several decades and constitutes the main source of income of the inhabitants. Thus, the investigation has involved two Douars: "DOUAR BAKIR» "Douar Oulad LHLAL", which are the most representative in term of agricultural areas and human group.

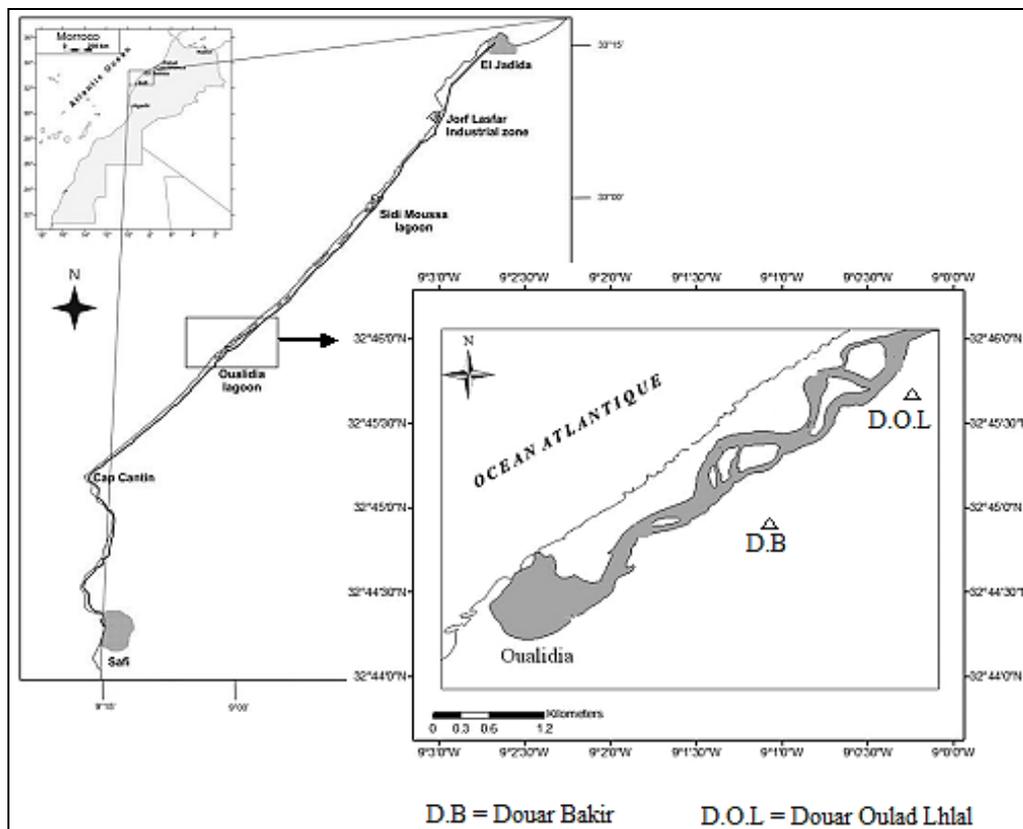
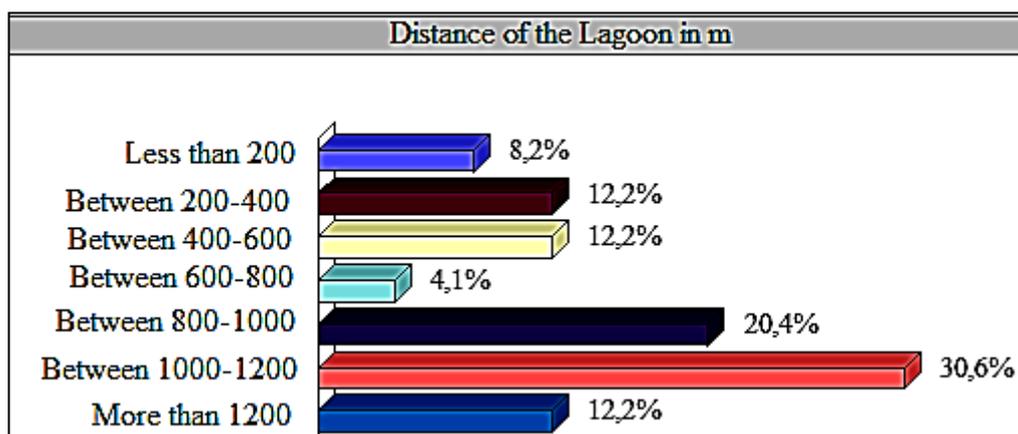


Figure 1. Study area and location of the Douars in investigations

Survey sample

The sample size is of 21 farmers belonging to Douar Oulad Lhlal and 28 farmers of Douar Bakir. The type of agriculture is for family in the two douars . Thus, the number of respondents is representative of the full range of land under cultivation, a single farmer type for each field to avoid redundancy in our results. The survey consists of three parts: the first concerns descriptive of the wells or it is specified: the depth of the wells, their distances from the lagoon, type of protection and pumping and the second concerns the mode of irrigation used and also identified the given on the use of the system to dripping, the clogging problems that can intervene and the frequencies of irrigation, periods during which the crops are irrigated. The third party is interested in the type of crops per farmer.

The wells surveyed are classified according to their distances from the lagoon with 30% of the wells are far from 1000 to 1200 m and that 20.4 % of the wells are far from 800 to 1000 m. The strips of cultivated land is divided into two sub-geomorphological units separated by the cliff Ouljienne. In this survey, the majority of wells do not exceed the depth of 80 m, with 46.9 % of the wells have a depth less than 20 m and 24.5% of the wells have a depth between 60 to 80 m. The minimum depth of the wells is 4 m and the maximum depth is 130 m (Figure 2B). If we integrate the factor of "Douar" to our analysis, we find that the wells of the Douar Oulad LAHLAL majority are less than 50 m and do not exceed 100 m. However in the Douar BAKIR, we find more of wells whose depth exceeds 50 m, as shown in the table below. This can be explained by the topography of the two "Douar" and the lithology of soils.



2B

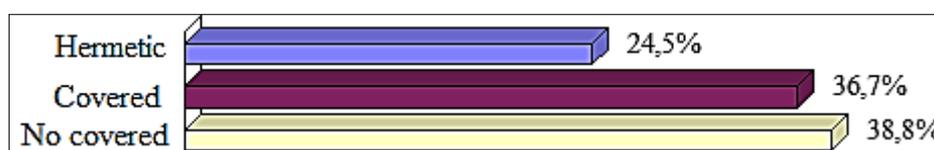
Figure 2. A & B Descriptive of the depths of the wells and their provisions of the lagoon

III. Results And Discussion

Cover and pumping wells

The figure 3A shows that 38.8% of the wells surveyed by the questionnaire were found covered with an equal proportion in both "Douar". While 36.7% of the wells are covered by a metal grid fine links and 24.5% of the wells are sealed. Wells cover modes that limit the risk of pollution, but does not provide complete protection.

The investigation carried out has confirmed the absence of traditional methods of water pumping. All wells use motors of different types with the predominance of butane gas engines (55.1%), followed by heat engines consuming gas oil (42.9%). As for the use of electric motors, it remains very limited due to the consumption cost and difficult access to rural electrification. Heat engines tend to be replaced by butane gas engines and are present mainly in shallow wells, which consume less fuel for water pumping. Also due to the small quantity / price resulting from the operation of butane gas in comparison with the quantity / price resulting from the operation of diesel. Also note the almost total lack the electrical pumping, knowing that it is three times cheaper than a standard pump (Arnaud & Gay, 1994).



3A



3B

Figure 3. A & B. Descriptive of the wells and their location of the Douar

Table 1 : Water pumping of wells by Douars

	Pumping of water			Coverage of the wells			Well Depth		
	Thermal Engine	Electrical Engine	Gas Engine	Airtight	Covered	Not Covered	Less than 50 m	Between 50-100 m	More than 100 m
D. BAKIR	7	1	20	7	12	9	11	15	2
D.OULAD LAHLAL	14	0	7	5	6	10	17	4	0

D. = Douar

Mode of use and irrigations

Concerning the mode of use, all the farmers surveyed agree that they use the waters of wells in three responds: direct consumption, irrigation and the drink of livestock. The treated water is inaccessible for the two Douars. The type of irrigation is accurately from the four suggestions: irrigation by drip; gravity-fed irrigation, irrigation by basin and spray irrigation. The purpose of this question is to supervise the establishment of the irrigation system by drip subsidized in majority by the state in the context of a project started in 2010 with a view to economy of irrigation water and a participatory management of overexploited aquifers. This will allow a better use and exploitation of water resources (PNEEI, 2009).

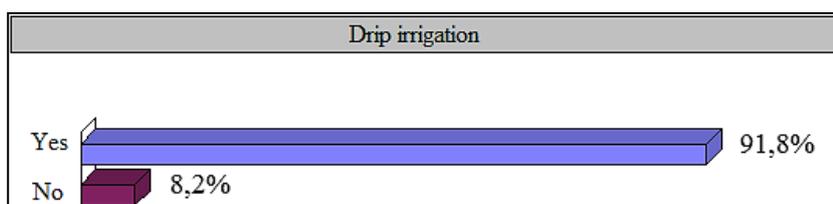
The responses have shown that 91% used the mode of drip irrigation and can be associate with the mode of traditional irrigation by the use of basin irrigation (represented the main method in the past and always drawn by the farmers who have not yet the means to install the mode of drip irrigation). The mode of gravity-fed irrigation or by swaths are not exploited in the region of Oualidia only occasionally and limited way for specific varieties of seeds.

The system of drip is known for its efficiency in irrigation water management and production, however, problems of plugging of pores can occur in ways recurring, but without great influence and are controllable. Among the farmers questioned, 91.8 % responded "yes" to the problem of clogging of the pores at least once a month and 8.2% did not answer the question and this by what they are not affected by this issue. The frequency of clogging is fairly low this could be explained by the precautions taken by the farmers in preceding the water distribution system by a sand filter. There are several types of restrictions: the biological clogging caused by the algae, bacteria, fungi, the physical restriction due to the deposit of fine particles, sands of silt or clay, as well as of foreign particles and the chemical clogging due to the problem of precipitation limestone, or grouting of silt or clays.

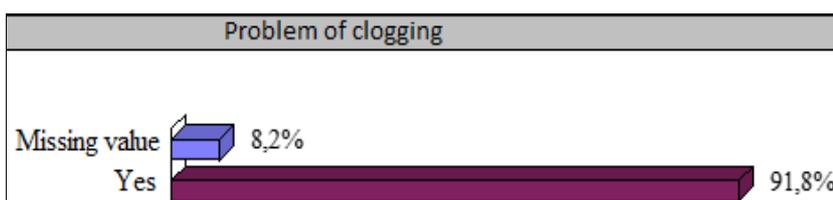
The groundwater can be loaded in sands responsible for physical blockage or bicarbonate ion responsible for chemical clogging. It is reversible by stay of the strong acid 24h in the channels whose pores have been closed previously and then drain and flush with water before irrigating. This is the method collected from farmers, whereas in bibliography, for the chemical clogging, due to the problem of precipitation limestone, or grouting of silt or clay, is injected at the hydrochloric acid (Elattir, 2005) (Phocaides, 2008).

Other studies, on the region of Doukkala demonstrated that the irrigation system drop-to-drop has allowed an economy of water ranging from 30% up to 50% (FAO, 2012). Thus, technique contributes to the improvement of the productivity of the irrigation water (INRA, 2012). The majority of farmers admit a frequency of irrigation two to three times per week (77.6%) and 8.2% less than two. Therefore, 14.2% of the owners of the lands cultivated questioned irrigate more than six days per week.

According to the statements, irrigation can last all day continuously or not. The frequent irrigation would allow plants to better withstand the rationing of water especially for those who are sensitive to drought. However, irrigation in small doses causes a strong localization of the water and nutrients. Therefore, the root system itself. Irrigation is stopped in the rainy periods. The type of distribution to dripping is the one who has the greater effectiveness: of the order of 90 %. It adapts to all types of soils and is recommended for dirty floors (Arnaud & Gay, 1994).



4A



4B

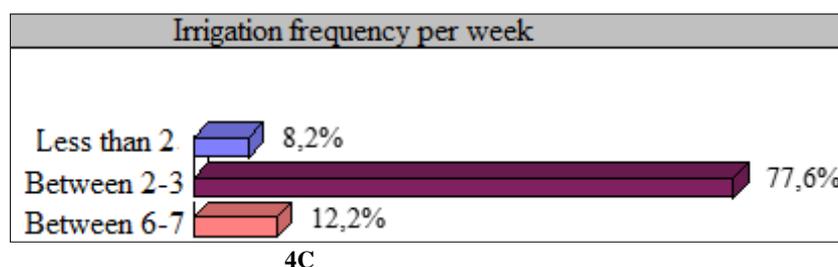


Figure 4. A to C. Mode of use and irrigation of wells

Type of agriculture

The region is known by the richness and diversity of its agriculture (Jamal, 2002), which is confirmed by our survey, reveals a great diversity of cultures in the majority of sections of land prospected. We note that 87.8% of farmers grow all types of pulses either simultaneously or spaced in time during the year with the predominance of truck farming. However, a minority of farmers (11.2 %) concentrated their agricultural activity on the cereals for their better profitability. According Moghli and Benjelloun (2000), the enhancement of irrigation water by the wheat board would be equally as important as that of the cultures of market gardening in season and would amount to 2.7 Dh/m³ against 2 Dh/m³ for truck farming. Generally, it should also be noted the total absence of the difficult arboriculture has established in the coastal zones. Only the cultivation of the olive tree represents the bulk of the arboriculture Sahelian belt which develops in a coastal zone, be deemed by the particularity of its climate and geography (Houimli E. 2008).

Table 2 : Type of agriculture

Type of agriculture	% of Responds
Truck farming	87,80
Cereal and carrots	4,10
Cereals and legumes	8,10

IV. Conclusion

The investigation conducted in the coastal area, Oualidia and concerned two Douars: "DOUAR BAKIR" in the center and "Douar Oulad LHLAL" toward the upstream, which are predominantly agricultural. In view of its direct contact with the Atlantic Ocean, the aquifer system of the Sahel of the Oualidia to dominance carbonate is exposed in continues at the risk of marine intrusion. The overexploitation of groundwater to meet the needs of the rural population in consumption of water and irrigation contribute to the degradation of the water quality of wells. All the farmers questioned approve the inaccessibility to safe drinking water and their total dependence on the waters of wells. As well, the farmers are aware of the importance that provides the wetland development of agriculture foreshore, their main source of income, and have integrated the National Program of Economics of irrigation water began in 2010 and were introduced in majority mode the drip irrigation.

This has resulted in improved management of groundwater resources in water and is reflected on weekly consumption of water in irrigation, which is reduced by two to three days per week for 77 % of users. In addition, the low frequency of clogging of the system to dripping, proves the effectiveness precautions undertaken by the farmers on the one hand and can be explained by the absence or the minimal presence of bicarbonate ions responsible for the chemical clogging. The approach, which could help to more economy in water consumption, is the substitution of truck farming dominant in the region by other cultures less consumers who bear the arid conditions of agriculture foreshore. Other efforts are deployed for the protection of the wells by covers sealed to avoid the external pollution, which included the marine aerosols which sources are non-negligible salinization of groundwater.

Reference

- [1]. Arnaud L. & Gay B. 1994 : De l'eau pour le maraichage, Expériences et Procédés. Editions du Gret. 126 p.
- [2]. Choukr-Allah R. 2004 : Protected cultures in Morocco : new trends and developments, International workshop : The production in the greenhouse after the era of the methyl bromide. Comiso (RG) Italy, p 187- 191.
- [3]. Elattir H., 2005 : La conduite et le pilotage de l'irrigation Goutte à Goutte en Maraichage. TRANSFERT DE RECHNOLOGIE EN AGRICULTURE. Bulletin Mensuel d'information et de liaison du PNTTA, p6.
- [4]. Food and agriculture organisation of the United Nations (FAO), 2012 : Le passage à l'irrigation localisée collective les résultats d'une expérience dans le périmètre des Doukkala. Rapport de capitalisation des acquis du Projet pilote d'économie et de valorisation de l'eau d'irrigation dans le périmètre des Doukkala (GCP/MOR/033/SPA), 73 p.
- [5]. Haut-Commissariat au Plan (HCP, 2010) : Monographie de la région Doukala-Abda 2010. 90 p.

- [6]. Hilmi K., Orbi A., Lakhdar J.I & Sarf F. 2005 : Etude courantologique de la lagune de Oualidia (Maroc) en automne. Bull. Inst. Sci., sect. Sci. Vie, 26-27, 67-71.
- [7]. Houimli E. 2008 : Les facteurs de résistance et de fragilité de l'agriculture littorale face à l'urbanisation : Le cas de la région de Sousse nord en Tunisie, Thèse de doctorat d'état, Ecole nationale supérieure du paysage de Versailles, 419 p.
- [8]. Institut National de Recherche Agronomique (INRA), 2012 : Rapport d'Activité. Division de l'Information et de la Communication, Editions 2013. 79 p.
- [9]. Jamal A. 2000 : Croissance démographique et mutations agraires dans le Sahel des Doukkala. Thèse de doctorat d'état, Université Chouaïb Doukkali d'El Jadida, 246p.
- [10]. Jamal A. 2002 : Irrigation et développement agricole au Sahel des Doukkala : maîtrise inégale d'un espace différencié. Eau et environnement au Maroc aride et semi-aride, Actes du colloque organisé à El Jadida 30 et 31 octobre 2000, Publications de la Faculté des Lettres et des Sciences Humaines El Jadida, Série Colloques & Séminaires, El Jadida, pp 163-168.
- [11]. Moghli E. & Benjelloun Touimi M. 2000 : Valorisation de l'eau d'irrigation par les productions végétales dans les grands périmètres irrigués au Maroc. HOMMES TERRES & EAUX, (116), pp 30-38.
- [12]. Oulaaross Z. 2009 : Etude climatologique, hydrogéologique et géophysique du Sahel Côtier des Doukkala (Maroc). Apport de l'analyse statistique et de l'inversion des données géoélectriques à l'étude du biseau salé de la lagune de Sidi Moussa, Thèse de doctorat d'état, Université Chouaïb Doukkali d'El Jadida, 279 p
- [13]. Phocaidès A. 2008 : Manuel des techniques d'irrigation sous pression. Organisation des nations unies pour l'alimentation et l'agriculture. Rome. (2), 300 p.
- [14]. Programme National d'Économie d'Eau d'Irrigation (PNEED), 2009. Ministère de l'Agriculture et de la Pêche Maritime, Plan de Gestion Environnemental et Social, Maroc, 5 p.