Farming transitions under Socio-economic and climatic constraints in the southern part of Sétif, Algeria

Amar Rouabhi*, Abdelhamid Mekhlouf, Sihem Mokhneche, Nawel Elkolli

Department of Agronomy, Faculty of SNV, University of Ferhat ABBAS, Sétif1, Algeria

* Corresponding author: amarouabhi@yahoo.fr

Abstract: This study was carried out on a sample of 224 farms in the southern region of Sétif-Algeria, aimed to identify the different typologies and the agricultural changes caused by the climatic constrains experienced in last three decades. Indeed, the combined effect of climatic and anthropogenic factors on agricultural practices transitions is too tangled. A series of multivariate and classification statistical analysis have been implemented to demonstrate the main trends and adaptation strategies of farmers in such conditions. The farming characterization analysis showed that the medium scale farming was more economically efficient than small and large scale farming. Moreover, the study showed the effect of climate change on some farming transitions, where farming practices transited to bovine and poultry farming as well as for market gardening cultivation. Indeed, these changes occurred at the expense of rainfed agriculture (cereals) and ovine breeding. These transitions have impacted the economic performance of farms in some municipalities. However, greenhouse crops and tobacco cultivation were observed as being a Local Production Systems (LPS) that could be a good alternative to mitigate the natural and socioeconomic constraints. The emergence of LPS in an agricultural system may facilitate farmer adaptation that will provide a tool for agricultural development policies, through financial and technical assistance.

Key words: *climate change, farming, Local Production Systems, Sétif*

Introduction

Since the French colonization until the beginning of the seventies, agriculture was traditionally the dominant sector of the Algerian economy and gratified almost all the country's food needs. However, it has always been confronted with severe handicaps, such as technical and natural conditions, which are closely interrelated and

which fall within the socio-historical and political natural conditions (Bessaoud, 2004). According to MARD (2001), the private status represents 90% of a total number of farms in the Sétif province. The characterization of the private farm in the rural region is of prime importance in understanding the functioning of the agricultural sector, in fact, in the early 1990s, no less than 22% of the population lived in rural areas and depend agriculture for their livelihood. But a number of natural and anthropogenic factors are governing the functioning of Algerian agriculture such as socio-economic factors and climatic fluctuations. In North Africa, agriculture posed the more problems for technicians, because of its agro-climatic conditions (Dumont, 1949). Since the national independence, the Algerian agricultural sector has gone through several experiences so-called reform policies; which have continued to change it continuously, with the aim of finding a suitable combination to improve economic productivity and social anchor, especially for rural landscapes. As a result, the challenges that face farmers to maintain efficient agricultural activities are too complex given the diversity of farming systems (OECD, 2001). Hence farmers should be provided with a minimum flexibility with respect to their operating farming activities in order to ensure sustainability. This goal can be achieved by governmental judicious policies, acting on the technical, social, administrative and financial ways. Through the National governmental subsidy programs, the Algerian government has injected significant funds, reaching 2.3 billion Euros between 2000 and 2005 for the upgrade of farms and modernizing their production process (Habibi *et al*, 2008). Indeed, these aids are granted to farmers in the form of financial and technical assistance. Colson *et al.* (1998) considered that technical change in production systems was closely linked to the allocation of subsidy.

The study therefore aims to diagnose agricultural practices in order to identify both the farms typologies and the impact of governmental subsidy programs on the development and the adoption of new agricultural practices. The target area is the southern zone of Sétif province, including six municipalities namely Ain Azel, Ain Oulmene, Bir Hadada, Ouled Tebbene, Rasfa and Saleh Bey. This area is considered as the driest in Sétif region, where annual rainfall is about of 300mm (Baldy, 1974). Which implies that, farming in this area is suffering and struggling more, this harsh climatic effect can induce farming transitions. Hence, the study attempts to conclude a set of major observed impediments facing the agricultural development and how they could eventually be overcome.

Material and Methods

Location and characteristics of the study area

Situated south of Sétif province, the study area includes six municipalities: namely Ain Azel, Ain Oulmene, Bir Hadada, Ouled Tebbane, Rasfa and Saleh Bey (Fig. 1). It covers an area

Figure 1- Location of the study area within Sétif province.
Source: Author's own elaboration

of 1,025.75 km² or 15.66% of the total area of the province. Although it is located in the Algerian high plateaus, the study area is characterized by a flat landscape, with an altitude between 800 m and 1000 m, except some mountainous chains, rising to 2000 m (Boutaleb Mount). The climate area is semiarid, unpredictable and very constraining, where annual rainfall is between 200 mm and 400 mm.

Preparation of the schedules

The sample includes 224 private farms spread over six municipalities. Taking into account the total number of farms in the area study, the number of surveyed farms is apportioned to each municipality according to a sampling rate of 5%. The survey is followed by data entry on a Microsoft Access form, specially designed for this operation. Indeed, this technique is intended to exclude outliers caused by typing errors and so that, the transfer and the statistical treatment would be more accurate. The structured schedules included thirty questions

designed to collect data related to the structure of farming system, the socio-economic environment, potentials and constraints facing the farmers.

Tools and Data Analysis

Given the various natures of the studied variables (quantitative, qualitative, ordinal and binary) and the objectives of the study; aiming to analyze the typologies and the agricultural transitions. The statistical analysis will focus on a series of data analysis compiled by two statistical software namely SPSS version 18.0 (statistical Package for Social Sciences) and EXELSTAT version 12. Indeed, some statistical tests are interdependent, for this purpose, their execution requires a methical chronology.
    Thus,
- Two-Step Classification,
- Categorical Principal Components Analysis (CatPCA) and
- Multiple Correspondence Analysis (MCA)

Before running the statistical analysis, some numerical variables were transformed into ordinal ones in order to maximize inertia. Indeed, these transformations depend on the approach and the purpose of the test. The Two-Step classification was used to transform the "Utilized Agricultural Area (UAA)" into ordinal variables with three scales, namely large, medium and small-scale farming. The factorial map including the three area scales will show the geographical pattern and associations between variables. However, CatPCA was used for constructing typologies by implementing selected variables. An iterative series of CatPCA was performed to sort out variables with a maximum of Variance Accounted For (VAF). The tolerance threshold was maintained above 0.1 of VAF. The number of retained variables was 13 variables, including 10 numerical and 03 categorical variables. MCA was used to describe the socio-economic environment given the quality of the treated variables, which are qualitative. MCA was performed to identify the spatial pattern of farming practices, such the implementation of "*Municipality*" and "*dominant activity*" variables in highlighting the LPS phenomena.

Results and Discussion

Socio-economic conditions

The study limited the socio-economic environment of the heads of the household to age, level of education, professional experience (Table 1). Through the analyzed data, it appears that educational level of farmers is generally low, with 45% of them having a basic level and 31.69% are medium level, however, a small portion of 8.03%

have reached the high level. This basic educational level seems to be the main cause of underdevelopment and non-adoption of technological progress in agriculture, this constraint is also due to institutional factors and structural policies (Anseur, 2009). Thus Algerian agriculture cannot respond to the expectations of a growing population through the current application techniques that lack efficient use of time and space.

The most represented age range is between 30 and 50 years (46%) while 37.5% of ages are above 50 years. In general, younger age (under 30 years) is less represented, with only 15%, which corroborates the results of the General Census of Agriculture of 2001. This finding may be due to the weak acceptance of the farming profession by the young people job seekers and the lack of a direct outlet to use the structures of vocational or technical training in an agricultural field. Indeed, the role of the agricultural training centers in educating farmers and training of young investors is very limited, where the training rate between 2000 and 2006 concerned only 1% of Algerian farmers (Berranen, 2007).

The involvement of farmers in governmental subsidy programs is low, comparatively to the expectations and the financial resources deployed by the government, where more than two billion Euros were provided through various aid funds (Naili, 2009) which unfortunately, is not valued. In fact, only 27.23% of farmers participated in aid programs, while the rest of the farmers were excluded because of poor awareness, weak extension program and administrative channels overly complicated, especially for the less educated farmers.

Private investment on equity recorded a good level, where 57.58% of farmers have initiated new investments while 31.69% has introduced modern techniques. However, some changes in agricultural practices are caused by the climatic constraints, for instance, the adoption of water-saving irrigation methods, the abandonment of classical irrigation methods (channel and aspersion) which are more water wasting and more demanding in labor and maintenance. The adoption of greenhouse crops is another face of water-saving irrigation concerning the replacement of market gardening in open fields by greenhouse crops, which are more intensive and less water demanding.

The proportion of farmers who practice agriculture as a single profession is 75%. Farmers in the study area allocate most of their time to work in the farm, which means a strong commitment to their original jobs, although it's a subsistence profession for majority of them.

For the reasons that majority of farmers do not hold accounting records and their susceptibility towards financial information, which represent for them a kind of personal secrets. Thus, we tried approaching indirectly this dimension by a variable called "*Economic Performance* "(EP), it is a quantity from a scale of 5, as in the case of a Likert scale. During the process of administering the questionnaire, the farmer assigns a score of 1 to 5, through which he considers the average ability of his farm to generate economic and financial benefits during a campaign. This variable is treated as numerical or ordinal variable according to the aim of the statistical test. Majority of farms have an acceptable level of economic performance, whereas; some has a low level.

Table 1- Household socio-economic environment characteristics

VARIABLES	MODALITIES	% OF FARMERS
Instruction level of the respondent	No instruction	29.46
	Primary	15.17
	Medium	31.69
	Secondary	15.62
	Higher institution	8.03
Age	Between 30 and 50 years old	46.87
	More than 50 years old	37.50
	Less than 30 years old	15.62
Adhesion in subsidy programs	No	72.76
	Yes	27.23
Professional Experience	Beginner (less than 10 years)	13.83
	Medium (between 10 and 30 years)	43.75
	Experienced (greater than 30 years)	42.41
Investment on equity	No	42.41
	Yes	57.58
Adoption of a modern Techniques	No	68.30
	Yes	31.69
Practicing other non-agricultural activity	No	75.00
	Yes	25.00
Economic performance	Very high	8.93
	High	23.66
	Moderate	47.77
	Low	18.30
	Very low	1.34

Source: Survey data

Farms typology

The treatment of the socio-economic environment by Multiple Correspondence Analysis (MCA) indicates that the first axis explains 31.61% of the total inertia model while the second axis accounts for 27.10% of total variability (Table 2).

The contribution of variables in the overall inertia shows that, at the first axis an association between "*Age*" and "*Instruction-level*", where elderly farmers are less educated. In contrast, young farmers have a relatively high level of education (Figure 2). These two indicators "Age" and "Education" are significant variables that explain the adoption of an innovation in the farm (Adéoti, *et al*, 2002; Nkamleu and Colibaly, 2000; D'souza *et al*, 1993). While the second axis describes additional associations between "*Adhesion in subsidy programs* ", "*Economic performance*" and "*Investment on*

Table 2 - Accounted inertia derived from the MCA

DIMENSION	VARIANCE ACCOUNTED FOR (VAF)		
	TOTAL (EIGEN VALUE)	INERTIA	PERCENTAGE OF VARIANCE
1	1.90	0.32	31.61
2	1.62	0.27	27.10
TOTAL	3.52	0.59	

Source: Author's own elaboration

equity", this associations may explain the personal motivations of farmers. This motivation could be drawn by the high level of instruction because the intellectual farmers in addition to their agricultural know-how, they can overcome the administrative barriers to achieving their subsidy applications and / or bank credit and implement investment projects. This feature has a positive impact on improving the economic performance of farms in particular at the municipality of Ain Oulmene (Figure 2). However, the least educated farmers are those who did not participate in subsidy programs or invested capitals; therefore, they always record poor economic performance, particularly in Bir Hadada and Rasfa. Indeed, the low rate of return is due to the dysfunction of subsidy programs and adverse administrative conditions (bureaucracy and lack of access to credit) (Salhi *et al*, 2012).
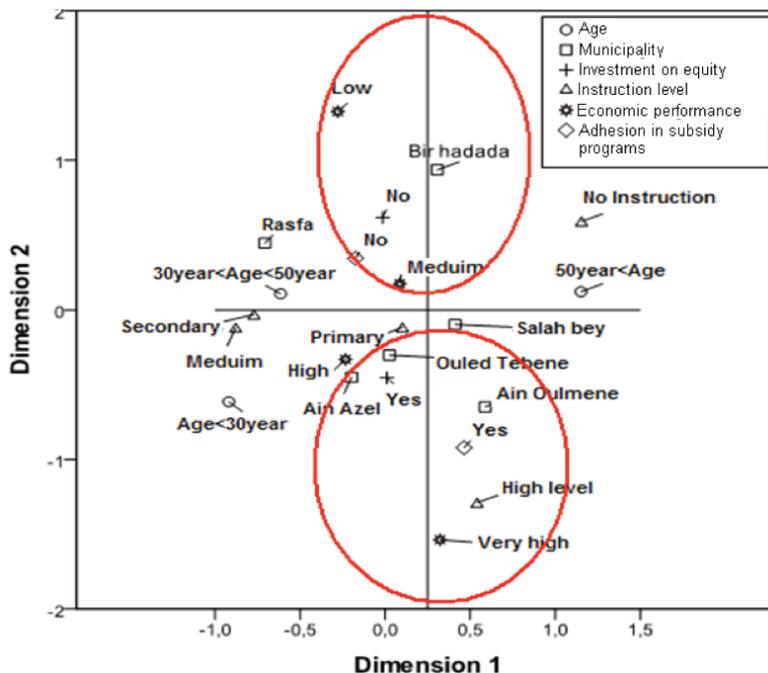

Figure 2 - Socioeconomic environment described by MCA.

Source: Author's own elaboration

Types of farming practices differ from one municipality to another. Farming in the lower semi-arid at Sétif region is characterized by a mixed farming system (Benniou and Brinis, 2006). However, crops and livestock activities are complementary and combine together to determine the performance of the farm. As well, the water potential and the endowment by production means, play an important role in the economic development of the farms. The UAA classification gave a silhouette of cohesion of 0.8. The silhouette of cohesion is a quantity used to determine the quality and the importance of separation groups (Tan *et al*, 2006). A greater value than 0.5 means that the groups are well separated (Mooi, and Sarstedt, 2011; Elleithy, 2010).

The first group of UAA has an average of 5.01 ha for small scale farming, 22.14 ha for medium scale and 62.26 ha for large scale. The coefficient of variation recorded a very high rate of 130%. These indicate an important heterogeneity of UAA between surveyed farms. These indicate an important heterogeneity, where the coefficient of variation is 130%. The transformation has led to high significant different groups of farm scaling, which can lead to different typologies. The model derived from the CatPCA explained 69.23% of the total inertia, where 42% was explained by the first dimension while the second dimension explained 27.23% of the total inertia (Table 3).

Table 3 - Model summary of the inertia derived from the CatPCA.

DIMENSION	CRONBACH'S ALPHA	VARIANCE ACCOUNTED FOR (VAF)		
		EIGEN VALUE FOR MNV	EIGEN VALUE FOR NMNV	TOTAL EIGEN VALUE
1	0.88	1.62	3.83	(5.45 EV) (42% VAF)
2	0.78	1.41	2.13	(3.54 EV) (27.23% VAF)
TOTAL	0.94	1.51	5.96	(7.48 EV) (69.23% VAF)

MNV: Multiple Nominal Variables
NMNV: Non Multiple Nominal Variables
EV: Eigen value

Source: Author's own elaboration

The set of variables contributed positively to the formation of the first axis, some of them recorded the maximum loadings, such as field crops (*FC*) and non-irrigated areas (*non_irrig*). While for the second dimension, a group of variables is positively associated with it, including irrigated areas (*irrig*), fodder areas (*fodder*) and ovine and bovine breeding (Table 4).

Based on this finding, the study can identify three typological forms namely: the large, medium and small scale farming. Typology of large-scale farming is

Table 4 - Component loading resulting from the CatPCA.

VARIABLES	DIMENSIONS	
	1	2
Number of drills by farm (Drill)	0.55*	0.20
Bovine breeding (bovine)	0.59*	0.54*
Ovine breeding (ovine)	0.59*	0.58*
irrigated area (irrig)	0.68*	0.62*
Non-irrigated area (non_irrig)	0.87*	-0.67*
Arboriculture area (arboriculture)	0.39	-0.05
Field crops area (Cereals) (FC)	1.01*	-0.44
Fodder area (fodder)	0.46	0.62*

*: significant correlation between the variable and the component (P < 0.05)

Source: Author's own elaboration

characterized by large non-irrigated areas; usually characterized by practicing field crops (cereals). Such allocation area is a function of legal status, where, the majority of farmers who are members of collective farms (*Exploitation Agricole Collective "EAC"*) opt for this classical system, as in the municipality of Salah Bey where the property of the State dominates the private status. However, the typology of the medium scale farming is represented by the second axis. It is characterized by bovine, ovine breeding, with irrigated areas and staffing artesian drills. It should be noted that the medium scale farming is the most economically performing typology; combining livestock breeding with irrigated crops, as cited by ElKolli and Mokhneche (2012) in Ain Azel and Ouled Tebene municipalities. Meanwhile, the municipalities that have registered high economic performance, have recorded a high subsidy programs adhesion and a high investment rate (Figure 3). Indeed, the medium scale farming is more dynamic than the large and small scale farming in term of diversity and profitability. Organizational problems of large farms (especially EAC) lie in the failure of farmers to freely manage state lands under the framework of law enjoyment promulgated under the law 87/19 between beneficiaries and the State (Le Coz, 1991). Indeed, the guidelines of this law were not heeded and lacked clarity and rigor (Imache *et al*, 2008). Also, the type of tenure of land is among the reasons that prevent the development of farms (Bouchaib *et al*, 2011). From a certain threshold of farm size, the small scale farming can lead to a subsistence activity and low profitability; it is more prevalent in the municipalities of Rasfa and Bir hadada. While, large scale farming predominates in the municipality of Salah Bey, it represents one of the reasons for having a low economic performance, in addition to other socio-economic factors, such as lack of adhesion in the subsidy programs and the reluctance of farmers regarding the investment on equity.
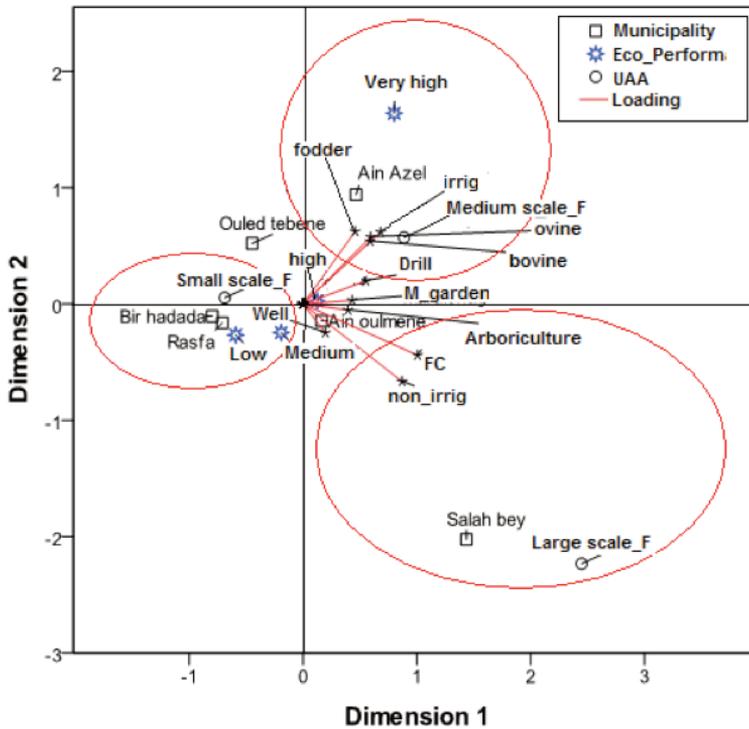
Figure 3 - Main typologies observed in the area study.

Source: Author's own elaboration

The Localized Production System (LPS)

Results of ACM explain 76.51% of the total variability; also this demonstrates a strong association between agricultural practices and their geographical distribution. Thus, the model shows a strong spatial clustering practices, where Bir Hadada and Rasfa municipalities practice exclusively and respectively greenhouse crops and industrial crops (Tobacco cultivation), this is well described by the first dimension, while the municipalities of Ouled Tebene and Ain Azel are represented on the second dimension, where dominant speculations are aviculture and arboriculture (figure 4).

The study reported earlier that Bir Hadada and Rasfa municipalities are characterized by the dominance of small scale farming and low rate of subsidy programs adhesion. The spatial concentration of agricultural practices in these communities is governed by natural and anthropogenic factors. In Bir Hadada municipality, farmers believe that the adoption of greenhouse crops depend on the acquired knowledge, farmer's mutual help, types of agricultural products (seeds, fertilizers, pesticides and equipment) where the agricultural territory is mainly
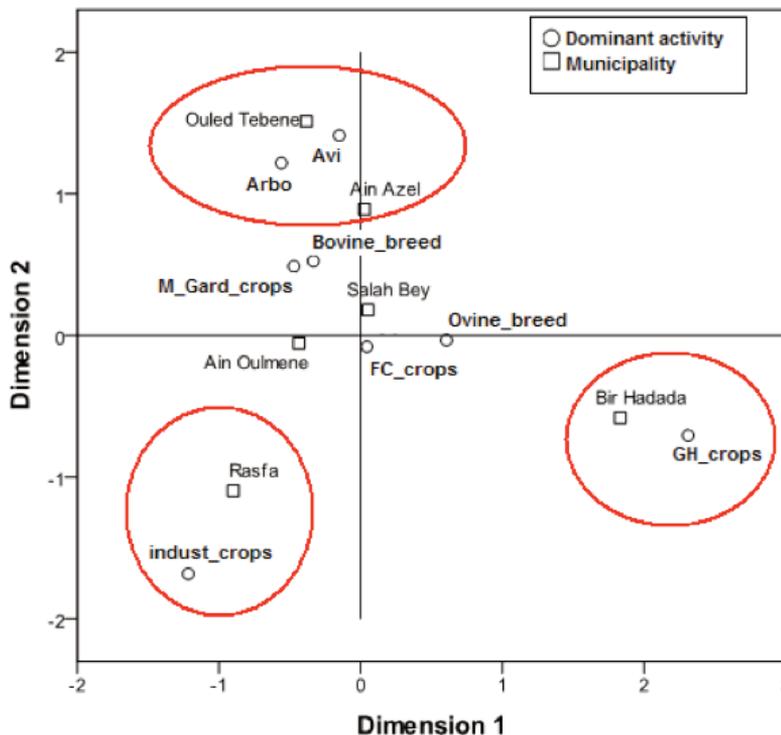
Figure 4 - Spatial distribution of the dominant agricultural activities

Source: Author's own elaboration

distributed in scattered family centers. Other farmers consider greenhouse crops is a way to save irrigation water and also an alternative to replace the loss of rainfed area by implementing a more intensive system production. Some authors consider that cropping intensification is a way to deal with declining revenues (Chassany, 1994). Currently, several craft units of greenhouses, sellers of seed, pesticides etc. have emerged following the development of greenhouse crops in this municipality, suggesting that these factors lead to the emergence of a relatively autonomous economic district and self-complementary. The municipality of Rasfa is characterized by the dominance of the tobacco cropping; this crop seems to take place of cereals. Indeed, the partnership agreements signed between farmers and the National Society of Tobacco and Matches (SNTA); the latter undertakes to provide tobacco seeds and other financial incentives to farmers who hold in turn to deliver harvest at the end of a season. In Algeria, the tobacco cropping is a regulated activity, where state and SNTA are exclusive parties, holding rights of production and marketing. Thus, a large number of farmers have adopted tobacco cropping not only in the conventional framework but also in the parallel (illegal) framework, because tobacco products are highly taxed and bring considerable profits.

The knowledge created during the production process and the mobility of employees has enabled production districts to develop (Malmberg and Maskell, 2001). Actors in *localized production system* (LPS) are facing to a common technical and economic reality, collectively develop and share information (scientific, technical, industrial, commercial) on the external constraints and the problems to be solved as well as possible ways of solution (Peyrache-Gadeau , 1995; Gilly , 1990). Geographical clustering of economic activities is often observed in the sectors of crafts, industries, and agribusiness in developing economies. The creation of an LPS is determined by five components, among which are: the capitalist labor market and the attractiveness of the region, these two components are far from being met, in view of local conditions and the overall policies of state management.

Conclusion and Recommendations

The sample included a range of different production systems, this diversity was dependent on agro-climatic conditions, structure of production units and motivations of farmers to invest and join government subsidy programs; this undoubtedly affected the speculation choice. The study therefore, identified three typological forms namely: the large, medium and small-scale farming. The large scale farming was characterized by the dominance of field crops (cereals) conducted under rainfed regime. This typology is governed by the legal status of land which is mainly observed in Salah bey municipality. However, the medium scale farming seemed to be more dynamic, with a higher number of adopted agricultural activities. Where, farming transitions recorded a trend in favor of intensive activities such as breeding and irrigated cultivation. It should be noted that this trend has improved significantly EP of farms. The third typology, was also characterized by small scale farming, which was more conservative, but dominated by greenhouse cropping and tobacco cultivation, this group contained two geographically disjointed and specialized areas, in which Bir Hadada and Rasfa municipalities were distinguished by greenhouse crops and tobacco cultivations respectively, which represented a form of LPS that not reached yet a level of economic stability. The impact of the climate constraint on farming transition was observed in Bir Hadada municipality; where farmers have shifted to greenhouse crops in order to manage water scarcity by minimizing crop evapotranspiration. Moreover, greenhouse crops required less water especially if they are conducted under "drop by drop" irrigation system. Unfortunately, the study was unable to highlight on the significant effect of government policies on the adoption of new agricultural activities. However, it emphasized a strong association between EP and the rate of the adhesion in subsidy programs. The maintenance and development of agricultural units in the study areas depend on the ability of farmers to develop appropriate production systems according to environmental factors, taking into account the level of

structuring and economic conditions of the farm. The major impediments to agricultural development observed in the southern region were summarized in a set of natural and anthropogenic items Indeed, the scarcity of water and the excessive exploitation of groundwater limit the potential of irrigated cultivations. However, some anthropogenic factors led also to a handicap of agricultural progress mainly the weakness of agricultural investment on equity, the poor extension of subsidy programs and the low technical quality of farmers. The study therefore recommends that the irrigation should be promoted with water-saving process over many districts especially "Ain Azel district", which is the major involved district in the project of "THE GREAT TRANFERS" which consists of transferring water from the north to the southern part of Sétif Province. Moreover, policies should be directed to improve access to investment credit for poultry, bovine breeding and market gardening. Likewise the local economies should be encouraged through the development of agri-business, research and promotion of localized production systems such as greenhouse and tobacco cultivations.

References

Adéoti R. Coulibaly O. Tamò M., 2002. Facteurs affectant l'adoption des nouvelles technologies duniébé *Vigna unguiculata* en Afrique de l'Ouest, Bulletin de la Recherche Agronomique du Bénin(36): 19-32.
    www.fidafrique.net/IMG/pdf/Adeoti_36_2002.pdf

Anseur O., 2009. Usages et besoins en information des agriculteurs en Algérie, Thèse de doctorat en Sciences de l'information et de la communication. Université Lumière Lyon 2. p. 233

Baldy C., 1974. Etude fréquentielle du climat. Influence sur la production des zones céréalières en Algérie, Document MARA, pp. 52.

Benniou R. & Brinis L., 2006. Diversité des exploitations agricoles en région semi-aride algérienne, Sécheresse vol. 17, n° 3.

Berranen H., 2007. La Formation agricole en Algérie : Problématique et prise en charge des nouveaux besoins. Premières rencontres euro-méditerranéennes de l'enseignement agricole public. 15 au 17 décembre 2007. Saint-Rémy-de-Provence France.

Bessaoud O., 2004. L'agriculture et la paysannerie en Algérie : Les grands handicaps, Communication au Symposium - Etat des savoirs en sciences sociales et humaines. CRASC-Oran.

Bouchaib F., Djibo Donguey M., Jouve A-M., 2011. Le développement du mode de faire valoir indirect informel en Algérie. Cas du secteur public dans la Mitidja Ouest, In : Elloumi M. (ed.), Jouve A.- M. (ed.), Napoléone C. (ed.), Paoli J.C. (ed.). Régulation foncière et protection des terres agricoles en

Méditerranée. Montpellier : CIHEAM, 2011. p. 103-113 (Options Méditerranéennes : Série B. Etudes et Recherches; n. 66)

Chassany J.P., 1994. Emergence et adaptation de formes de développement local : analyse de quelques expériences observées en moyenne montagne, CIHEAM, 1994. p. 87-95 (Cahiers Options Méditerranéennes; n° 3)

D'Souza G., Cyphers D., Phipps T., 1993. Factors affecting the adoption of sustainable agricultural practices, Agricultural and Resource Economics Review 22 : 159-65.

Dumont R., 1949. Evolution récente et perspectives de l'agriculture Nord-africaine, Institut observation économique. Etude spéciale n°3. Paris. 32 p.

ElKolli N. & Mokhneche S., 2012. Etude des pratiques agricoles dans la zone semi aride : cas du sud de la wilaya de Sétif, Mémoire d'ingéniorat d'Etat. P46

Elleithy K., 2010. Advanced Techniques in Computing Sciences and Software Engineering, New York, NY: Springer.

Gilly J.P., 1990. Groupes et nouveaux espaces productifs : le cas de Matra-espace à Toulouse, Communication au colloque ASRDLF, Saint-Étienne, France

Habibi A., Chekired-Bouras F.Z, Mouhouche B., 2008. Analyse de la mise en œuvre du plan national de développement agricole dans la première tranche du périmètre de la Mitidja Ouest, Algérie, Actes du quatrième atelier régional du projet Sirma, Mostaganem, Algérie, available at :
http://hal.cirad.fr/docs/00/36/64/83/PDF/18_Hadibi.pdf

Imache A., Bouarfa S., Dionnet M., Kemmoun H., Hartani T., Ouzri B., 2008. 'Les arrangements de proximité sur les terres publiques : un choix délibéré ou une « question de survie » pour l'agriculture irriguée en Algérie', Acte du quatrième atelier régional du projet SIRMA, Mostaganem Algérie. Montpellier : CIRAD, colloque-cédérom, 11 p.

Le Coz J., 1991. L'Algérie. Décennie 1980 : les étapes de la désocialisation, Université Paul Valéry-URA-CNRS. 92 p. (coll. Espace rural, n. 24).

MARD (Ministry of Agriculture and Rural Development), 2001. Statistiques agricoles. Direction des Services Agricoles de la Wilaya de Sétif.

Malmberg A., Maskell P., 2001. The elusive concept of localization economics-Towards a knowledge-based theory of spatial clustering, Paper presented at the AAG Annual Conference, New York, Feb 27-March 3, 2001.

Mooi E. & Sarstedt M., 2011. A Concise Guide to Market Research the Process, Data, and Methods Using IBM SPSS Statistics, Berlin; New York: Springer.

Naili M., 2009. Evolutions et adaptation nécessaire du secteur agricole en Algérie, les notes d'analyse du CIHEAM, N°52 septembre 2009.

Nkamleu G.B. & Coulibaly O., 2000. Le choix des méthodes de lutte conte les pestes dans les plantations de cacao et de café au Cameroun, Economie Rurale 259 : 75-85.

OECD, (Organization for Economic Co-Operation And Development), 2001.

Adoption of technologies for sustainable farming systems Wageningen Workshop Proceedings. http://www.oecd.org/greengrowth/sustainable-agriculture/2739771.pdf

Peyrache-Gadeau V., 1995. Dynamiques différenciées des économies territoriales : Apports des analyses en termes de districts industriels et de milieux innovateurs, Grenoble, Université Pierre Mendès-France, Thèse.

Salhi S., Imache A., Tonneau JP., Ferfera MY., 2012. Les déterminants de l'adoption du système d'irrigation par goutte-à-goutte par les agriculteurs algériens de la plaine de la Mitidja, Cah Agric 21 : 417-26. doi : 10.1684/agr.2012.0598.

Tan P.N., Steinbach M., Kumar V., 2006. Introduction to Data Mining, Boston, MA; London: Pearson Addison Wesley.