

Full Length Research Paper

Exploring family farm development in dryland agricultural areas: A case study of the Laghouat region of Algeria

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Family farming is the predominant agricultural system of dryland agriculture in Algeria. The National Agricultural and Rural Development Program (PNDAR) was implemented in the last decade to enhance the development of family farms in drylands. The objective of the present study was to explore family farm development in Algerian dryland agricultural areas. Specifically, we were interested in the behavior of farmers and stockbreeders toward various institutional and agricultural development policies. To this end, surveys were conducted on 35 randomly selected stratified farmers using closed structured questionnaires in 5 municipalities, which were used to represent the three bioclimatic zones in the Laghouat prefecture. The results showed that the main form of organization at family farms depends on the bioclimatic zone, which affects the production systems, public support and conservative adaptation strategies. Constraints related to production factors are widespread, affect farm operations and challenge public policy. Agricultural diversification such as the introduction of livestock farming and non-agricultural activities occurred on the majority of the farms, and two primary strategies for achieving food security were observed. Namely, food crops were prioritized and diversified on family farms, and speculative crops and livestock were raised simultaneously. Nevertheless, the acquisition of subsidies and farming intensification did not yield significant results due to the non-continuity of actions in time and space. The results of the present study indicated that family farm development policies in drylands should be adaptable and account for the heterogeneity of agriculture, especially bioclimatic factors.

Key words: Family farm, dryland, agricultural policy, agricultural development, bioclimatic.

INTRODUCTION

Family farming is the most common agricultural system in the world. Family farms represent approximately 1.4 billion people, and 96% of family farms are located in southern countries (Ferraton and Touzard, 2009). Family farms supply more than 70% of the local and regional food market, contributing significantly to food security at the local, national and regional level (ILEIA conference, 2009). Family farming is a form of production characterized by the special link between economic activities and family structure. This relationship affects the decision-making process, including the choice of

activities, the organization of family or paid labor and the management of family resources (Gastellu and Dubois, 1997).

In Algeria, the largest dryland country in Africa, family farming is the primary form of agricultural activity and provides several economic and social functions. Moreover, family farms play an important role in maintaining the rural population. At the farm level, family labor accounts for 43.86% of the agricultural labor force (Benmouffok, 2006). Nevertheless, since Algeria became independent in 1962, several agricultural reforms and policies (socialist era) have marginalized family farms in the agricultural development process (Baci, 1999). Moreover, arid and semi-arid regions are scattered over nearly 2 million hectares, and approximately 100,000 ha

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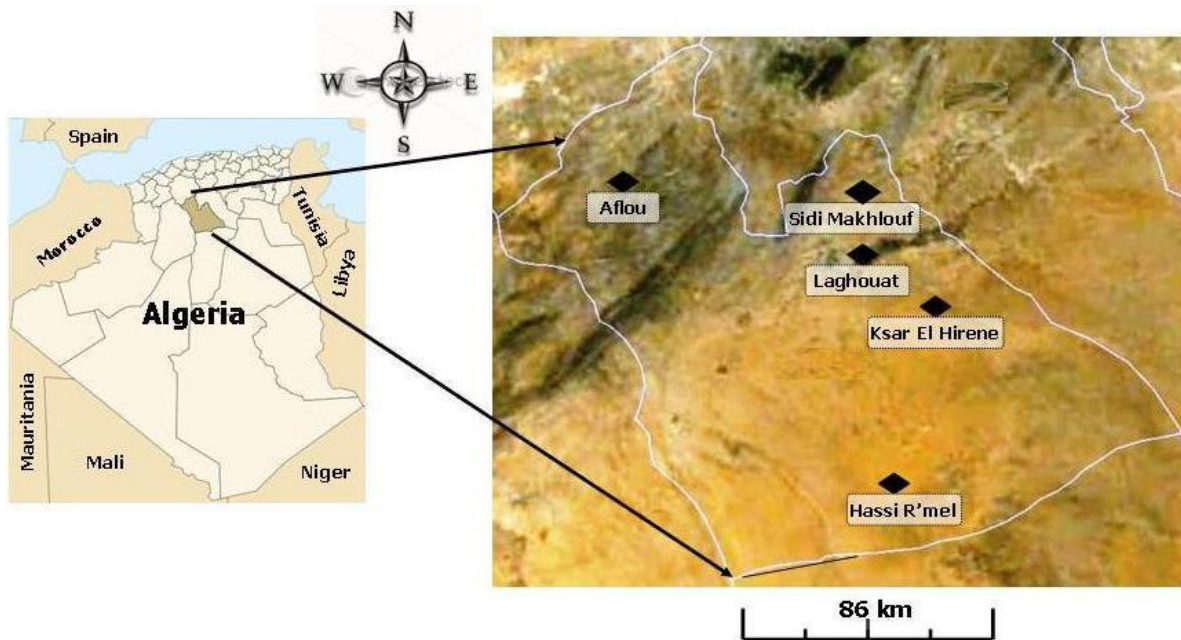


Figure 1. Location of the study region: Laghouat prefecture, Algeria.

of arable land are subject to rigorous arid environments. Indeed, family farms are faced with variable and adverse climatic conditions, especially with respect to the mobilization of water resources, supervision of farmers, etc. These factors are the major constraints to the implementation of intensification processes and the stabilization of agriculture in the region (Campagne, 1997). Furthermore, family farms must cope with globalization and economies that are internationally oriented. To face reforms in market organizations, consumer demands and public opinion, and to remain a major player in rural development, the competitiveness of farming must be strengthened to enhance the future performance of agriculture.

To meet the aforementioned goals, the Algerian government launched the National Agricultural and Rural Development Program (PNDAR) in 2000. The implementation of this program was a decisive stage in the history of agricultural policies in Algeria and promoted the role of the farmer as an active economic player. Moreover, the program transformed the traditional relationship between the farmer and agricultural administrations into a confident, responsible, cooperative relationship.

Rural development policies are based on local rural development projects (PPDR) and are aimed at the sustainable improvement of food security and living conditions of households. Moreover, rural development policies are constructed within the framework of a participatory, decentralized, territorial based plan. The PNDAR was designed to be a comprehensive and coherent response to the primary challenges and

constraints of natural, technical, organizational and institutional problems that are responsible for the weakening of the basics of national food security, the degradation of natural resources and the lack of cohesion and social peace in rural areas, which are essential for Algerian society (MADR, 2007).

Although effort has been extended toward agricultural development, academic studies have not been conducted in Algerian dryland areas to evaluate the effectiveness of these measures on family farm development. Thus, the goal of the present work was to explore family farm development in Algerian dryland agricultural areas. Specifically, we were interested in the behavior of farmers and stockbreeders toward various institutional and agricultural development policies. In the current investigation, the following research questions were explicitly addressed: What are the main forms of organization at the family farm and bioclimatic level? Were the objectives of the development policies achieved?

METHODOLOGY

Case study

The Laghouat region was selected as the case study area and is located in southern Algeria, 400 km from Algiers (the capital city), between 33.5° North latitude and longitude 2.6° East latitude (Figure 1). The prefecture of Laghouat is divided into 10 municipalities and possesses an arid bioclimate with a mean minimum temperature (m) of 2.4°C, a mean maximum temperature (M) of 38°C and an annual rainfall (P) of 171.5 mm. The region has a total area of 2,469,700 ha, of which 73,013 ha are agricultural

Table 1. Laghouat features by bioclimatic zone.

Bioclimatic zone	North zone	Central zone	South zone
Bioclimatic type	Cool semi-arid	Cold semi-arid	Pre Saharan
Altitude (m)	800-1400	1200-1400	700-1200
Rainfall (mm/year)	200-400	400-500	100-200
Total area (ha)	464,500	342,000	1,663,200
Rangelands and Alfalfa (ha)	367,650	216,113	1,208,970 ¹
Agricultural land (ha)	29,510	14,491	29,012
Irrigated land (ha)	9,075	3,188	18,549
Forest and scrub (ha)	0	85,036	0

¹Rangelands only : Field survey, 2010.

land and 30,812 ha are irrigated land. The agricultural sector employs more than 241,112 inhabitants or 65.82% of the total population. Currently, there are 27,297 farms in the region, of which 11,245 are crop-based farms, 2,116 are agro-pastoralist farms and 13,936 are stockbreeding farms.

The region consists of three homogeneous areas (Table 1):

1. North zone: High steppes plains, agro-pastoral regions and alfalfa: The north zone has a total area of 464,500 ha and ranges in altitude from 800 to 1400 m. In addition, the north zone possesses a cool semi-arid bioclimate, and rainfall ranges from 200 to 400 mm per year. Arable land in the north zone consists of rangelands and alfalfa (367,650 ha, 79%), agricultural land (29,510 ha, 6%) and irrigated agricultural land (9,075 ha, 30% of the total agricultural area). The north zone is characterized by an extensive degree of vegetative degradation. Namely, 70,185 ha (19.06%) are characterized as severely degraded, 224,589 ha (61.03%) are moderately degraded and 73,280 ha (19.91%) are in good condition.
2. Central zone: The foothills and mountains of the Saharan Atlas sylvo and agro-pastoral lands: The central zone has a total area of 342,000 ha and ranges in altitude from 1,200 to 1,400 m. Moreover, the central zone possesses a cold, semi-arid bioclimate, and rainfall varies from 400 to 500 mm per year. The arable land in the region consists of 216,113 ha of alfalfa and rangeland (63%), 85,036 ha of forest and scrub (24%), 14,491 ha (3%) of agricultural land and 3,188 ha of irrigated agricultural land (21% of the total agricultural area).
3. The Sahara plateau: The Sahara plateau is located south of the prefecture and has a total area of 1,663,200 ha. The plateau ranges in altitude from 700 to 1,200 m and possesses a pre-Saharan bioclimate. In the plateau region, rainfall varies from 100 to 200 mm per year, and the land consists of 1,208,970 ha of Saharan rangeland (72%), 29,012 ha of agricultural land (1%) and 18,549 ha of irrigated agricultural land (64% of the total agricultural area). Degradation is extensive, and 81% of the rangelands are considered degraded.

Data sample and analysis

Because all of the municipalities could not be investigated, information on the importance of agricultural land in various municipalities were reviewed (Agricultural Services (DSA), and five municipalities were selected to represent the entire prefecture. The municipalities of Sidi Makhlof (North zone), Aflou (central zone), Laghouat, Hassi R'Mel and Ksar El Hirene (sahara plateau) were selected based on their geography (Figure 1). Namely, the selected municipalities represent the three bioclimatic zones in the prefecture of Laghouat. To address the objective of the present study, primary data were collected at the farm level. Due to the lack

of a comprehensive list of farmers in the selected municipalities at all levels (DSA, agricultural subdivision, chamber of agriculture), we constructed a list of farmers from people who know or work with farmers in the selected municipalities. In this manner, a network of farmers was constructed, and 35 farmers were selected according to the method of stratified random sampling (7 farmers in Laghouat, 8 farmers in Sidi Makhlof, 9 farmers in Aflou, 7 farmers in Hassi R'Mel and 4 farmers in Ksar Elhirene). The surveys were conducted in April of 2010, and a well-structured questionnaire was used to interview the head of each farm. The questionnaire included quantitative and qualitative socio-economic questions and was divided into 3 parts. Part 1 was used to obtain information on the farmers, and part 2 was used to determine the characteristics of the farm. Lastly, the third section of the survey was used to obtain information on the relationship between the farmer and the environment. Questionnaires were constructed to understand changes in the production system and the effect of the intervention of the state through agricultural policies on family farming. The survey was used to identify the current situation of the farms and to provide a retrospective study on the past decades to determine transformations in Algerian agriculture in relation to changes in climatic conditions. The data obtained from the survey were analyzed using SPSS (version 15.0), and descriptive statistics including frequencies, percentages and means were used to summarize the information. Tabular techniques were used to classify the data and derive meaningful results from arithmetic means and percentages.

RESULTS AND DISCUSSION

Farmers' socioeconomic characteristics

Gender

The results of the present investigation (Table 2) revealed that all of the farmers in Sidi Makhlof, Aflou Hassi R'Mel and Ksar El Hirene were men. In Laghouat, more than 70% of all farmers were male, and women farmers represented approximately 30% of the population, which is equivalent to 5.7% of the total sample and is approximately equal to the national average (4%) (Benmouffok, 2006) . In addition, our survey showed that 45.7% of farmers have less than four children, 42.9% of farmers have 4 to 10 children, and 11.4% have no children or are single, which explains the presence of young farmers.

Table 2. Socio-economic features of farmers.

Gender (%)	
Male	94.3
Female	5.7
Age (years)	
Average	40
Minimum	20
Maximum	80
Education (%)	
Literate	52.82
Illiterate	47.18
Occupation (%)	
Agriculture only	26.3
Agriculture and business/services	73.7
Farming experience (%)	
> 20 years	26
10-20 years	57.62
< 10 years	16.38

Field survey (2010).

Age

The average age of the farmers in our sample was 40 years, and the extreme values ranged from 20 to 80 years. However, disparities were observed among municipalities in the prefecture. Kar El Hirene displayed the youngest population (50% under 40 years), followed by the municipality of Laghouat (42.9%) and Hassi R'mel (37.5%). In the municipality of Sidi Makhlouf, the majority of farmers were between 40 and 50 years of age (37.5%). Farmers with early retirement ages predominated in the municipality of Aflou (44.4%).

Education

According to the results of the survey, the majority of farmers can read and write (literate), and literate farmers were overrepresented in the municipality of Laghouat (100% literate) and Sidi Makhlouf (57.1%). Illiterate farmers were primarily located in Hassi R'Mel and Aflou due to the distance from the main municipality of the prefecture (Laghouat) and the proximity of schools.

Farming experience

The results of the survey (Table 2) indicated that 26% of farmers have over 20 years of experience. Thus, agriculture is an ancient activity for the majority of the

farmers. Farmers less than 20 years old are the beneficiaries of the land development program of 1998.

The sample analysis also revealed that 57.62% of farmers have 10 to 20 years of experience in the agricultural sector, and large disparities were observed among municipalities. The majority of farmers in the municipality of Laghouat (42.9%) had less than 10 years of experience, while farmers with 10 to 20 years of experience predominated in Sidi Makhlouf, Aflou and Hassi R'Mel (75, 66.7 and 71.4%, respectively). Farmers with more than 30 years of experience were observed in the municipality of Ksar El hirene (25%).

The attraction of youth to agricultural activities can be partially attributed to the agricultural development policies adopted by the government in recent decades. Approximately 70.56% of farmers in our sample were tenants, and 30% operated their own farmland. Of the tenant farmers, 70% rented state land.

Labor

In total, 53.12% of farmers reported that farming was a full-time activity. This trend was particularly evident in Aflou, Hassi R'Mel and Laghouat. As shown in the Figure 2, in Sidi Makhlouf, Aflou and Ksar El hirene, the labor force was essentially wage labor (87.5, 55.5 and 75%, respectively). Only 12% of farmers used family labor, which is considered permanent employment. Moreover, the majority of the workforce (80%) comes from the town

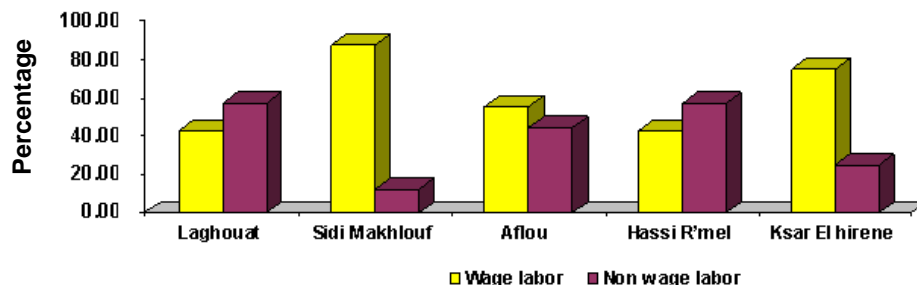


Figure 2. Wage labor by municipality in the Laghouat region.

Table 3. Distribution of farms by municipality according to size.

		Laghouat (%)	Sidi Makhoulouf (%)	Aflou (%)	Hassi R'mel (%)	Ksar el hirene (%)
Agricultural area (ha)	<1	14.3	0	11.1	42.9	0
	1-5	71.4	83.3	44.4	42.9	0
	5-10	14.3	0	22.2	14.3	75
	10-20	0	16.7	22.2	0	0
	> 20	0	0	0	0	25

Field survey (2010).

in which the farm is located, except in Laghouat, where 66.7% of the workforce comes from outside of the municipality. This result was attributed to the fact that Laghouat is the administrative and economic capital of the prefecture and displays high rates of urbanization, which enhances other economic sectors to the detriment of agriculture. Besides, farmers state that the workforce in Laghouat is scarce and unqualified.

Off-farm income

According to our survey, the majority of farmers (73.7%) practice one or more non-agricultural activities (pluriactivity) in addition to farming; however, disparities were observed among municipalities. In Laghouat, 80% of farmers reported that they are pluriactive (obtain on-farm and off-farm income), while 77 and 70% of farmers in Hassi R'Mel and Ksar El hirene have a source of off-farm income. Pluriactivity is prevalent due to the fact that these municipalities are important urban centers. In particular, the municipality of Laghouat is the capital of the prefecture, Hassi R'Mel is an important Gas Branch center and Ksar El hirene is a source of significant commercial activity. The presence of commercial and industrial areas leads to pluriactivity, which is a lucrative practice. As a result, more than three out of four farmers in the region are pluriactive. Among off-farm activities, business and/or public service (administration) are common practices.

According to our investigation, the nature of external resources available to households in various municipalities

and their relative importance are a key indicator of the degree of autonomy and level of integration of agricultural households in other branches of economic activity. In all cases, external resources are far from negligible and have a significant effect on the general conditions of the farm. Non-farm activities can provide flexibility to cover the risks of farming (failure of crop year), to increase the number of options available to farmers (not to be forced to alter agricultural production for pressing needs) and to upgrade or transform their farms.

Analysis of farm characteristics and the environment

Farm size

As shown in the Table 3, small farms are predominant in the prefecture of Laghouat. Indeed, farms that are less than 10 ha represent more than 75% of the total farms surveyed, and farms that are smaller than 5 ha are common (85.7, 83, 85.6 and 55.5% in Laghouat, Sidi Makhoulouf, Hassi R'Mel and Aflou, respectively). Average-sized farms (between 5 and 10) are prevalent in Ksar el hirene (75%), while 25% of farms are classified as large (> 10 ha).

Farming system

As shown in the Figure 3, farming systems were variable among municipalities. Laghouat is characterized by

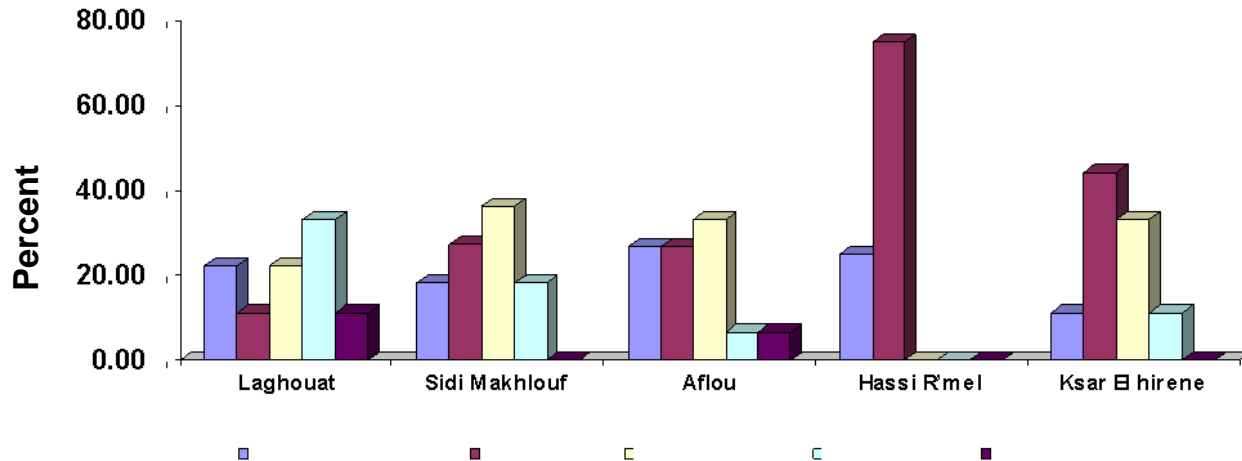


Figure 3. Farming systems in Laghouat region.

arable crops (33.3%), vegetable farming (22.2%) and orchards (44.4%) such as olive trees (11.1%). Sidi Makhoulouf is characterized by forage (45.5%) and vegetable farms (36.4%), while Aflou is characterized by arable crops (53.7%) and vegetable farms (33.3%). Alternatively, Hassi R'Mel is characterized by forage (100%) due to the fact that livestock farms are predominant in this region. Finally, Ksar El hirene is characterized by arable crops (55.5%) and vegetable farms (33.3%). In general, the municipality is an agro-pastoral region.

Agro-pastoral farming systems are predominant due to agricultural and bioclimatic factors and current agricultural policy orientations. Indeed, in recent years, the state has subsidized different crops (including orchards) according to the objectives set in various development plans. The cultivation of olives in steppe zones is the most striking example of the effects of state intervention.

At this stage of the analysis, significant differences in the occupation of agricultural land were observed among municipalities. For instance, the predominant type of agricultural land in the region was arable crops (61.94%), of which 37% were forage crops. This result was attributed to the agricultural practices conducted in the study area, which include both breeding and farming. These activities are complementary and are referred to as agro-pastoralism. Farmers who grow forage and cultivate orchards rely on a large number of employees because these crops require extensive hand labor. Moreover, farms with an area of 5 to 10 ha use more hired labor than other farms and focus primarily on forage production and secondarily on orchard cultivation. Mixed farming is predominant, and farmers who apply single crop systems are rare. Mixed farming is a feature of family farms because diversification is conducted to obtain a secure food supply (diversification in vegetable farming) and revenue (in orchard and forage farming).

Irrigation methods

In total, 82.4% of all farms can practice irrigation. The results of the survey indicated that 100% of the water comes into the region from boreholes. However, in Hassi R'Mel, all of the farmers lack water resources for irrigation. Nevertheless, three irrigation systems are used including traditional systems such as spate irrigation (20%) for vegetable farming and basin systems (85%) for orchard farming (Table 4). Drip systems are used by 24.4% of farmers, especially on young plantations. However, this system is poorly managed by most farmers. Drip systems are most commonly used in the municipality of Laghouat (44.4%) and Aflou (30%) due to investments made by farmers. Sprinklers are the predominant irrigation system in the prefecture (43.9%) and are employed primarily in Aflou and Ksar El hirene (70%), and Sidi Makhoulouf (44.4%). Sprinkler systems are used on arable crops.

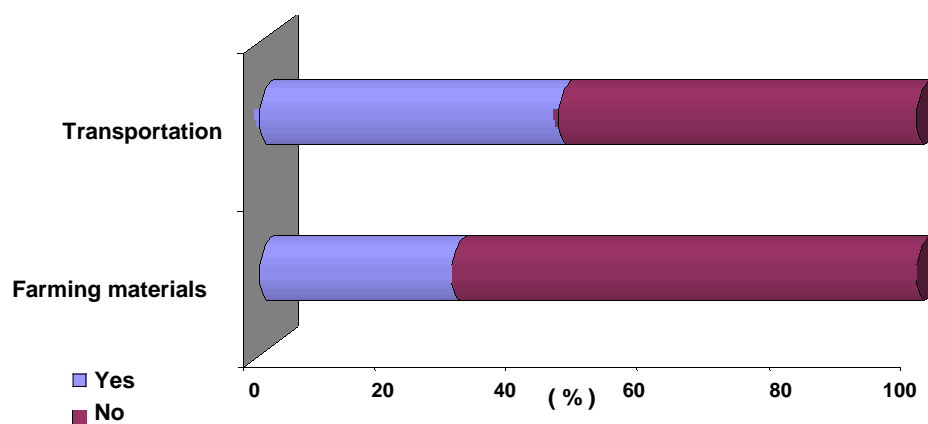
Farm equipment

The equipment required for cultivation and the availability of transportation are significant indicators of farm modernization and the intensification of production (Figure 4). This equipment consists of material available on the farm. In our sample, only 29.4% of farms were capable of applying mechanized tillage operations. The majority of farmers (70.6%) stated that they do not have the equipment necessary for proper farming activities. The availability of equipment was variable among municipalities and was more important in the municipality of Laghouat and Sidi Makhoulouf (85%), followed by Hassi R'Mel (71.4%). Alternatively, in the municipalities of Ksar El hirene and Aflou, only 50% of farmers stated that they possess the necessary farm equipment. Moreover, 25% of farmers who do not own the required materials stated

Table 4. Methods of irrigation in the prefecture.

	Laghouat (%)	Sidi Makhoulouf (%)	Aflou(%)	Hassi R'mel(%)	Ksar Elhirene(%)
Drip	44.4	11.1	30	0	0
Sprinkler	22.2	44.	70	0	70
Traditional	33.3	44.4	0	100	30

Field survey (2010).

**Figure 4.** Farm equipment availability by percentage.**Table 5.** Yield by municipality.

	Laghouat	Sidi Makhoulouf	Aflou	Hassi R'mel	Ksar El hirene
Cereal farming (ql/ha)	30	22	40	8	40
Forage (bales)	90	90	90	60	91
Vegetable ql/ha)	290	300	350	/	290
Orchard (ql/ha)	250	230,5	200	/	230
Olive (ql/ha)	-	-	-	-	-

Field Survey (2010).

that they lease the necessary farm equipment, and the remaining farmers use manual farming operations. In total, 54.5% of farmers stated they that do not have sufficient means of transportation; however, differences in the availability of transportation were observed among municipalities. In Laghouat, Sidi Makhoulouf and Ksar El hirene, 61.8, 71.4 and 75% of farmers have sufficient means of transportation, respectively. Alternatively, in Aflou and Hassi R'Mel, 50 and 14.3% of farmers have means of transportation, respectively.

Yield

Performance data were not measured but were estimated by farmers (Table 5) . The average yield for all varieties and age groups was 152.03 ql/ha. The distribution of the average yield among municipalities is provided in the

following Table 5.

As shown in the Table 5, the highest yields for cereal and forage crops were obtained in the municipalities of Aflou and Ksar El hirene, which presented an average yield of 40 ql/ha and 90.5 bales/ha, respectively. For vegetables, the dominant crop in the region was potatoes, and the average yield was 307 ql/ha. The best yields were obtained in Aflou (350 ql/ha), followed by Sidi Makhoulouf, which presented an average yield of 300 quintals/ ha. In contrast, the lowest yield was recorded in Laghouat. For orchards, the highest yields were obtained in Laghouat (250 ql/ha), followed by Sidi Makhoulouf and Ksar El hirene (230 ql/ha). Nevertheless, many orchards are young due to the introduction of olive orchards in 2002 under National Agricultural and Rural Development Program (PNDAR) programs. The capacity for productivity depends on the conditions of the farm and the bioclimatic zone.

Table 6. Livestock characteristics in Laghouat region.

Farmers engaged in livestock activity by municipality				
Sidi Makhlouf	Aflou	Ksar El hirene	Hassi R'mel	Laghouat
44.4 %	44.4 %	75 %	100 %	28.6%
The use of animal feed concentrate by municipality				
Sidi Makhlouf	Aflou	Ksar El hirene	Hassi R'mel	Laghouat
33.3 %	75 %	33.3 %	100 %	50 %
Type of livestock				
Sheep	Cattle		Goats	
54.4%	12 %		33.6 %	
Type of animal product				
Meat	Milk		Wool	
52.8 %	25 %		22.2 %	

Field Survey (2010).

The barn

Nearly 56% of farms have livestock throughout the prefecture; however, disparities among municipalities were observed (Table 6):

1. All of the farmers (100%) in the municipality of Hassi R'mel engaged in livestock husbandry;
2. 75% of farmers engaged in livestock husbandry in Ksar El hirene;
3. Almost half of the farmers (44.4%) practice livestock in Aflou and Sidi Makhlouf;
4. In Laghouat, 28.6% of farmers raise livestock.

Nearly half of the farmers raise livestock because the vast majority of farmers are landless and lack an irrigation source, especially in the southern region of the prefecture (Hassi R'Mel), which is dominated by stockbreeders without surface tillage. In our survey, different types of livestock were observed, including sheep, goats and cattle. Sheep appear to be the most important type of livestock (54.4%), while cattle were the least important (12%). Moreover, goats consisted of 33.6% of the total livestock. The aforementioned results demonstrate the tendency towards the concentration of livestock at the farm level. Qualitatively, sheep herds remain dominated by local races, which represent 99% of the total sheep.

The results indicated that 64.8% of farmers in our sample use animal feed concentrate; however, differences were observed among municipalities in the region (Table 6) . For instance, 100% of farmers in Hassi R'Mel, 75% of farmers in Aflou, 50% of farmers in Laghouat and 33.3% of farmers in Sidi Makhlouf and Ksar El hirene use concentrate.

The most important animal products in the study region

are meat, milk and wool (Table 6). The production of meat was dominant (52.8%), followed by milk (25%) and wool (22.2%). In addition, 89.5% of farmers reported that more than 60% of these products were intended for the market, 5.3% of farmers stated that 45% of these products were intended for the market and 5.3% of farmers reported less than 10% of these products were for the market.

Coverage of food needs for the family

The search for food security is the primary concern of any head of the household, and this motivates his of her decisions. In practice, several scenarios are possible:

1. Family farms are able to feed themselves independently;
2. Family farms are able to feed themselves independently with external contribution from a family member;
3. Family farms are in need of food assistance.

In our study, half of the farmers (Table 7) were able to meet their food needs; however, significant differences were observed among municipalities. In Aflou, Laghouat and Sidi Makhlouf, 88.9, 57.1 and 50% of farmers were able to satisfy their family's food needs, respectively. Alternatively, in Ksar El hirene and Hassi R'Mel, only 28.6 and 25% of farmers could meet their food needs, respectively.

Self consumption

The main objective of the family farm is to provide food

Table 7. Coverage of food needs for the family (CFNF) (%).

		Laghouat	Sidi makhlouf	Aflou	Hassi R'mel	Ksar El hirene
CFNF (%)	Yes	57.1	50	88.9	28.6	25
	No	42.9	50	11.1	71.4	75

Field survey (2010).

Table 8. Share of self consumption.

		Laghouat (%)	Sidi Makhlouf (%)	Aflou (%)	Hassi R'mel (%)	Ksar Elhirene (%)
Self consumption (%)	< 10	14.3	33.4	33.3	90	25
	10-40	57.1	50 (83.8)	33.3	0	50
	40-60	0	16.6	33.4	0	0
	> 60	28.6	0	0	10	25

Field survey (2010).

security and sell surplus production in the market. The share sold depends on the farm size, crop type and mode of farm operation.

According to the results shown in the Table 8, 71.4% of farmers in Laghouat consume less than 40% of their production, and 14.3% consume less than 10% of their production. These results were attributed to the fact that orchard production is generally intended for the market. In Sidi Makhlouf, 83.8% of farmers consume less than 40% of their production, and 33.4% consume less than 10%. In Aflou, 66.6% of farmers consume less than 40% of their production, and 33.3% consume less than 10%. In Hassi R'Mel, 90% of farmers consume less than 10% of their production, and 10% of farmers use more than 60%.

Investment

In our sample, 64% of farmers invest in a PNDAR program. A significant proportion of farmers invest in Aflou (76%) and Laghouat (89%), while a total absence of investors was observed in Hassi R'Mel. The goal of the aforementioned program is to improve the farming and living standards of rural populations. Indeed, 51% of investors stated that they improved their income due to investment, and 60% of the investors are involved in future investment projects. Although there are many investment practices, the most common method is to increase the amount of acreage under cultivation, especially forage (alfalfa) and orchards, and to enhance livestock husbandry or increase the number of sheep. In total, 68% of farmers use extension services; however, the essential source of information for 90% of farmers is discussion and idea exchange among farmers.

Farmer's investments were highly variable among

municipalities (bioclimatic zone). In Laghouat, the vast majority of farmers invested in orchards, and few invested in livestock. The municipality of Laghouat was highly specialized in orchards, followed by vegetable farming and livestock production. Alternatively, in Sidi Mekhlouf, farmers primarily invested in orchards and vegetable farming. Moreover, in addition to orchard and vegetable cultivation, half of the farmers raised livestock. In Aflou, farmers primarily invested in vegetable farming (generally potato), followed by forage farming for animal feed. Due to the total absence of water resources, Hassi R'Mel was specialized in livestock, and a total absence of investment was observed. Finally, in K'sar El hirene, farmers invested in vegetable farming or vegetable associated with orchard trees.

Regarding the mode of operation and reproduction of farms in relation to public policies and the national environment, farmers (as a function of their bioclimatic zone) suggested that policy must take into account the following points:

1. Support for rural youth including the promotion of social aspects and employment, which will restore confidence in their ability to reside in rural areas;
2. Vocational training for rural people and the development of professional qualifications for occupations (agricultural and nonagricultural);
3. State intervention for the improvement of cold storage;
4. The promotion of farming practices that is adapted to the region;
5. State intervention in livestock cultures that are independent of the number of livestock;
6. The identification of water resources and a reduction in the price of concentrate in southern regions;
7. State intervention to assist small stockbreeders;
8. The state must intervene in each region as needed by the farmer.

Conclusion

The present study allowed us to identify the primary forms of organization within family farms based on bioclimatic zones and enabled us to determine how natural conditions affect production systems. Moreover, the results allowed us to identify the adaptation of conservative strategies under difficult working conditions, including the diversification of production and the role of public support in family farming.

The results revealed significant differentiation among municipalities, especially in terms of the production system (crop type, availability of irrigation water according to the bioclimatic, non-agricultural activity, etc.) and public support.

Irrigated areas were characterized by better access to surface water, allowing for the growth of several crops in the same year. Cereal crops (or forage) and vegetables were grown in the northern part of the prefecture, and orchards and vegetables were cultivated in the center of the prefecture. In general, farmers preferred to diversify their crops and non-agricultural activities through various methods, depending on the economic, technical and human resources of the farmer.

In rain fed areas (south of the prefecture), the production system was extensive. These areas are characterized by an arid climate (low rainfall and high temperature), which forces the farmer to acquire non-farm income to meet family needs, usually through stockbreeding or industrial employment. In addition, some family farms have been incorporated into new businesses. Although the survival of farms in rural areas is not necessarily compromised, they are significantly challenged in well-identified non-agricultural sectors, especially after the installation of industrial zones.

Constraints related to production factors are widespread, affect farm operations and challenge public policy. Agricultural diversification such as livestock farming and the practice of non-agricultural activities was conducted on the majority of the farms. Strategies for securing families were performed, demonstrating the capacity for the adaptation of family farms. Nevertheless, subsidies and farming intensification did not yield significant results due to the non-continuity of action in time and space.

Food security had a significant effect on all of the family farms. Two primary methods were employed to ensure food security, and each approach has different effects on food sovereignty:

1. Farms prioritize food production and diversify crops to ensure food security;
2. Farms cultivate speculative crops and raise livestock to diversify their income.

In conclusion, the family farm remains the backbone of farming in the study region and continues to provide significant economic and social function. Moreover, family farms play an important role in maintaining the rural population and affect the development of dryland areas. However, family farm development policies in drylands should be adaptable and consider the heterogeneity of agriculture such as bioclimatic factors.

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