

Original Research

Cultivation of potatoes in the Sahara; current situation and future prospects

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ABSTRACT:

This work aims to highlight the development of potato in the Saharan regions of Algeria, especially in Ouargla and Oued-Souf. Where, their cultivation is leading in the last decade occupying an important place among the productive regions of this crop in the national scale. Our investigation focuses through a survey on a series of 400 potato farms.

We seek to carry out a comparative diagnosis between both regions; Ouargla and Oued Souf in order to highlight the strengths, weaknesses and opportunities on the development of potatoes in farms where the enhancement of land happened. The results showed that the strengths and opportunities of one region are weaknesses and handicaps for the other. Therefore, they revealed some major differences between these two regions. The results obtained could be summarized as follow:

- The 98% of Oued Soufs farmers practice both large and small trade. On the other hand, Ouargla's represent only 25%.
- 75 % of farmers in Ouargla exploit collective drilling. Contrary to Oued Souf where 75 % of the farmers exploit individual wells with a tolerated water salinization.
- Almost all farmers in Oued Souf use the so-called "pivot spraying" irrigation system. While in Ouargla, it is only the 20% who practice this system.

These results are discussed by updated knowledge about the development of this crop.

Keywords:

Potato development, Saharan regions, Skills of knowledge, Water source, Pivot system.

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INTRODUCTION

With more than 30 million inhabitants, Algeria is today one of the world's leading importers of food and agricultural products. Nowadays, Algeria with more than 42 million inhabitants appears among the first worldwide importers of food and agricultural products. The bill average reaches 2.5 billion dollars / year, with a useful and fertile agricultural area that does not exceed 8 million ha, or 3.3% of the national territory (Bessaoud, 1994). Faced with this alarming situation, the Algerian strategy has been oriented towards the extension of the farming surface area with the aim of achieving self-satisfaction and ensuring national food security, by implementing the policy of land enhancement for agriculture in the major Saharan expanses (MADRP, 2014). Agricultural sector began assuring an important agro economic activity particularly in certain regions by ensuring throughout the year a more regular market supply (Belateche, 2007). Its role has grown more and more in terms of market satisfaction.

The Saharan regions which occupy 3/4 of the national Algerian area (where Ouargla and Oued Souf are part of these Southern Provinces "Wilayas") knew very tough social and economic lives (Troin, 1985) through oases scattered here and there in the desert (Toutain *et al.*, 1988). A large part of these areas was the object of considerable expansion in terms of farming land because of the development of new perimeters (Bouammar, 2010). This strategy is based on intensive farming using new technical itinerary, including the irrigation system (Mesli, 1998).

The potato crop has made its mark in the world in terms of consumption. The average consumption per person in the world is about 31 kg / year. The Algerians can consume up to 111 kg / year. These indicators revealed that this crop has become one of the most widely consumed agricultural products in the world and particularly in Algeria (MADRP, 2018). The region of El Oued has thus become the first producer of potatoes in

the country. Oued Souf produced alone 11.180.000 quintals of potato (MADRP, 2016). Therefore, it exceeds the 33 % of national production on an area of 34000 ha. But on the other hand, there is a low industrial promotion of the product (Omari, 2011). Our preliminary investigations showed that despite these potentialities, and despite the important place which occupies the potato's yield within national economy, there is not a significant evolution of this crop in the Ouargla region. On the other hand, for the period displayed between 2000 and on 2017, a large part of the eastern Erg was transformed into huge area of green circles (of 01 ha) where potato was cultivated using the irrigation system called "Center Pivot Irrigation".

For the purpose of understanding, control and intervention in a development perspective, it is up to us to know the strengths and weaknesses of the farming system through the knowledge of the agricultural production units of the two regions in their diversity, their functioning and dynamics. In order to do that, we relied on a series of surveys in both study regions to highlight the technical and socio-economic parameters.

MATERIALS AND METHODS

In order to achieve the study goals, it is judicious to adopt a systemic approach, considering the region particularity, the zone and the farm as well as the socio-economic and cultural life of the farmers (Ababsa, 1993). Our work was in 04 steps and can be summarized as follows:

First Step: Choice of the site study (Ouargla and El Oued) - Collection of information.

Second Step: Study area stratification (zoning) and Pre investigation (elaboration of the survey).

Third Step: The survey itself.

Fourth Step: Results and analysis.

Therefore, our survey was based on 200 samples in El Oued region (also known as Souf). Samples are chosen across the 05 most productive Communes

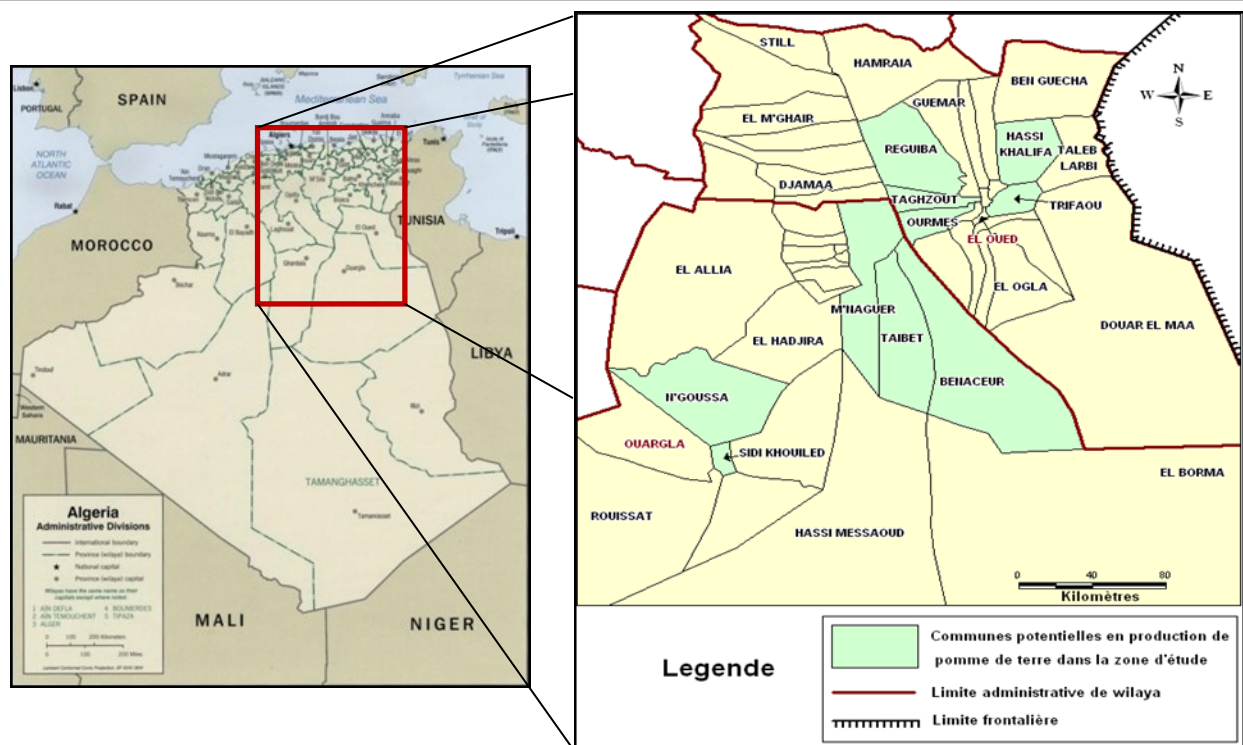


Figure 1. Geographical location of the study zones

(group of villages) on the national scale; they are: Hassi Khalifa, Ourmesse, Trifaoui, Réguiba, Taghzout.

For the Ouargla region, surveys are carried out in 03 productive zones of potato; we have chosen 200 samples divided in three zones. They are: Taibet, Sidi Khouiled (in the site called Ain Moussa) and N'goussa. The questionnaires used were validated by Laboratoires des Systemes Agraires. Institut National des Recherches Agronomiques (INRA), France.

The parameters to highlight are as follows: knowledge and know-how, water resources, type of drilling, irrigation system and financial capacity. A statistical analysis using the Chi² hypothesis is accomplished on the samples of both regions. The purpose of the test is to highlight the differences existing between

these 02 regions studied via the development of potato farming. The analysis is carried out by the software XLSTAT version 2009.1.02

Nature of the studied zones

Both provinces "wilayas" are characterized by very high daytime temperatures, which may exceed 45° C. Very rare and irregular rainfall varies from 0 to 150 mm during the winter period. The winds are strong and frequent from February to June and might be sandstorms. The sirocco prevails especially from June to September (Djennane, 1990).

According to Daoud and Halitim (1994), the vast areas of both regions have created a huge reservoir of groundwater. The organic fraction is very low or

Table 1. Independence test (Chi²) related to Knowledge and know-how

Chi ² (Observed value)	150,000
Chi ² (Critical value)	5,991
DDL	2
P-value	< 0,0001
Alpha	0.05

Table 2. Independence test (Chi²) related to financial capacity

Chi ² (Observed value)	123,785
Chi ² (Critical value)	3,841
DDL	1
p-value	< 0,0001
Alpha	0.05

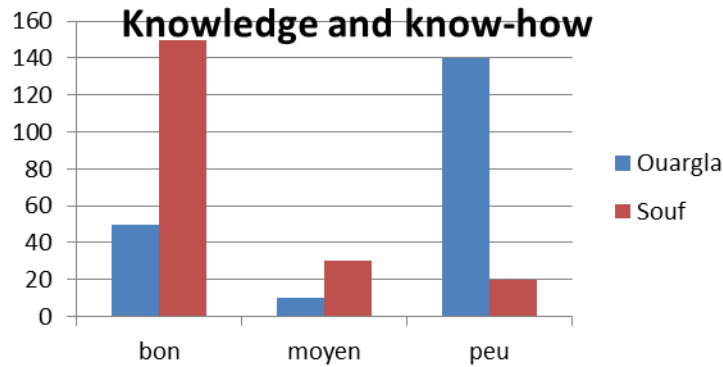


Figure 2. Knowledge and know-how in Ouargla and Oued Souf zones

even zero (except the oases). On high topographies, the soils are rocky or sandy (Hamadas, regs, ergs). In depressions, the texture might be soft but soils are salty (Sebkha and Chotts). Saharan agriculture is generally carried out under irrigated conditions, since no development can take place without pumping water (electrification), except for a few areas known as "Bour".

Considered parameters

Knowledge and know how (Good, medium, a little): from some visual indicators are windbreak, choice of seeds, mastery of the technical itinerary, etc.,

Financial capacity (yes, no): The farmer's ability to plant one or more potato plots.

Water source: (Individual wells, collective drilling): we mean by this parameter, collective drillings are those realized from the Mio-Pliocene or Albian aquifers watering tens hectares of several grantees. While individual drillings are, the ones accomplished from aquifers,

less deep.

Irrigation system (Pivot, drip)

The "Pivot" system: sprinkler arm that rotates around an axis connected to the water pipe.

RESULTS AND DISCUSSION

We present the parameters that make an amendment to our work and are related to the goal of our study according to a technical and socio-economic approach. In the results that follow, we display the number of answers with respect of the number of samples.

Our investigations showed that 50 farmers out of 200 in the Ouargla region (25%) have good know-how. 10 of them (5%) have medium know-how and 140 (70%) have Megger know-how Figure 2. Regarding the region of Souf, 150 farmers among the 200 (75%) have good know-how, 30 among them (15%) have medium know-how and 20 (10%) have little know-how.

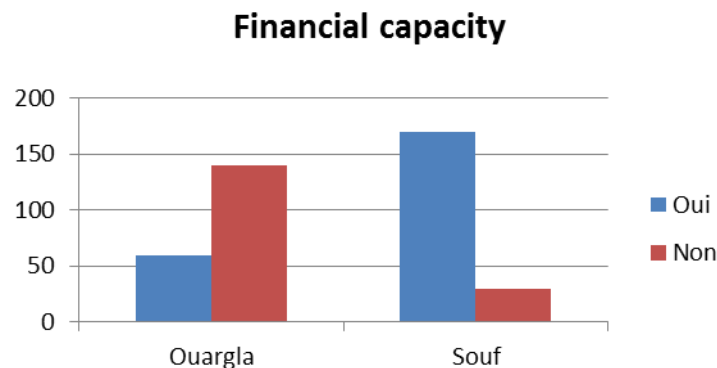


Figure 3. Financial Capacity in the zones of Ouargla and Oued Souf

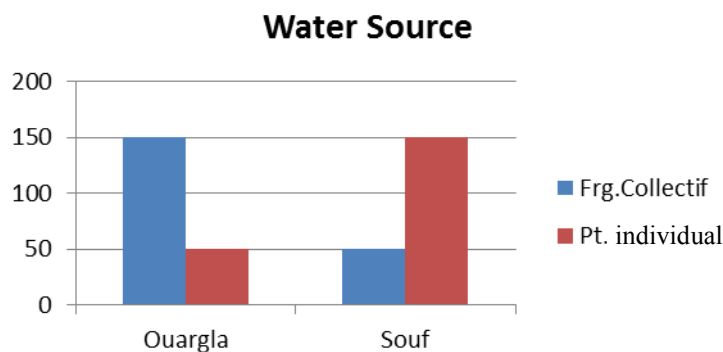


Figure 4. Water Source at the regions of Ouargla and Oued Souf

The analysis of data on knowledge and know-how by the test of chi² Figure 1 showed a highly significant difference (P<0.0001). Knowledge and know-how are dependent on the regions of study Table 1. This showed that Souf farmers master some ancestral techniques such as the fight against desertification by the construction of "Tabia" and windbreaks inherited from the "Ghout" system. In addition there is a good mastery of the technical itineraries.

According to our results, 60 farmers among 200 in the Ouargla region (30%) of them have financial capacity and 70% do not have this capacity Figure 3. Regarding the Souf region, 170 farmers among 200 (95%) have a financial capacity and 30 (15%) do not have this capacity. These are financially limited, however, they may have the mobility to do irrigation in a very limited area not exceeding 1/4 ha. This analysis by the chi-square test Figure 2 showed a significant difference (P<0.0001).

Financial capacity is dependent on the studied region Table 2. It is understood that without this capacity, the success of the cultivation of potato plot will never happen knowing that the cost of one hectare is about

500,000 DA. Whereas, the commercial or entrepreneurial thinking in the Souf region allows to cover these expenses either by cash financing or by post-harvest payment through a partnership with the suppliers of goods and services.

Our results showed that by 200 farmers investigated in the Ouargla region, 150 (75%) operate collective boreholes, while 50 (25%) use individual wells Figure 4. In this picture, the majority of Souf farmers, namely 150 (or 75%) exploit individual wells, while the remaining 50 farmers (25%) operate collective wells. The analysis of water source data by the Chi-square test Table 3, showed a significant difference (P<0.0001). The water source is dependent on the studied area. Field observations have shown that the source of water creates conflicts between the beneficiaries, which prevent the increase in the area (case of Ouargla region).

According to our results, 160 farmers in the Ouargla region (80%) use the drip system as an irrigation system, the 40 remaining farmers or the 20% use the pivot system Figure 5. In the Souf region, 180 farmers (90%) use the Pivot, while the 20 farmers (10%) use the drip system.

Table 3. Independence test (Chi²) related to the water source

Chi ² (Observed value)	100,000
Chi ² (Critical value)	3,841
DDL	1
p-value	< 0,0001
Alpha	0,05

Table 4. Independence test (Chi²) related to the irrigation system

Chi ² (Observed value)	197,980
Chi ² (Critical value)	3,841
DDL	1
p-value	< 0,0001
Alpha	0,05

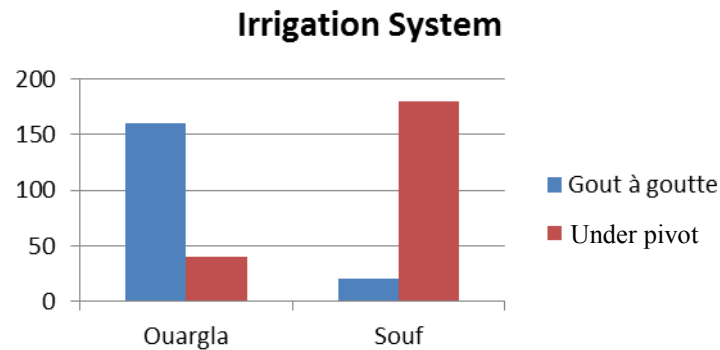


Figure 5. Irrigation System in the regions of Ouargla and Oued Souf

The analysis of irrigation system data by the chi-square test Table 4 showed a significant difference ($P < 0.0001$). The irrigation system is dependent on the area of study. Souf farmers have adapted the locally produced pivot system with which potato production has progressed.

The majority of the Souf farmers (75%) exploit individually using ameliorated wells where there deep is not exceeding 60 m. These are slicks characterized by low salinity of water favoring the emergence of the potato crop (Dadamoussa, 2015). The potato crop has a very limited tolerance to salinity; therefore water quality has played a role in the persistence and development (Côte, 2002).

On the other hand, in Ouargla the most exploited aquifers are the Mio-Pliocene and the Albian, this parameter does not generally allow the development of this crop, due to the fact that exploited water contain salt up to 06 g/L (Côte, 2002). Another parameter seems very important in the development of the potato in Oued Souf which is the "pivot" system: spray irrigation through a metal pipe rotating around an axis. It has been an important parameter in the potato growth. The bottom line is that the genius "Soufi" could develop this idea by making this equipment with local performances (Ahmed *et al.*, 2018). And by the process of spreading, large areas of the Souf region are transformed for a decade into multiple concentric circles of potatoes (Korichi, 2013). The Souf region geomorphology has been a favorable factor for development. Indeed, it is thanks to

the large areas of fine sands dune (erg), that the availability of land has been made possible and that natural environments have been enhanced for the development of this crop (Dadamoussa, 2017).

Otherwise, this diagnosis has affected not only the technical aspect and level of knowledge and know-how, but also the socio-economic aspect which hides the main causes of strengths and weaknesses reported in both regions of the study. Regarding the socio-economical aspect, the results showed that there are remarkable differences between the farmers of the two regions in the crop management and all types of input availability of this so-called "strategic" plant. In fact, the potato producers in the Souf region are mostly small farmers (0.5 - 01 ha). But it is their big number that has contributed to the development of this crop in the vast expanses of sand dunes with the spirit of trade and entrepreneurship as well as their social links.

Thus, the potato sector in the Souf, has resulted to the creation of a real workshop of economic movement and extraordinary social interaction: cooperatives and input supply companies, welders, transporters, cold-storage rooms, etc., and a technical framework that carries out these missions in a favorable atmosphere. This kind of socio-economical relationship characterizing the "Sufi" population has contributed either directly or indirectly to the development of the potato in El Oued region.

CONCLUSION

Despite the early appearance of the potato in Ouargla region by the early 1980s, its evolution did not take place, contrary to the region of El Oued which has known in a short period of time; a remarkable development; transforming this part of southern Algeria into a real workshop and combination of different professional service providers specifically: qualified farm labourers, carpenters, welders, transporters, different kinds of input cooperatives, traders, etc.

If the history as well as the different steps of potato development and evolution in Ouargla are considered the failure met is a function of several interrelated factors could be solved. In fact, after browsing and analyzing the farms through the surveys carried out among the farmers of both regions studied, we can conclude as follow:

- A remarkable failure in the access of agricultural land in the Ouargla region, compared to Oued Souf.
- A lack of involvement of Ouargla farmers in the context of knowledge and know-how. Whereas in Oued Souf, it is the know-how transmitted between the small farmers in a very reduced time, called in another term "spreading".
- The existence of entrepreneurial thinking among Oued Souf farmers linked to other socio-economical parameters is a strength for the Souf farmers. These parameters are absent for most farmers in other Saharan regions, especially in Ouargla.

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