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Socioeconomic Analysis of Date Palm Sector: The Case of Biskra Region (Algeria)

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ABSTRACT. Regarding the importance of date palm sector for local development, this study aims to explore and analyze empirically the main socioeconomic characteristics of date palm sector in Biskra region. The study uses an extensive micro-database containing 21,502 date palm farms. The technico-economic aspect of date palm farm is reflected by two structural features: size and tree density; since the social aspect is reflected by human capital dimension measured by farmer's age and his experience. Our study is mainly explorative and attempts to extract the empirical regularities which would be helpful for policy making.
KEYWORDS: Date Palm, Farm Size, Density, Human Capital, Biskra Region

1. INTRODUCTION

The date palm sector gains an increasing importance for the national economy in Algeria. Besides, it has an increasing interest in terms of exportation, subsidies and promotion last years. Nowadays, Algeria has a total cultivated area for date palm of 162 372 ha (with a total number of palm trees roughly 18 millions). We mention also that Algerian date palm sector includes about 800 date palm cultivars[1].

It recognized that the Wilaya of Biskra occupy the first place at the national level for date palm farming. This Wilaya (known also as Ziban Region) is the focus of our study. From our data, it has a total cultivated area of 124 826 ha, i.e., it represents about 42% of the total date palm cultivated area in Algeria. In addition, date palm sector in Biskra region contains 3.5 millions of palm trees representing nearly 30% of national sector. This confirms the fact that date palm sector in Biskra Region has a considerable importance in the national economy.

Our study aims to explore and analyze the main socioeconomic characteristics of date palm sector in Biskra region through an extensive micro-database containing 21,502 farms. The date palm farm is the unit of study. The economic component of date palm farm is reflected by two structural features: size and tree density. Since the social component includes the human capital by farmer's age and experience. Our study is mainly explorative and attempts to extract the empirical regularities which would be helpful for policy making.

[1] These statistics are provided from the studies of Benziouch (2013) and Bouguedoura et al. (2015)

The paper is organized as follow. The next section describes the research methodology. Section 3 analyzes the economic aspect of date palm sector, since section 4 focuses on its social dimension. Section 5 concludes.

2. RESEARCH METHODOLOGY

The study uses an extensive micro-database collected by the Ministry of Agriculture (Department of Extension Services, Biskra). It concerns the date palm farming sector in Biskra region. It contains 21,502 observations as date palm farms. Several measures were captured. The first reflects the farm size expressed in terms of the effectively irrigated and cultivated area of the date palm farm (in hectares).

Another measure is captured which reflects a technological aspect of date production. It concerns the technical density for date palm farms expressed in terms of palm trees *per* one hectare. Other measures were also included in the data such as whether the farm is specialized or diversified; and the total number of palm tree in the farm. For the socioeconomic measures, the data we have captures two. It concerns the farmer's age (in years) and the farmer's experience in date palm farming.

For the purpose of the study, we employ some basic statistical tools, namely, the statistics of central trend (mean, median and mode), the dispersion (standard deviation), two-dimensional plots, and frequency distributions. The later include the relative frequencies distribution (with adequate number of bins) and the non-parametric kernel density estimation. Kernel density estimation proceeds by defining a set of evenly spaced reference points, and attributes a weighted sum of the data frequencies in the neighborhood of the point being

estimated. The formula used to compute the estimated density at each reference point, x, is

$$f(x) = \frac{1}{nh}\sum k(\frac{x - x_t}{h})$$

where n denotes the number of data points, h is a bandwidth parameter, and $k(.)$ is the kernel function[2]. For facilitating the analysis, the densities presented in this study were estimated using the same bandwidth of 2.0[3].

3. ECONOMIC ANALYSIS OF DATE PALM SECTOR

In this section, we focus on the economic aspect of date palm farm by analyzing its main structural characteristics, namely, farm size and tree density. Farm size, according to cropping pattern here[4], correspond to the cultivated are (in hectares), where the technical density in date palm farms express the number of date palm trees in one hectare reflecting the main component of date palm technology farming.

3.1. Farm Size

Table 1 (in Appendix) summarizes the main statistics of date palm farm size in Biskra region. From the data we have (with 21 502 pal date producers), it seems that the date palm farm size has an average of 6.68 ha (having a minimum value of 0.09 ha and a maximum value of 906 ha) with a low standard deviation (13.38).

From the side of the median and the mode, they represent respectively 4 ha and 1 ha. The significant differences between these basic central moments require a more deep investigation for the date palm farm size dimension.

In order to analyze this dimension in more detailed terms, we have split the farm size in three classes. The first represents the small size farms (farm area less than 5 ha), the second for the medium size farms (farm area between 5 and 10 ha), and the last one for the large size farms (farm area more than 10 ha).

As shown in Table 1 (in Appendix), frequencies of different size classes are as follows: Small date palm farms represent roughly 54% (i.e., 11 646 farms), whereas the medium size corresponds to 22.5% (i.e., 4 835 farms), since larger farms has a fraction of 23.5% (i.e., 5 021 farms). It seems that the small date palm farm has the important share in date palm sector of Biskra region.

In more detailed terms, small farms have an average of 2.13 ha with median value of 2 ha (having low standard deviation: 1.16). Since the medium farms have an average of 6.2 ha with median value of 6 ha (having low standard deviation: 1.37), meanwhile large farms have an average of 17.66 ha with median value of 12 ha (having high standard deviation: 24.34).

In order to shows more accurately the modality structure of date palm farm size, we proceed results of the kernel density estimation. The results are shown in the following figures. Figure 1 shows the plot of the estimated frequency distribution for farm size which are less than 5 ha, since the Figure 2 shows plot of the estimated frequency distribution for farm size which are more than 5 ha[5].

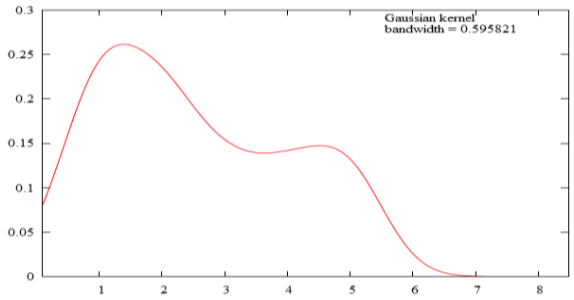

Figure 1. Estimated Frequency Distribution for Farm Size (Less Than 5 Ha)

From these tow figures, the multimodality of farm size is obviously observed. The first model value is about 1 ha (more exactly from 1 to 1.5 ha), the second modal value is 5 ha (more exactly from 4.5 to 5 ha) and the third one is exactly 10 ha. The shape of large farm distribution in Figure 2 is justified by the higher value of the standard deviation. We mention that there is just 27 observations beyond the size of 100 ha, and 940 observations between 20-100 ha. Hence, by using the remaining significant observations (i.e. 20 536 farms), we proceed a frequency distribution plot (with 10 bins). The result is shown in Figure 3 below.

From Figure 3, we can observe that the small farms (less than 5 ha) have the higher frequencies in date palm sector, since the higher frequency beyond that (i.e., large farms) is for the size of 10 ha. The main finding from this explorative analysis is that the date palm farm size in Biskra region exhibits a bimodal distribution with the dominance of small farms.

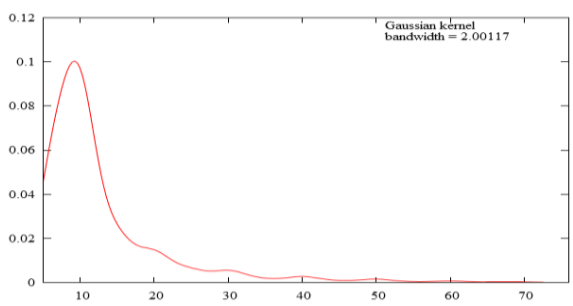

Figure 2. Estimated Frequency Distribution for Farm Size (More Than 5 Ha)

[2] Where the larger the value of the bandwidth parameter (the width of the neighborhood), the smoother the estimated density, i.e., varying the bandwidth parameter allows for control of the degree of smoothing in the estimated density (Silverman, 1986).

[3] Estimation with different bandwidths did not produce qualitatively different results.

[4] To the extent that the farm size is a complex issue in empirical literature. See Eastwood *et al.* (2010) for more details on this matter.

[5] This classification seems to give more visibility for the multiplicity of modal values in the data.

3.2. Technical Density

From the plantation density in date palm sector, expressed by the number of date palm trees in one hectare, Table 2 (in Appendix) displays the main statistics of date palm tree density in Biskra region. From the extensive data we have, it seems that the date palm plantation density has an approximate average of 46 tree/ha (having a minimum value of 0.05 tree/ha and a maximum value of 437 tree/ha) with a high standard deviation (46.71).

The divergent value of the mode for the overall data implies further detailed investigation. It seems that, from our data, there are just 190 observations having values higher than 200 palm tree/ha. Then, we proceed a frequency distribution plot (with 200 bins). The result is shown in Figure 4.

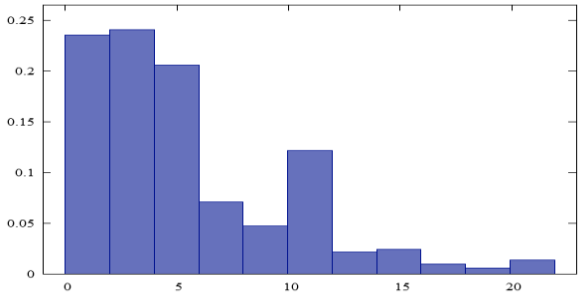

Figure 3. Frequency Distribution for Farm Size (Less Than 20 Ha)

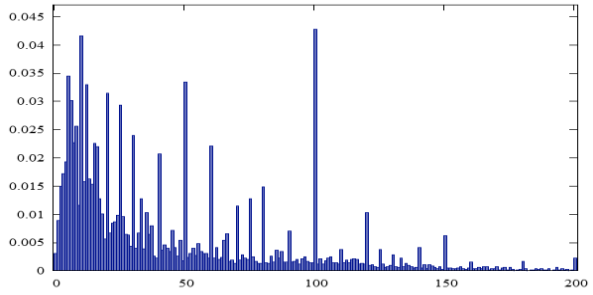

Figure 4. Estimated Frequency Distribution for Palm Tree Density

The result form Figure 4 shows that the higher frequencies for the technical density for date palm farms are respectively for less than 20 tree/ha and exactly 100 tree/ha. The first modality could reflect lower densities as a typical characteristic of modern date palm farming system. As for the second modality, reflecting higher typical density of 100 tree/ha, it could be explained by the presence of highly specialized and traditional date palm farming system.

In order to investigate the relationship between this measure and the size dimension (analyzed above), we plot the two measures in two-dimensional graphic as shown in Figure 5 below.

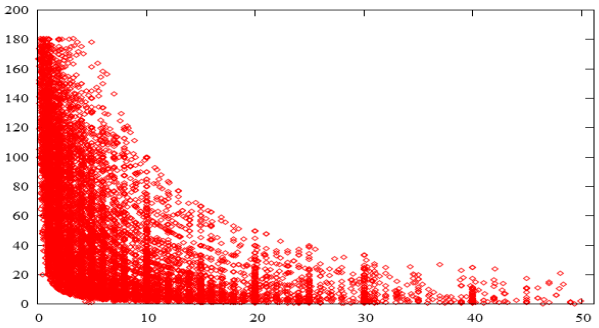

Figure 5. Palm Tree Density in Terms of Farm Size

It obvious from the resulted plot that there is an empirical regularity between date palm farm size and palm tree plantation density. A decreased non-linear slope could be visibly detected. Larger farms tend to have lower densities, where small farms have higher ones. These tendencies could be explained also by the dual nature of date palm farming systems. Larger farm is the main attribute of traditional system since smaller farm is an attribute of modernized and newest farms.

4. HUMAN CAPITAL IN DATE PALM SECTOR

The social aspect will be the focus of this section. The study highlights the farmer's age and its experience as proxies of the human capital[6] in date palm sector. These two measures will be analyzed mainly in terms of farm size, density, and specialization.

4.1. Age Structure

In order to analyze the date palm farming sector in terms of farmers' age structure, we have proceed a plot for frequency distribution of date palm producers' age (with 3 bins). The result is shown in Figure 6 below.

The plot in Figure 6 shows three distinguished age classes. The first class represents farmers having less than 40 years old including 3 137 farms (14.5%). The second class is between 40 and 80 years old including 16 019 farms (74.5%), since the third one include older farmers (i.e., more than 80 years old) including 2 346 farms (11%). The overall average of date palm producer's age is about 57 years (with median and modal values of 56 years and 47 years respectively).

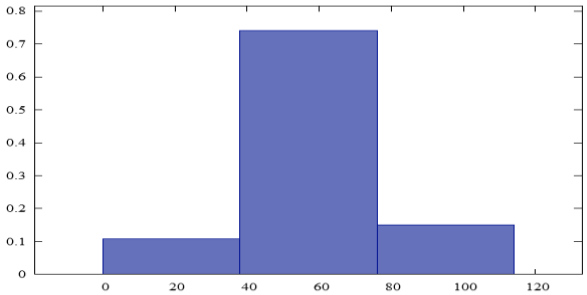

Figure 6. Frequency Distribution for Palm Date Producer's Age

[6] See Huffman (2001) for more details on human capital in agriculture

The Table 3 (in Appendix) shows the main statistics of farmer's age classes. The first age class has the following characteristics: A mean age of 34 years, a mean farm size of 6.43 ha, a mean total trees number of 195 palm trees, a mean density of 49 palm tree/ha, 77% of them are specialized in date palm farming, and they have in average 16.6 years of experience.

Besides, the second age class has the following characteristics: A mean age of 57 years, a mean farm size of 6.63 ha, a mean total trees number of 157 palm trees, a mean density of 46 palm tree/ha, 68% of them are specialized in date palm farming, and they have 14.6 years average of experience. Since, the third age class has the following characteristics: A mean age of 85 years, a mean farm size of 7.1 ha, a mean total trees number of 140 palm trees, a mean density of 45 palm tree/ha, 67% of them are specialized in date palm farming, and they have 16.4 years average of experience.

These findings allow us to conclude that date palm farming is dominated by the second age class by having an intermediate values for the underlying attributes. More interestingly, younger farmers (the first age class) have smaller size, higher density and they are the most specialized compared to the others, whereas conversely, older farmers (the third age class) have larger size, lower density and they are the less specialized.

4.2. Human Capital

We aim now to analyze the human capital aspect, as reflected by the years of experience in date palm farming. In order to do so, firstly, we have proceed a kernel frequency distribution of date palm producers' experience. The result is shown in Figure 7 below.

The Figure 7 allows us to distinguish obviously two classes: The first class for the less experienced farmers (less than 10 years) with a share of 18%, and a second class for the more experienced farmers (more than 10 years) with a share of 82%. Therefore, more detailed investigation is required. Table 4 (in Appendix) summarizes the main statistics of farmer's experience in terms of two classes.

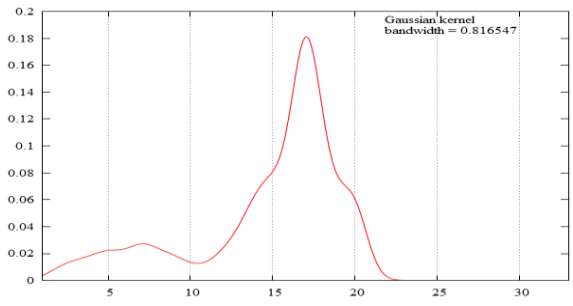

Figure 7. Estimated Frequency Distribution for Farmers' Experience

The first class (less experienced) has the following characteristics: A mean experience of 6 years, a mean farm size of 6 ha, a mean total trees number of 149 palm trees, a mean density of 57 palm tree/ha, 68% of them are specialized in date palm farming, and they have 61 years old in average.

Since the second class (more experienced) has the following characteristics: A mean experience of 16 years, a mean farm size of 7 ha, a mean total trees number of 163 palm trees, a mean density of 44 palm tree/ha, 70% of them are specialized in date palm farming, and they have a mean of 56 years old.
These findings suggest the following: date palm farming is dominated by more experienced old farmers with medium size, lower density and they are more specialized compared to the class of the less experienced. The analysis of this aspect could have important implications on the knowledge transfer between the two generations present clearly here.

4. CONCLUSION

The aim of this study was to explore and analyze the main socioeconomic characteristics of date palm sector in Biskra region through an extensive micro-database containing 21,502 farms. By using some analytical tools, the findings of this study can be summarized as follow: In date palm farming of Biskra region, the average farm size is about 6.6 ha having a bimodal distribution, the averaged density is about 46 trees/ha, younger farmer has smaller size, higher density and they are the most specialized, there is a dominance of more experienced old farmers with medium size and lower density.

The present study should be extended by examining the potential drivers of the date palm farm efficiency, with a particular emphasis on the potential role of land regulations, subsidies and agricultural policies in date palm sector. More accurate analysis would contribute to the debate on the efficiency of a public intervention in date palm sector to promote the modernization of farming, particularly oriented toward a specific model. However, this research is still a useful exercise in itself, since it lays the framework for subsequent future testing and refinement.

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APPENDIX.

TABLE 1. SUMMARY STATISTICS OF THE DATE PALM FARM SIZE

	Obs.	*Mean*	*Median*	*Mode*	*Min*	*Max*	*S.D.*
Farm Size (ha)	21 502	6.68	4	1	0.09	906	13.38
Less 5 ha	11 646	2.13	2	1	0.09	4.99	1.16
From 5 to 10 ha	4 835	6.20	6	5	5	9.99	1.37
More 10 ha	5 021	17.66	12	10	10	906	24.34

TABLE 2. SUMMARY STATISTICS OF THE DATE PALM TREE DENSITY

	Obs.	*Mean*	*Median*	*Mode*	*Min*	*Max*	*S.D.*
Tree Density	21 502	46.47	30	100	0.05	437.50	46.71
Less than 50 palm/ha	14 413	19.91	16	50	0.05	50.99	13.82
From 50 to 100 palm/ha	3 744	72.03	70	60	51	99.83	12.81
More than 100 palm/ha	3 345	132.30	120	100	100	437.50	43.37

TABLE 3. SUMMARY STATISTICS OF FARMER'S AGE CLASSES

Classes	*Obs.*	*Mean Age*	*Farm Size*	*Palms Number*	*Tree Density*	*Specialized Farms (%)*	*Farmer's Experience*
Age Class 1	3 137	34.26	6.43	194.96	49.05	77	13.63
Age Class 2	16 019	57.32	6.63	157.04	46.13	68	14.60
Age Class 3	2 346	85.48	7.10	140.76	45.31	67	16.49

TABLE 4. SUMMARY STATISTICS OF FARMER'S EXPERIENCE

Classes	*Obs.*	*Farmer's Experience*	*Farm Size*	*Palms Number*	*Tree Density*	*Specialized Farms (%)*	*Mean Age*
Less than 10 years	3 815	6,12	5,99	148,85	57,08	68	61,64
More than 10 years	17 687	16,64	6,82	163,38	44,19	70	56,04