

## **Socio-economic analysis and typology of agricultural holdings in the Souf region CITY-ALGERIA-**

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### **Abstract:**

Algerian Saharan region is considered the most vulnerable area to the microclimate degradation effects, due to the fragility of its ecosystem, economies, and infrastructure. In fact, from an economic standpoint, this climatic fragility affects the agricultural production in the oases, which largely affects the quality of life in brittle desert areas. This study highlights farming in the Oued Souf area (southeast of Algeria) through work includes, as well, two main factors such as technological intervention and informed policy support, which mainly affect the farms currently. Furthermore, this study analyses these farms at both terms of socioeconomic and technical levels. Moreover, the surveys concerned 120 randomly selected farms located in five municipalities (Hassi Khelifa, Trifaoui, Ouermes, Reguiba, and Taghzout), and used a close questionnaire containing structured and semi-structured questions. As a result, the study determined four types of farms based on economic, social, and technical criteria using multivariate statistical techniques such as Multiple Correspondence Analysis (MCA). The first type is composed of farms, where the owners/managers are the most engaged in agriculture; in the second type, along with the marketing of horticulture, there are arboriculture and date palms, where pivot irrigation and drip irrigation are used. The third type includes farms with large areas and less consumption of incoming budget. Finally, the fourth type covers farms whose Owners/managers are changing their activity.

**Keywords:** Typology, Farm, Type, Oued Souf, Agriculture, Owner/Manager.

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## Introduction

The ongoing worldwide socio-economic transformations have a considerable effect on global food security and present the issue of access to quality food for population. In order to support food production, Algerian government uphold agricultural projects and develop large vertically-integrated entities in rural zones, comprising regions with lower agricultural development such as Sahara lands.

In recent years, an unprecedented dynamic in the field of agriculture has been witnessed in the Oued Souf (Souf) wilaya (province) in Algeria, with more than 30,000 farmers and 90,000 Ha of SAU (DSA EL Oued 2020). This state has become an essential agricultural pole in terms of agricultural production not only of dates but also of market gardening.

Undoubtedly, the implementation of the program for access to agricultural land ownership (APFA 1983) as well as the aids granted to farmers within the framework of the National Plan for Agricultural Development (PNDA) are not the only precursors of this agricultural change. (DAOUDI & LEJARS, 2016, p. 9)

The agricultural dynamic is also due to the fact that the Soufi farmers differ from other Algerian farmers by his ability to adapt to the hostile environment where he lives (COTE, 2006, p. 56), along their ability to innovate constantly, which allowed them to live for hundreds of years in an environment which at first sight seems very hostile to all human life. (REMMINI, 2006, p. 10)

The Ghouts (Oases) made in the desert constitute a reliable proof of the Soufi's insight in confronting nature and the climate and transforming the sand dunes into verdant gardens. (ACOURENE & ALL, 2007, p. 08)

Currently, the wilaya of Souf intends to become the El Dorado of the Saharan agriculture since, in view of the results achieved, these performances give it legitimacy and deserve either first or second place at the national level in terms of production of potatoes, peanuts, dates, tomatoes, olives, etc (BELLALL, 2009, p. 05). This comes despite the lack of production means.

Such agricultural dynamics can be beneficial for the national economy and can generate significant economic benefits for farmers, but in terms of sustainability, the intensive use of natural resources such as land and groundwater can pose long-term environmental issues including skeletal soils (sandy texture) poor in nutrients and therefore requiring large amounts of fertilizer and significant irrigation for a crop cycle that does not exceed three years. (KHIARI, 2002, pp. 27-30)

Our research project comes in response to this major concern through interviews carried out in March with various actors in agriculture and water at the level of the wilaya of Souf.

We recall that the objective of the interviews is to discover the real causes that have favored this agricultural dynamic while emphasizing the agricultural and water potential of the region as well as the evolution of this dynamic over time and its possible repercussions in terms of sustainable management of natural resources in the Valley of Souf and that of Wadirigh.

The main objective of this study is to study the main factors and actors that have enabled this agricultural development in two study areas, namely the municipality of Ouermes and Hassi khelifa, the first two producing areas in Oued-Souf. The research methodology is based on the use of data from different agricultural services and case studies from different actors that have enabled this agricultural development (28 farmers, grain makers, technical and commercial representatives of agro-supply companies and others). This new agriculture was driven by the various public development programs (APFA Law 83-18 and concession) and the advent of the PNDA in the 2000s.

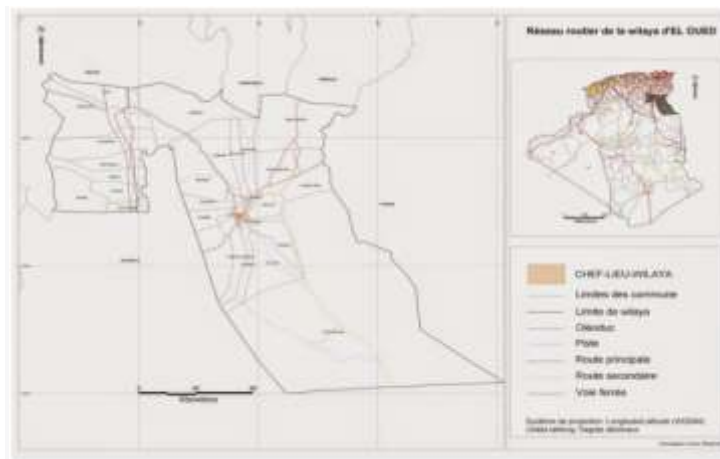
## **2. Methodological approach**

### **Study Area Description**

#### **2.1. Location and characteristics of the study area**

Geographically, the Oued Souf valley lies in the southeast of Algeria in the middle of a large synclinal basin at the lower Sahara (because of its low position between 32°30'00" and 34°12'00" N as latitude and 6°15'00" and 7°20'00" E as longitude) and on the Noutskirts of the great Oriental Erg. It is bordered Tunisia in the east, Chott Melghir and Merouane in the north, Oued Righ in the west, and by the extension of the great eastern Erg in the south.

Actually, the Oued Souf valley covers an area of 44,586.80 km<sup>2</sup> (1.87% of the Algerian territory), divided into 30 municipalities. At the end of 2021, 791,000 inhabitants lived in its 30 municipalities, which represents 2% of the national population, with a Population growth rate of 3.50% in 2020. According to 2015 data from the National Statistics Office, the population of Oued Souf exceeds half a million, mainly concentrated in a group of large cities in the region (41.41 inhabitants/km<sup>2</sup>).



**figure.** Access map to the wilaya of El Oued

## 2.2. Climatology of the Study Area

The climate of Oued Souf is hyper-arid characterized by a hot and dry summer, low precipitation, and high temperatures, furthermore, rainfall is very low (75 mm) and intensive evaporation. According to the meteorological station of Geumar Airport data, the total annual rainfall was 67.63 mm per year over 42 years (1978–2020), with a maximum of 233.7 mm/year observed in 2009, and the lowest was remarked in 2020. Moreover, Precipitation in these arid desert regions has different origins, according to the seasons (Dubief, 1965).

In El-Oued, the length of the day varies significantly along the course of the year, whereas the predicted shortest day in 2023 is December 22, with 9 hours, 57 minutes of daylight; and the longest day is June 21, with 14 hours, 22 minutes of daylight (weatherspark.com). This region is characterized by high values of annual potential evapotranspiration exceeding 2200 mm (Khezzani et al. 2016).

Winds are often mild, but in spring and autumn, they become strong (Khezzani & Bouchemal 2017). Globally, winds are frequent and cyclical, where the strongest have been recorded during the spring (Dahraoui) in a West-South-East direction. From August to October the Bahri takes over with an East-North orientation. On the other hand, Sirocco (Chehili) will be dominant throughout the summer, which can cause plants to dry out. The effect of BAHRI during the night considerably attenuates the harmful effect of Chehili on the vegetation and the population as well (Najah, 1970, p.00).

Previous studies (Debaeke, et al.; 1996, Bouchet et al., 1964) showed that the evaporation rate decreases from July to January from 260.13 mm to 62.16 mm, then then inversely increases to reaches a maximum annual amount value of 1850.7 mm. Where the study indicated that after calculating the real evaporation, it was observed that the amount of precipitation is less than the value of evaporation.

Table 1. Water balance for Guemar airport climatic station between (1978–2020). (Barkat et al; 2022).

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
P (mm)	13.89	5.06	7.84	7.38	4.47	1.44	0.23	1.81	5.62	6.56	7.41	5.92	87.63
PET (mm)	62.16	81.14	133.59	177.32	222.80	246.43	260.13	234.27	175.67	124.95	75.44	56.75	1850.66
EUR (mm)	0	0	0	0	0	0	0	0	0	0	0	0	0
RET (mm)	13.89	5.06	7.84	7.38	4.47	1.44	0.23	1.81	5.62	6.56	7.41	5.92	87.63
AD (mm)	48.28	76.08	125.75	169.94	218.33	244.99	259.90	232.46	170.05	118.38	68.03	50.83	1783.03
R (mm)	0	0	0	0	0	0	0	0	0	0	0	0	0
I (mm)	0	0	0	0	0	0	0	0	0	0	0	0	0

### 2.3. Regional demography

The ancient settlers of the Souf region are Amazingly, the names of Souf de Taghzout, Taksebt, and even that of many varieties of dates probably prove it (COTE, 2006, p. 37). This may be the case in for other inhabitants of the Saharan regions who have Amazigh origins (The Zenatas). However, the Senjas, the Beni-Ouerra and El Adouani form the indigenous populations of the Souf before the in-migration of the Arabs that took place in the early day of Islam. However, beside the Amazigh fringe, the Soufi population is dominantly made up of two main tribes: The Adouane and the Troud, Both are of Arab origin. The first sedentary in nature settled in Souf in the 14th Century since the first Muslim migrations, whereas the Trouds are nomads who settlement in Souf goes back to the beginning of the 15th Century (COTE, 2006, p. 48). It is reported that, among nomads, strength and vitality are a necessary for the survival of all their tribes, traditions and customary rules that have been established for a long time so that the Sufis can exert their influence on their environment by taming it in a subtle way and forming a kind of socio-geographical complementarity (Najah, 1970, p. 42).

Other groups have mingled with the Sufi population since the 14th Century, the Aachèches, the Chaambas, the Rebaia and finally the Ouled Amor during the 20th Century from Fezzan.

The Jews also in the past were part of this population and that mainly in Guemar and El Oued. Their population numbered about 2000 people before the independence of Algeria (COTE, 2006, p. 37).

Also mixed with this same population are black slaves who came mainly from the South and who at that time constituted free labor intended for domestic or agricultural needs. This fringe of the population has now ended up blending into the population through interbreeding with the natives.

Apart from the Jews who preferred to leave for independence, all the other fringes of populations ended up forming a cosmopolitan population that was sedentary, coherent, structured and attached to exploiting the land (COTE, 2006, p. 37).

## 2.4. Agriculture and vegetation

Farming in arid areas has often been associated with traditional or subsistence agriculture, where farmers rely on low-tech and low-input systems to cultivate crops and raise livestock. However, Over the past few decades, there has been a considerable evolution in agricultural intensification in many arid areas, including the Souf region in Algeria. This significant development in agricultural practices over time is mostly due to changes in the use of technology, the expansion of irrigated crops through the exploitation of groundwater through drilling wells, crop varieties, farming techniques, or other aspects of agriculture that have led to increased productivity, efficiency, or sustainability.

Generally, the climate of the Souf is of the Saharan type which is best suited to the cultivation of date palms, this means the sunshine needs of the latter are of the order of 3000 to 3500 hours per year and this weather suits it best. But in recent years, the agricultural sector in this region has seen significant growth and modernization, thanks to the evolution of the irrigation process that is considered as a determining factor of agriculture in Oued Souf (M & KHELIL, 2015, p. 19), this has made it the El Dorado of Saharan agriculture. In view of the results achieved, its performance gives it legitimately either first or second place at the national level in potato production, peanuts, dates, tomatoes, olives,...

The second factor which played a major role in the expansion of this agricultural dynamic is the easy access to land (TRIA & CHEHAT, 2013, p. 109), thanks to the old Saharan customary rule, which requires that whoever develops becomes the owner of the land. This rule was later reinforced by the agrarian revolution during the seventies. Moreover, the principles of this revolution are clear with regard to "the elimination of all forms of exploitation of the labor of others by re-establishing in agriculture direct labor relations, based on the principle: the land belongs to those who work" (Charter of the Agrarian Revolution and Ordinance 71-73 of November 8, 1971 on the Agrarian Revolution, Official Journal of the Algerian Republic No. 30 November 1971). Although these rules have had a positive impact on the spectacular extension of the irrigated area in OuedSouf, they also constitute a danger for the uncontrolled exploitation of agricultural land which will be difficult to control in the future by the agriculture Department ( (MANI.M, 2014, p. 43).



Tableau 1: La distribution totale des terres dans les régions d'études (hectare)

Commune	SAU		Terres en jachère et pastorales	Terres non productives réservées pour l'agriculture	Terres agricoles improductives	SAT
	Total	Irrigued				
Ouermes	5776	5196	0	4624	2	10400
Hassi khelifa	11 584	10 488	52 500	22 516	5	86 600
Trifaoui,						
Reguiba,						
Taghzout						

Source : DSA, 2016

Oued Souf has emerged as a leader in agricultural production, to the extent that it has secured the first rank nationally in producing various agricultural crops, particularly early ones. Its success in agricultural production is due in large part to its leading production of crops such as potatoes and peanuts, as well as dates and field tomatoes. This can be attributed, as well as, to the increasing number of young people who have entered the field of agricultural investment and established their own ventures using their own resources and capabilities. In 2019, El Oued took the lead nationally in potato production, producing a total of 15 million quintals, which accounted for 45 percent of the national production and represented 70 percent of the total value of local vegetable production

The cultivation of peanuts has been widely popular among farmers with an area of more than 3,000 hectares, which put them in a leading position in the production of this agricultural material, with a contribution of 80 percent of the national production, with a production of more than 90,000 quintals, cultivated in (6) agricultural municipalities in the eastern and northern of Souf region. For its part, tobacco cultivation sits on a total area estimated at 2,500 hectares, with a production of 70,000 quintals, which allowed it to occupy the first place nationally with 60 percent of the national production. Tobacco cultivation is based in the municipality of Kamar, which produces 70 percent of the total local production. Recently, the region has seen a quantum leap in crop production, where the tomatoes topped the list of these field crops, with the amount of production achieved a 611,000 quintals in 2019. The production of early red watermelon, has also taken the lead among field crops, on a total area of more than 1,500 hectares (APS, 2019). This recorded agricultural movement, provided more than 150,000 jobs between 100,000 permanent and 50,000 seasonal positions, contributing to the local development in its socioeconomic aspect. It should also be noted that the agricultural chamber in the valley

includes 50,000 affiliated farmers and represents 13 agricultural professional divisions, including agricultural and livestock (APS, 2019).

### **Sampling**

We are conducting a survey focused on agricultural production, specifically in the potato sector, within the five municipalities in our region. The aim of this survey is to gather valuable insights and data from local farmers in order to better understand the current state of potato farming and identify areas for improvement. (z)

The survey was conducted in five municipalities that are potentially agricultural producers, particularly in potatoes, in which covered a total of 120 farms at the end. Three field trips were carried out in the Souf region using the random sampling technique. The first phase of our survey lasted for a duration of 5 days and was specifically designed for data collection from various agricultural actors, after which the data was processed and analyzed. The second and third outings were conducted over a total duration of 22 days divided into two periods of 11 days each, where its primary objective was to conduct field interviews with farmers.

By referring to Table No. 01 and Graph No. 06, it becomes evident that approximately 70% of potato production is attributed to five key municipalities, Hassi Khelifa, Trifaoui, Ouermes, Reguiba and Taghzout. The remaining 30% are produced in other municipalities of the wilaya of Souf (25 municipalities). According to the available data, the directorate of Hassi Khelifa holds the first place in potato production within the wilaya, and manages on its own about 34% of the total production of the wilaya on an area of 11,200 Ha. Guemar municipality occupies the third place in terms of potato production, or 12.7% of total production covering an area of 4200 Ha. The rest of the potato production (about 30.4% of the total production) is distributed over 25 remaining municipalities, is allocated to an area of 10,034 Ha, with an average of 400 Ha per municipality.



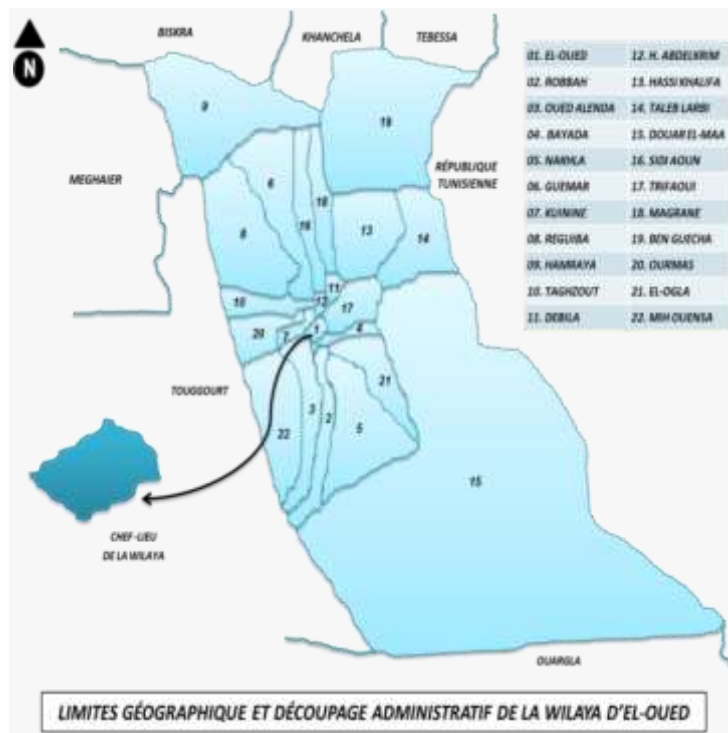


Figure 1 : Eloued souf study location

Table 1 . Potato production in Souf Municipalities

Dairas	Municipalities	Ranking	Surface		production (Qx)
			(Ha)	(%)	
Hassi Khelifa	Hassi Khelifa	1	6 580	19,9	2173000
Hassi Khelifa	Trifaoui	3	4 620	14,1	1527000
S/Total			11200	34,0	3 700 000
Guemar	Ouermes	2	5 417	16,4	1 788 216
Guemar	Taghzout	5	2149	6,5	710 150
S/Total			7566	22,9	2 498 366
Reguiba	Reguiba	4	4 200	12,7	1 392 000
S/Total			4 200	12,7	1 392 000
Reste des communes (25)		6	10 034	30,4	3 299 634
S/Total			10 034	30,4	3 299 634
Total			33 000	100,0	10890000

Source: DSA Oued Souf 2020

## Results and discussion :

### Typology of farmers included in the Agricultural Development

#### The Multiple Correspondence Analysis (MCA)

Multiple Correspondence Analysis (MCA) is a multidimensional descriptive statistical method which makes it possible to study the association between at least two qualitative variables. It is particularly useful when working with nominal or ordinal categorical variables [Anderson, 1990; Devillers and Karcher, 1991; Chou, 1994, Greenacre, M. (1998, 2007)]. It is inspired by the Association of Factorial Correspondence (AFC) analysis, which focuses on studying the relationship between two qualitative variables. MCA, on the other hand, extends this concept by allowing for the exploration of associations between multiple qualitative variables [Baspinar and Mendes, 2002; Mendes, 2002; Abdi, H., & Valentin, D. (2007).]. Like other factorial methods, the MCA seeks to find similarities of differences in the proximities between individuals and other modalities of qualitative variables [Greenacre, M. (2007); Benzécri, J.P. (1979)].

- The principle of MCA involves reducing the information contained in the categorical variables and concentrating it on the first two or three axes through a change of coordinate system. This reduction and concentration of information allow for a more manageable and interpretable representation of the data.

- The analysis will therefore focus on the first axes which summarize the information because other axes providing only a small additional part of information.

Typological analysis makes it possible to sort data in exploratory research contexts, with the aim of forming homogeneous groups, in order to facilitate the analysis, classification and study of complex realities. These individuals are described by a set of characteristics. To succeed in constituting these groups (or classes, categories, types), the individuals or objects belonging to one of them are statistically identified as being close in relation to a set of characteristic elements [Miles, et al., (2013) à verifier].

As a suitable method for exploring relationships between categorical variables and identifying patterns in the data, the Multiple Correspondence Analysis (MCA) was applied to develop a typology of farmers activating in the perimeters of agricultural development in the Souf region, which help to identify groups or clusters of farmers with similar characteristics, practices, or profiles. Furthermore, MCA allowed us to examin multiple categorical variables

simultaneously and assesses their associations. Moreover, to proceed to the typology of market gardening farms, (18) some variables have been retained (see Tab. No. 02 ), such as age, market gardening experience, agricultural area, labor, irrigation system, cost of expenses/campaign, income/campaign, sales technique, mode of promoting, reasons which led you to practice market gardening, type of organic fertilizer, potato variety, practicing arboriculture, practicing date palm. other economic activities, income from other economic activities. By applying MCA and analyzing the relationships between these variables, the analysis revealed patterns in the data, which assist us to identify distinct groups of farmers based on their characteristics and practices, and revealed, as well as, underlying dimensions or factors that contribute to the differentiation of farmers.

Table 2 . The variables used in the MCA analysis

Table 02	Variables	Terms	Meaning
V <sub>1</sub> =Age : Ag		Ag1	[20-41]
		Ag2	[41-60]
		Ag3	[more then 61[
V2= = farming experience : FE		FE 1	[1-10 years ]
		FE 2	[11-20years]
		FE 3	[more than 21 years [
V3= Total agricultural Area :TAA		TAA 1	[1-5 he]
		2	[6 à 20 he]
		3	[More than 21 he[
V4= Irrigation system :IS		1 Pivot	Pivot Irrigation
		2 Drip	Drip
		3 Pivot+Drip	Pivot +Drip
		4 Localized	Localized
V5= Total value of intermediate consumption / 01pivot/ 01 year.		CostCharg1	500000DA-1000000DA
		CostCharg2	101 0000 DA- 1500000
		CostCharg3	More than 1510000DA
V <sub>6</sub> =Total value of agricultural production PBA		PBA1	500000DA-1000 000 DA
		PBA2	101 0000DA -150 0000 DA
		PBA3	More than 1510000 DA
V7= Techniques used to sell :TS		TS1	Wholesale Markets
		TS2	Conservation (Cold storage )
		TS3	Market + Cold storage

V <sub>8</sub> =Level of instruction of the operations manager	Lev of OM 1	Illiterate
	2	Quranic school
	3	Primary school
	4	Secondary school
	5	University
	6	Other
V <sub>9</sub> Funding source	Fund S1	Self help
	2	Loam
	3	Self help + Loam
	4	Subsidy
V <sub>10</sub> legal status of the farm	Em S1	APFA
	Em S2	Concession
	3	Individual farm
	4	Collective farm
	5	Melk Titled
	6	Melk (Aourfi)
	7	Arch. (/ Tribal)
	8	Untitled
	9	lease
V <sub>11</sub> = Other economic activities	Activ remu1	Trade
	Activ rému 2	Art and crafts
	Activ rému 3	Administration (civil service )
	Activ rému4	Service delivery
	Activ rému5	Liberal profession
	Activ rému 6	Transpiration
	Activ rému7	Other
V <sub>12</sub> How did you get this money?	Acqu Arg1	Parental gift
	Acqu Arg2	Change of activity
	Acqu Arg3	Farmer
	Acqu Arg4	Inheritance
V <sub>13</sub> = Type of tenure	Mode OC 1	Direct

	Mode OC2	Indirect
V14 = Reasons that led you to practice vegetables production	RPV 1	Nature of soil or presence of water
	R 2	High demand and high price
	R 3	Local product
	R 4	Technical advice
	R 5	Do not know
V15 =Organic fertilizer type	OFT 1	Cow Manure
	2	Sheep
	3	Chicken Litter
	4	Goat
	5	Cows + Chicken Litter
	6	Cows+sheep
	7	Sheep+goats
	8	Sheep+ Chicken Litter
	9	Sheep+cows+ Chicken Litter
	10	Goats +poultry
	11	Cows+sheep+goats
V16 Potato variety	Var 1	Spontaneous
	Var2	Pertina
	Var 3	FABILA
	Var 4	CONDOR
	Var 5	SPONTA+PERTINA
	Var 6	KIRODA
V17 practice arboriculture	PA 1	yes
	PA 2	No
V18 Practice date palm	PDP1	yes
	PDP2	No

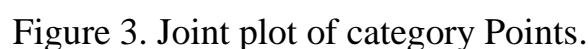
Source: *Our Study*

According to results in Table 3, it seems that the variables included in the analysis have been identified dimension (1, 2), with a total of 65.4% [Tabachnick, (2019)]. Additionally, this proportion is considered quite satisfactory as it captures a significant portion of the variability in the data [Hair, (2019); Jolliffe, (2016)]. In addition, to assess the internal consistency or

According to the relate diagram (factorial plane), four different types of farms has been determined as showed in the Figure 3:

Dimension	Alpha de Cronbach	Variance expliquée	
		Total (valeur propre)	Inertie
1	,762	3,566	,198
2	,680	2,797	,155
Total		6,364	,654
Moyenne	,726a	3,182	,177

## Study



2300



**Type 1:** In the factorial plane, this identified type represents farms, in which the producers exploit the largest areas of land. As well as, farms belonging to this type are characterized by having an area of more than 21 ha up to 200 pivots, thus exploiting an area of 200 ha, commonly called "El GHOUAL", they are monster of agricultural production. Furthermore, it suggests that these farms are relatively large in size and have extensive land areas under cultivation or irrigation. Along with, these farms do not engage in the cultivation or production of arboriculture (such as fruit trees) or date palms, but their focus is primarily on other types of agricultural activities. These farms have managed to minimize production costs not only by operating large agricultural areas but also by the early access to inputs (such as manure, fertilizers, and seeds) at advantageous prices. we can as well include efficient resource management, economies of scale due to their large size.

At a time when the costs of the latter are lower than the financial resources allow. In this way, these farms can pass on all the manure they can find on the market and then the stock in this way it will be better degraded and ready for use for fertilization, on the contrary for the other farmers who use the raw non degraded manure.

**Type 2:**

This type is centered in the positive side of Axis n°1 in the factorial plane, it is associated with operators who engage in trade and market gardening activities. On this positive side of Axis n°1, the farm group is involved in both trading (presumably related to agricultural products) and horticultural marketing. Market gardening also usually refers to the cultivation of fruits, vegetables, and other horticultural crops for commercial purposes. As well as, these operators engage in trade and market gardening activities but also practice arboriculture and date palm cultivation. Their legal status is specified as "land" with references to APFA (Agreement for the Promotion of Agricultural Activities) and CONSSMISSION, which suggests their legal agreements or permits related to land use for agricultural purposes. Furthermore, the irrigation system used by these operators is based on the drop system by drip next to the mini pivot, which is commonly used for efficient water management in agriculture. Moreover, they have average areas between 6am & 8pm with a significant experience in market gardening. Additionally, these operators have extensive experience in market gardening and arboriculture, with more than 21 years of practice in these activities. Their long-standing experience gave them a high level of knowledge, skills, and expertise in the field of market gardening and arboriculture. This accumulated experience is likely to contribute to their success and efficiency in managing these agricultural activities. Besides, farmers, in this type, derive income from others (more detail please)

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