

AREA VERSUS PRODUCTIVITY: CORRELATION BETWEEN AREA AND TREE PRODUCTION IN THE KHENCHELA REGION

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Abstract

The productivity per hectare of fruit growing is higher on large farms in the Khenchela region (Algeria). This positive relationship goes against the prevailing observation stamped in the economic literature as the «inverse relationship between size and productivity» or the positive relationship between them. In particular, this article examines the relationship between farm size and tree production of different fruit species in the Khenchela region; the methodological approach is based on statistical data from a survey of administrative staff of the Directorate of Agricultural Services (DSA), the results of analysis of these data indicate that the relationship between size of holding and productivity differs according to moderating factors and land factor, in addition, productivity appears to be higher for small and large farms than for medium-sized ones, therefore it reveals potential for tree productivity in the Khenchela region by exploiting the land factor and the location of farms near wetlands which are the main factors for increasing tree productivity.

Keywords: Productivity; Farm Size; Relation; Land; Khenchela.

INTRODUCTION

Fruit growing in Algeria is considered a sector of great importance because of its economic and social weight in the agricultural sector and its significant and essential contribution to the national agricultural economy and food security in general. On the economic level, fruit growing mainly represents pome, stone and hardy crops, it represents a total production of 1,820,000 qx during the 2022/2023 agricultural campaign. **(DSA, 2024).**

Fruit growing occupies a significant portion of cultivated areas and provides a considerable part of human food. In agricultural trade, imports of fruit species are mainly intended for the various stone and seed tree sectors, while exports (especially apple trees) represent 35% of national production. On a social level, this sector plays a vital role in establishing rural communities and in preserving agricultural employment and improving the living conditions of farmers. In addition, the number of farms has seen a substantial increase according to the ministerial department of agriculture. In 2024, there

will be 1,532 ha of pomegranate trees, 4,608.25 ha of almond trees, 4,405.25 ha of pistachio trees and 537 ha of walnut trees.

In general, this sector only meets a third of the food needs which constitute the basis of the Algerian consumer's diet by providing 52% of calories and 53% of vegetable proteins. Consequently, resorting to imports still remains the only solution to fill the gap between supply and demand. However, in an environment characterized by the volatility of international prices on the one hand and the limitation of productive resources on the one hand somewhere else. Optimizing the use of production factors becomes an essential objective to ensure the sustainability of the fruit industry, for which great potential exists for improving its production with a view to achieving the objective of self-sufficiency, targeted by Public powers.

Thanks to various economic development plans, the fruit sector has taken another direction in recent years where large industrial centers have been created in different regions with great productive potential. Fruit growing represents a very important pillar of agriculture and constitutes a real economic activity, highly specialized and very demanding in terms of investment, the aim obviously being the search for profit. The trend today is towards the creation of orchards with large spaces unlike small family farms.

Increasing agricultural productivity is recognized globally as one of the main pathways leading to sustainable agricultural growth (**Fuglie et al., 2020** **viloria., 2019**), **Doucellet and Girard., 2013**). In this perspective, one of the persistent debates in the economic literature on agricultural development and its productivity reveals that the total factor productivity (TFP) and the agricultural productivity of the land (PT) are the two indicators of agricultural productivity. No longer used. Total Factor Production is defined as the ratio between agricultural production achieved and the total quantities of all production factors (land, labor, capital, inputs, etc.) mobilized to obtain it.

While land production is obtained by dividing the agricultural production achieved by the quantity of land exploited. By using these two measures interchangeably (**Patrick Arnold OmbionoKitoto, 2023**). In previous literature, it is shown that there is a positive relationship between surface area and productivity in developed countries, however, in developing countries still remains controversial. Furthermore, the growth in tree production noted in the Wilaya of Khenchela in the last agricultural season is explained by the increase in the number of cultivated areas and not by productivity.

For this we carried out research work which is based on an analysis of the relationship between surface area and fruit tree productivity in the Wilaya of Khenchela; this involves estimating and examining the determinants of this relationship: (farm size - productivity), by exploiting the statistical data collected from the Directorate of Agricultural Services (DSA) of the Wilaya of Khenchela using a pre-survey of administrative staff.

MATERIALS

It is the whole of a questionnaire of 3 parts, which facilitates to make the survey and to record any information essential for our study; the questionnaire includes 3 part port on the state of the fields, types of areas and production by species.

A tape recorder to record all the information given by the interviewees as well as a pen and a pocket book were used to mention the various remarks made on the spot by ourselves.

METHOD

Sampling and data collection

The collection of information and statistical data from the interviewees of the administrative staff of the DSA, was started by an information meeting of the investigators using a tape recorder which allowed us to record all the information.

This briefing, allows to explain to the administrative staff of the DSA the objective of our research.

This phase presents a preliminary survey with the help of the Directorate of Agricultural Services of the wilaya of kenchela (DSA) in order to identify the size of the fruit farm and the production in this sector in order to highlight the moderating factors that influence the relationship (size of farm-productivity).

The pre-survey was carried out with the administrative staff of the statistical office (DSA).

Processing of data obtained

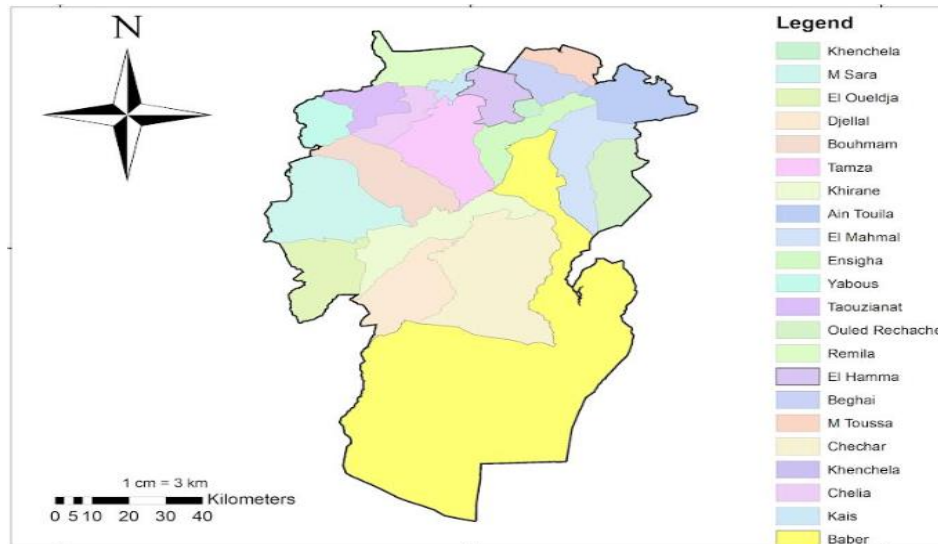
After the collection of statistical information and data, these data are processed using the Excel software, and the relationship between farm size and tree productivity in the Khenchela region and factors influences this relationship.

RESULTS

Study area

Location

The Wilaya of Khenchela is located in the north east of Algeria, southeast of Constantinois (Figure 1); and at the foothills of Mount Aurès between 34° 06 36 and 35° 41 21 latitudes North; and between 06° 34 12 and 07° 35 56 longitudes East. The wilaya of Khenchela occupies an area of 9715 Km², it includes 21Communes and 08 daïra, It is geographically limited to the North by the Wilaya of Oum El Bouaghi, to the South by the wilaya of El Oued, to the east by that of Tébessa to the west by that of Batna and to the southwest by that of Biskra (**Khaldoun, 2014**).



**Figure 01: Geographical location in the Khenchela region
(Source : Arc Map.10.41).**

Climate

The heterogeneity of the relief, the geographical situation and the lengthening of the territory North South give a great diversity to the climatic aspects over (relatively) short distances. Globally, the climate is continental in the North and Saharan in the South. Winters are very cold with very variable rainfall depending on the area, and summers are hot and dry. Temperatures are around -2°C at minimum and 42°C at maximum.

Annual rainfall ranges from a few 200mm, over the entire southern half of the Wilaya, at levels of 700 to 1200mm on some restricted areas of the high mountains of the Northwest Massifs. It snows about 12.4 days on average annually at the capital of Wilaya located at 1.116 m of altitude and certainly more in the high mountains of the Northwest. There are also 31.2 days of thunderstorm on average concentrated between May and September and an average of about 10 days of hail with nearly 80% between January and July and a maximum monthly average in March. Sirocco (warm south wind) also hits Wilaya, especially in summer (**Boukhacheme 2010**).

1- Changes in fruit yield in the study area

Fruit growing represents the majority of agricultural production in the Khenchela region, which is therefore crucial for food security and increased productivity. Fruit growing is a major development issue in the Khenchela region compared to other regions in Algeria.

The average yields of this sector is relatively, while this situation is mainly explained by a low mechanization of farms and the existence of degraded soils in which we are seeing nutrient losses. Average yields of different fruit species have increased significantly in recent years, as shown in Figure 1 above.

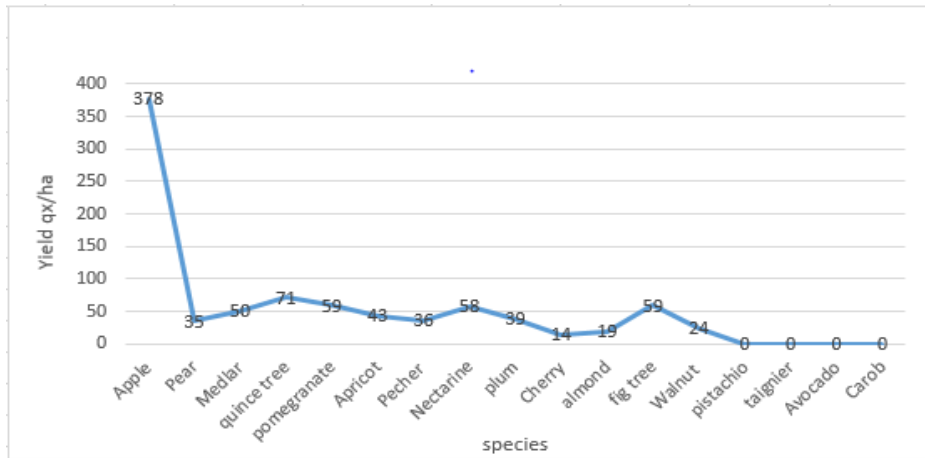
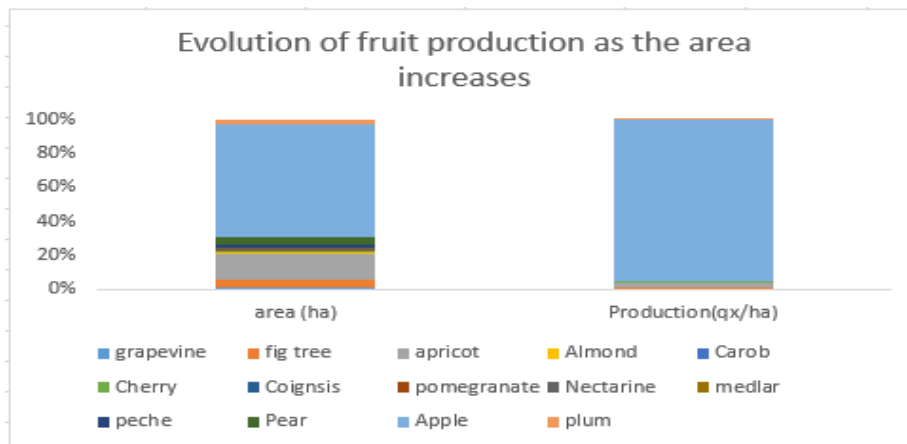


Figure 02 : Evolution du rendement des différentes espèces fruitier (Q/ha) dans la région de Khenchela (DSA., 2020/2021).

From the figure, we show that the yield of the fruit crop fluctuates from one species to another, among the species with pips it is noted that the apple tree has a value of 378qx/ha of the total production and the quince tree presents with a value of yield of 71qx/ha, on the other hand the crops with stones, nectarine species is found to yield 58qx/ha of total production followed by apricot tree with a value of 43qx/ha; for the hardy species it is noted that the fig tree presents the major species in this category with a yield of 59qx/ ha. The rest of the species represent low yields this translates by different factors more mainly the factor earth.

2- Impact of farm size on tree productivity

It appears in the wilaya of khenchela that fruit production is directly impacted by the increase in the size of farms. This direct relationship of cause and effect represented by Figure 2. Productivity is expressed in quintals per hectare and area (farm size) is expressed in hectare, while the wilaya of Khenchela has 21 municipalities.



According to the figure, fruit production is shown to increase as the size of the farm increases or the area from one species to another; it is noted that the area of the cultivated apple tree is the highest compared to other fruit species, on the other hand the production of this species increases. Which reaches up to 95% of the total fruit production of the Khenchela region.

DISCUSSION

Fruit growing requires strong mechanization, so production levels depend on inputs; which explains why the yields achieved vary essentially from one year to another depending on the level of mechanization available. Furthermore, these average yields hide significant variations from one species to another and from one farm to another.

The pome fruit arboricultural yields are approximately 593 q/ha, 190 q/ha for stone fruit arboriculture, 10qx/ha for hardy trees (**DSA, 2022**). The apple tree is the major species which is generally produced for self-consumption by the household and for export, the yield of which in this sector is very high. The other species have a very low yield compared to the national average in the same sectors which are sensitive to rainfall and for which the main intensification strategy is based on mechanization and efficient irrigation systems and qualification of labor as an essential factor in the management of tree farms.

In addition, yields vary from one farm to another, depending in particular on the characteristics of the households, the agricultural production systems adopted, the levels of intensification of chemical and organic fertilizers and the quality of the soil.

According to the data in Figure 2, larger farms can be more productive, this positive relationship is called linear relationship, which means that each additional unit of cultivated area leads to a constant proportional increase in production. At the same time, it can be shown that small farms are more productive, which is amplified in the economic literature as the “inverse relationship between “productivity and size” (**Feder, 1985**). Old empirical studies highlight this negative relationship in many developing countries (**Bardhan, 1973; Berry et al., 1979**) without however proposing a theoretical model capable of explaining this relationship, particularly under the classic hypotheses of the function of agricultural production at constant yields (no direct effect of size on yield) (**Berry et al., 1979**).

The inverse relationship between farm size and productivity (negative relationship) can be explained by market imperfections, in fact we find that family work on small farms is more present, because there is no market of work which makes it possible to absorb the surplus labor on small farms, which results in better yields, therefore production is more labor intensive on small farms.

We can also cite moderating factors as a controlling agent of this correlation such as the quality of the land which sets out in the history of land use and its fertilization, management practices, access to water and weather conditions.

Furthermore, carrying capacity could be considered as a factor controlling this correlation which means the carrying capacity or area can support a certain amount of production up to a point after which further increase in area would not result in any significant increase in production.

CONCLUSION

The Khenchela region in Algeria has transformed in a very short time into large centers of arboricultural production thanks above all to agricultural potential and favorable climatic characteristics. Different types of farms are created, mobilizing considerable means in terms of investment, land, water and human resources. Production and yield levels are still struggling to be constant and regular for several reasons and endogenous and exogenous factors. As a result, no previous study has focused on these aspects in order to carry out coherent diagnoses and appropriate analyzes to better understand the trends and strategies of tree production in the Wilaya of Khenchela.

Indeed, this study aims to examine and estimate the main factors influencing productivity in the Khenchela region, and its relationship with the size of the farm; this study seems that the relationship is negative for small farms (≤ 10 ha), while productivity increases as a function of farm size. The analysis of the data collected also reveals that the location of the farm, agricultural experience, the quality of the land, the conduct of the farms and their management are moderating factors likely to increase productivity and improve the level of production and yield of the entire tree production system in the Khenchela region.

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