THE EFFICIENCY OF STRUGGLE AGAINST SHEEP PRICE VOLATILITY IN DJELFA REGION OF ALGERIA

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SUMMARY

The paper aimed at measuring the volatility of sheep price in real pastoral market. It used a long-term empirical data (2003-2017), an Empirical orthogonal Functions analysis (EOF) and statistics. With cumulated variances of 57.89%, EOF divided the results into 3 batches according to linear coefficient of correlation of Pearson (r). It measured low degrees of positive or negative dependence between variables. State intervention was not efficient for stabilizing prices also. The implications of the observed findings are improved instruments based on fundamental market forces for struggling efficiently against price instability.

KEY WORDS

Localagonist market, public measures, feed input, livestock mobility, climatic factors.

JEL CLASSIFICATION: Q120; Q210; Q560.

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فعالية مواجهة تقلب أسعار الأغنام في منطقة الجلفة بالجزائر

ملخص

سجل المقال عدم استقرار أسعار الأغنام في السوق الرعوي الحقيقي، واستخدم سلسلة تجريبية (2003-20017) للتحليل تبعا للتعامد التجريبي (FOE) والإحصائي، فكان تباين النتائج التراكمية 57.89٪. والتي قسمها (FOE) إلى 3مجموعات وفقا لمعامل الارتباط برسون (r). وقد سجل درجات صغيرة من الارتباط الإيجابي أو السلبي في ما بين المتغيرات. ولم تكن تدابير الدولة فعالة في استقرار الأسعار و تشير النتائج إلى أن استخدام أدوات تستند إلى قوى السوق الأساسية تفعل من اجل تحقيق مكافحة فعالة لتقلب الأسعار.

كلمات مفتاحية:

مدخلات الأعلاف الحيوانية، المناخ، نظام تربية الماشية، الأسواق المحلية الناهضة، الموارد الطبيعية

تصنيف جال: Q120 ; Q210 ; Q560

EFFICIENCE DE LA LUTTE CONTRE L'INSTABILITÉ DU PRIX DU MOUTON DANS LA RÉGION DE DJELFA, ALGÉRIE

RÉSUMÉ

L'article a mesuré une instabilité de prix du mouton sur un marché pastoral réel. Il a utilisé des séries empiriques (2003-20017), une analyse en fonction orthogonale empirique (FOE) et statistique. La variance des résultats cumulés a été de 57,89%. La FOE les a répartis

en 3 groupes selon un coefficient de corrélation de Pearson (r). Il a mesuré de faibles degrés de dépendance positive ou négative des variables entre elles. Des mesures étatiques ont autant manqué d'efficience pour stabiliser le prix. Les résultats obtenus impliquent l'utilisation d'instruments basés sur les forces fondamentales du marché pour une lutte efficiente contre la volatilité de prix.

MOTS-CLÉS

Marché agoniste local, mesures gouvernementales, intrant agricole, mobilité du troupeau, facteurs climatiques

JEL CLASSIFICATION : Q120 ; Q210 ; Q560

INTRODUCTION

At the end of 17 century, economists knew with King's law an inefficiency and imperfection of an agricultural produce markets (APM) (Clément, 2006), it reflected perfect competition conditions; roughly speaking, perfectly competitive market (Krugman & Wells, 2013). Struggling constantly to escape from it, the period 1930-1970 was that of the measures taken by a state to support the producers and consumers or to limit low-price and high-price extremes related to the way of market forces under normal conditions or causes by factors which are exogenous for it (Galtier, 2009).

Between 1980 and 1990, the functioning markets, including the APM was based on a dominant logic of uncontrolled liberalization (Lilliston & Ranallo, 2012; Galtier, 2009).The advocates of these neoliberals' thesis (neoclassical economists) explain that free playing in the APM would promote developing countries development and improve food security worldwide. Thus, they lead to the dismantling of the agricultural policies which are mainly the state act of governing and the regulatory mechanisms of the APM.

And above all, they employ private tool of the risks coverage for the producers (forward contact, income or cash flow insurance, climatic index), without "touching at the prices" in 1980 and 1990, following the neo-liberalism critique (Lilliston & Ranallo, 2012);

private means which are not unfortunately available in developing countries in general. And yet, food insecurity continues, with the number of the individuals of our planet suffering from the hunger which has progressed since 1995, and 2009, even the billions of individuals exceeded (Food and Agriculture Organization of the United Nations (FAO, 2015).

During the last decade, people experienced two worldwide food crises, and above all, the prices volatility of the agricultural produce never ceased and rather increased. Thusly, economists perceive a growing understanding that the worldwide farming market has changed, and these changes have led to dramatic increases in price instability (Lilliston & Ranallo, 2012). It is not yet rigorous and durable according to another assumption of its reversal with macroeconomic indicators (including demographic and monetary) showing that agricultural sector is not disconnected off others (Benadjila, 2017; Westhoff, 2010).

In a purely descriptive sense volatility refers to variations in economic variables over time (Krugman & Wells, 2013). Small variations around average prices of produce (fluctuation) or extreme movements increasing or declining (low-price and high-price extremes) (volatility) of their prices linked to the way of market forces under normal conditions or causes by factors that are exogenous for it (nature and origin) make up all known terms which explain a concept of price instability (Lilliston and Ranallo, 2012; FAO et al., 2011).

In the same comprehensive and consistent manner, volatility relates back to an idea that the prices fluctuate much suddenly, with great amplitude, during time and it is positive that it acts: the price instability reflects a disequilibrium between supply and demand (Krugman & Wells, 2013). "An extreme range of values to which given production and consumption shocks translate into price volatility results from supply and demand elasticity which, in turn, give evidence of the responsiveness of producers and consumers to changes in prices" (Piot-Lepetit & M'Barek, 2011). A classical saying in economics is that price instabilities are a common characteristic of well-functioning APM, but when they become unpredictable, they are

characterized in terms of shocks. This means that there are the shocks to production and consumption transmit into price variability, like the demand shocks, likewise the income shocks and policy shocks.

At the local level, rising food prices hit badly poor consumers. It is the result of the important position (40-42%) that the food takes in their total expenditure (National office of statistics (ONS, 2013) and budget control which they come up against because of their low incomes and weak capital endowment. But the increase in the foodstuffs prices gives the farmers an opportunity to increase their incomes and harm them by reassuring excessive investment in production, which in turn aggravates long periods of depressed prices (Varangis et al., 2002).

Breeding contributes directly and indirectly to food security and represents a highly interlinked subsystem in the consumption system (Benfrid, 1986). Mutton was identified as a necessity and the socio-demographic parameters were important determinants in explaining supposed variations in the consumption (Sadoud & Chehat, 2011). A reduction in livestock feedstuff availability most likely provokes too in reduction in food security; an increased food supply (at the macro level) does not necessary enhance food security. An intensification of sheep production or the animal farming negatively impact alike increasingly extreme ecological disasters or food security, in particular in cases they are made up from inputs that can also be used for direct human nutrition (Benadjila, 2017; Baritaux et al., 2016).

Though increased knowledge, tools and technologies have been made in a fight against price volatility, the phenomenon remains an important threat and affects pastoralism too deeply. Pastoralism is a system of livestock production in the branch of agriculture that takes advantage of both the variety and seasonality of natural capital in the world's harshest environments that cover a third of the earth's land surface concerned with a travel mobility to find adequate grazing and water in the face of uncertain climatic conditions. In short , the movement decisions are not a way of life but result from a succession of decisions based on the benefits and costs of mobility (Tuner & Schlecht, 2019; Davies et al., 2018).

The animal and plant production activity always depend on a presence of the natural climatic conditions (appendix 1). They act according to time and space on the seasonal variables related to the dryness, with the floods, frosts, plants, and flock diseases (Garnett, 2012). The good season (GS) is the time of the year which is characterized by a relatively constant climate with the precipitations equal or higher than the average, more regular and distributed better in time, and by the state of the favorable vegetation, to farm in the area. It is opposed thus to the bad season (BS).

When climate and other factors are unfavorable for natural forage to satisfy the meat-based needs for growing population, farmer uses Concentrate Feed Input for Flock (CFIF). CFIF is defined as resource, rich in mineral and organic components, introduced as a food which enters sheep production. Its use seems risk management strategy, including price variability, in crunch period but is now in general use in mobile and sedentary livestock production systems and feeding practice is varied according to the various sources related to climate, feed availability, and price (Belkhiri et al., 2015). According to current or forecasted situation in Algeria, the highest public power reacts by employing 2 kinds of instruments.

Market access standards which are 3 rules (market access: no barriers to entry for new livestock enterprises or barriers to leave for existing farms and having all an information, prices setting and health rules) and 3 different categories of tools for producers and households. There is social welfare or support to poor households in time of increased price by direct money transfer or aids in kind. It is also interventions in the APM to limit the rise or fall of the sheep prices and concentrated food prices (import of CFIF with policy of support to their price and inter-region transportation costs, import of red meat or restriction of its export, subsidized loans for farmers, millers, and traders, in order to compensate roughs access terms to private sector loans). There are support measures granted to the farmers (subsidized several surgery products, agricultural water, with a partition in insurances damage and people since 2006) (Belkhiri et al., 2015).

In the local markets of sheep production are the farmers strategies and supreme government measures efficient often enough to prevent price volatility, according to its nature or origin? Explaining the nature and origin of the price volatility, two great conceptions are opposed: the random assumption and chaotic assumption, both being linked to unpredictable variability and hence characterized in terms of shocks (Krugman & Wells, 2013; Piot-Lepetit & M'Barek, 2011).

For the first, there are exogenous factors in APM which disturb them. There are, on the one hand, the climatic risks, which vary harvests and prices in unpredictable manners, on the other hand, the agricultural policies which are accused of perturbing supply-demand equilibrium by the rents. Finally, there is always more narrow connection between produces prices and those of energy, sudden intra-seasonal variation extended to climate change and said agricultural commodity market or financial assets led to exchange rate shock. There is the financial investment realized by traders (banks, insurances, wealth funds, hedge funds) in order to diversify their assets portfolio. Simplified market fundamental-forces analysis (supply and demand) fails for explaining worldwide prices volatility in APM. Scholarly study remains little conclusive as for the impact of the last category of variables on APM and international prices transmission into local market (Varangis et al., 2002).

The second considers that an essential source of instability comes from nature besides to APM. The exogenous agricultural factors are regarded like secondary in the well-functioning produce markets that creates volatile price (Piot-Lepetit & M'Barek, 2011). It is therefore structurally explained, on the one hand, by chaotic mechanism (based on cobweb theory; imperfect or adaptive expectation) of repulsion and attraction that draw aside and bring closer permanently the prices at the equilibrium point, on the other hand, by price instability coupled with rational expectations of market agents (Galtier, 2009). Apart from the previous reasons, the last endogenous design is strengthened by the conjunction of 2 supplementary assumptions:

- Local pastoral markets are characterized by uncertainty related to, on the one hand, a price-inelasticity of supply and demand of

produces and, on the other hand, an inflexibility of farming practices to adapt to the markets' fundamental forces.

- Uncertainty constraints or their combination and intensity generate complexity which turns local markets into market of agonist rational expectation. It means that permanent imbalanced price (Supply and demand are in disequilibrium) is generated by unstable APM itself.

In the following part, we need to verify these suppositions that are hard to satisfy. In other words, the purpose of this paper is to measure the volatility of sheep price in the local pastoral market of sheep production. This means that we will know an effectiveness of the measures taken to stabilize the sheep price. It follows that accurate instruments will improve struggle against price volatility, will prevent its undesirable consequences for populations and will stimulate agricultural production and conserve environment.

1- MATERIALS AND METHODS

First, a documentation leaded to collect some more information about this issue and climate parameters (1983-2017) provided by Office national météorologique- Djelfa (ONMD, 2018). It also delivered a few monthly data (2003- 2017) obtained by INRAA (Institute for National Agricultural Research of Djelfa) on the subject of sheep production markets. They were raw data including all categories of the sheep, and CFIF with their prices. In the wilaya of Djelfa, there were 2 pastoral markets visited by the highest number of breeders and consumers, but the volume of the sellers is clearly higher than that of the buyers. Thus, they are the municipalities of Ain El Bel and Djelfa chief town which form our study area (map N°1, appendix N°1).

In the study area, agriculture occupied more than 35 percent of working population and supplied the largest livestock. In 2009, the districts of Djelfa and Ain El Bell respectively contained 2094 and 1259 stockbreeders, and both brought together 25.08% of the production in the area estimated at 2.5 million heads according to ONS (2013).

Then, a survey allowed to collect the complementary data among the participants in the pastoral market practices and realities, because

belonging to the 2 pastoralist districts notable for high level of informal activity (not in accord with the usual regulations and elementary data). It was carried out over eight months from May 2017 to December 2017 on basis of half-open questionnaire. Looking at our 2 previous assumptions, these economic agents necessarily behaved rationally under real conditions so as to maximize their own self-interests in these APM with homogenous produces, there were no agreements to collude, any barriers to entry and all of producers and consumers had the complete information about existing options. Markets took place on every Sunday at Ain Roumia and every Monday at that of Djelfa. In fact, the survey focused on the main economic operators in the local APM.

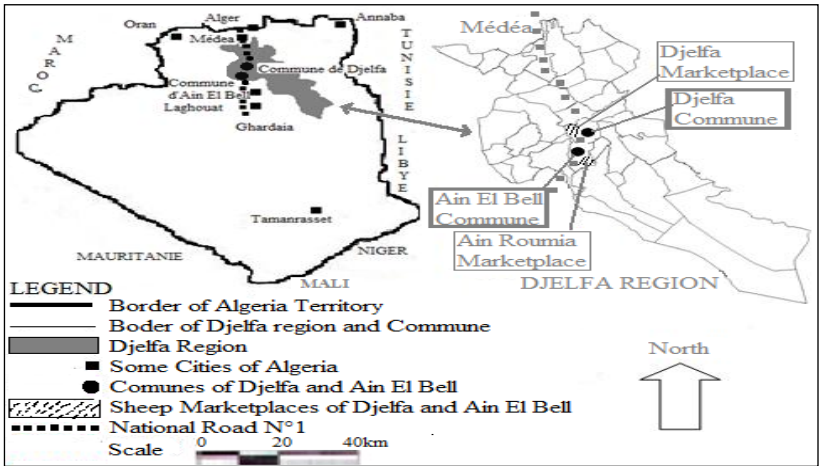
The preliminary survey was about stockbreeders, CFIF sellers and buyers to determine several problems which affect them and know their future prospects. It also asked the opinions of veterinarians and senior managers of INRAA and Administration of the agricultural services. Because they had to deal almost daily with data gathering, manipulation or management. This meant that we had a wide range of ideas on the studied subject and made possible a readjustment of the final survey questionnaire (appendix N°2).

As far as sampling methodology was concerned, random-sampling method was chosen, but with a wide sample size. Indeed, it contained 900 surveyed individuals (450 in each APM); this was 30 percent of general average of the breeding farmers was 3000 that often supplied their produces. This enforced the attention to this representative sample of socio-economic diversity, stockbreeder logics (flock mobility and size, CFIF practice) and state intervention; while uncertainties and complexity persisted, what they meant and how they could be efficient (Tuner & Schlecht, 2019; Davies et al., 2018).

In other words, from the survey, it was to explain the livestock enterprises' strategies towards the sheep price instability and change in feed costs according to the seasons and their ideas about the supreme authority interventions. It allowed determining the number of the sellers, which very often put their sheep on each APM and identifying pastoralism system in practice, flock control strategies,

access to forages, water, tariffs of hiring, flock vaccination and destocking, purchase of CFIF). And then, there were the remaining factors of production (specific and structural costs) and animal trade. It then allowed finding the most representative categories of sheep in the APM, trough the seasons and most homogenous in point of view of weigh, quality, and price. In the field, research work faced the greatest difficulty; in particular, time devoted to each survey individual exceeded 30 minutes, refusal to be inquired by several pastoral market participants and distance between the 2 APM. Thus, the research chose, for the demonstration, the categories of sheep and of CFIF in frequent usage, which were codified later.

Map 1. **Study area and weekly markets (Ain Roumia and Djelfa)**



Source: Map adapted of those of Atchemdi (2008)

1.1- Choice of the method of price volatility measurement

Temporal adjusted series of long-term were often used to measure price instability. Several indicators exist; one of the most used is the coefficient of variation (CV) (Atchemdi, 2008). Its pertinence nevertheless is controversial by several specialists who consider that small fluctuations around average price are not important. For them, only extreme values which price can take for a rise or decrease are significant (Galtier, 2009). Today, the majority of authors refer to price

volatility measurement which takes into account experience of producers themselves, enabling them to accurately predict the future of APM or certain forces and upward or downward trend of the pastoralist-markets prices (price determination (Piot-Lepetit & M'Barek, 2011).

For this part, the whole materials (climatic data, quantity, and market price of sheep and CFIF) made it possible to measure the price instability, then follow its impact on the participants in the flock markets. It was about the maximum, minimum, average and standard deviation (σ), CV and different variables (appendix N°3 and N°4).We accurately had to deal with statistics (after data gathering and handling or some data manipulation); tools of making sense of our both quantitative and qualitative data in different forms: data analysis (average value, proportion, variance). Working in the 2 space unities of large equal sizes, forming the study area, lead to avoid sampling risk or structural correlations skewing results (Guerrien, 2003).

In addition, the collected data from representative sample of a population, sheep and CFIF prices and climatic factors were raw data. In that case we operated some data manipulation before applying Empirical Orthogonal Functions (EOF) and statistical analysis with 'Statistica Model' in order to evaluate the phenomenon, discuss and interpret the findings.

This means the use of a linear function to simplify the original data set and eliminate the redundant information in order to make easy analysis in a simple way, with few disadvantages. Indeed, the appropriate use of EOF method is empirically determined from the survey and time series (Navarra & Simoncini, 2010).

1.1.1. Empirical Orthogonal Functions analysis direction

The EOF was a method which allows to project observations since space with p dimensions of p variables over the space with K dimensions (k<p) such as a maximum of information is preserved (measured here by global variance of scatter chart) on the first dimensions. If information associated with the 2 or 3 factors (major axis) represented a sufficient percentage of the global variability of

scatter chart, it will be able to represent the observations in a figure with 2 or 3 dimensions. This could efficiently ease use of statistical method, reduce, and interpret these large datasets. It uses a variance indicating a degree of similarity between the homogeneous individuals and variables to calculate matrices allowing the projection of the data upon new surface statistically orthogonal (Navarra & Simoncini, 2010; Guerrien, 2003). The EOF has been executed with software Statistica 6, which contains several techniques.

i)- Data coding

Their coding was done as following.

- Months: first 3 letters, then year (example: Jan 03 (January of 2003).
- Categories of sheep, prices (DA) (100DA, Dinar Algérien=1.01 euro).

* L: lamb	E.g: ewe in gestation	Et.g: ewe teg in gestation.
* Tg: teg	E.l: ewe with lambs	Et.l: ewe teg with lambs
* R: ram	O.e: old ewe	S.s: supply for sheep
* Em.e: empty ewe.		Em.et: empty ewe teg

- Categories of concentrated feed, with their prices (DA)

* B: Barley * Cw: Common wheat.

- Climatic parameters

* P: precipitation (mm) * T: temperature (°C).Cw:

In addition, methodology was based on an applied microeconomics, especially market-driven approach where producer struggle against the real complexity and uncertainty previously clarified. This drived also as the consequences from the real conditions under which the participants behaved face the fundamental forces of the APM. First, tested results will be exposed. Then they will be discussed in order to test the 2 assumptions of agonist-pastoral market with the nature and source of price instability.

2- RESULTS

2.1- Descriptive results from sampled pastoralists

An average age of the respondents was 45 years old, with a minimum of 25 and maximum of 76 years old. Among the sampling farmers, the majority of the participants were illiterates and 10 percent of them reached university level. Main activity in the area was obviously the breeding practice with or without fattening; the sheep dealing practice was the connected activity under development. The transactions were generally carried out between sheep dealers and stockbreeders, but 65 percent of the respondents have been dealers and pastoralists.

2.1.1. Pastoralism and pasture

Table n°1 gave details of the variables used in the data analysis and showed that a pastoralism can be associated with 3 kinds of pastoral systems and 3 scale farms. They fully used different preventive strategies relying more or less on central government pastoral economy mechanisms before competing together for the same clientele in the same APM. The nomad (46.64%) embraced the logics of permanent livestock mobility, this made possible an economic advantage to often avoid areas where demand for pastoral input exceeds regularly supply involving a minimum use of CFIF.

The transhumant based mainly his anti-risks strategies on the seasonal travel movement of herds (more predicable) between base locations and open rangelands in the same ecological area and reduced the use of CFIF. In breeding practices, this economic behavior has been declined logically into moving into the search of a maximum safety, obtaining most pastoral resources within the same ecological area or complementary ecological areas, and avoiding damageable consequences related to seasonal variations.

Semi-sedentary farmer (semi-transhumant) used mostly the CFIF and his magnitude of travel parameters is the lowest in comparison with those pastoral systems. But the most interesting logics were that the CFIF use was increasingly important whatever season, while

uncertainties persist, and currently in general use in the 3 pastoral systems according to 93.33% of the respondents.

2.1.2. Herd size management

i) Livestock mobility and access to forage, water, and vaccination practice

In fact, for access to free forage grasslands were belonged to public domains; majority of them have been located in the western part of Algerian steppe, and pre-Saharan areas (southern limit of steppe).

Table 1. Pastoralism and sheep population with preventive strategy

Category		Sheep population according to farmer (f.) Small f.; Medium f.; Large f.			Most strategy (+++) public measure (***)	
Pastoralism system (percent)		≤ 99 heads	100-299 heads	300-1400 heads	Mobility	C. feed
Nomad	46.64	26.66 %	16.66 %	3.33 %	+++ ***	+ *
Transhumant	26.66	0 %	26.66 %	3.33 %	+++ ***	+ *
Semi-transhu.	26.66	6.66 %	16.66 %	0 %	***	+++ ***

Legend: C.feed= Concentrate Feed Input for Flock; +++ or *** (great importance)

Source: Synthesis of descriptive results from sampled pastoralists, 2017

They were preferred by medium and large breeders who had vehicles; transportation costs were compensated by free of charge grazing. Among the sample, 70 percent of the pastoralists practiced pasture rentals for their livestock nutrition.

For these pastoralists, herd movements provided 42.30 percent of additional income over expenses compared to immobility, this one may saw as the benefits of pastoral mobility. Water price fluctuated between 100 and 200 DA/200 liters for farmers (tables N°2). In the two districts, 100 percent of the stockbreeders practiced vaccination of their herds at different periods during a year.

ii) Use of concentrated feed inputs for flock

Use of the CFIF for the respondents did not provided a same utility according to seasonal variations; the beginning of its use deferred from breeder to another (table N°3). Its intra-annual use intervened all long seasons if it was raining or not (appendix N°1).

Table 2. Spatial movements, pasture, and water access (Percent)

Spatial movement		Access to Pasture		Access to water	
Yes	73.34	Free	30	Paying and painful	56.67
No	26.66	Not free	70	Free water (rivers, dams, wells)	43.33
Pasture Price variation in bad season					
Breeder (%)		47		53	100
Price variation (%)		20-40		50-100	20-100

Source: Authors' conceptualization from synthesis of collected data, 2017

Table °3. Categories of concentrated feed for flock used in the areas

Feed ration 870g/day/head	GS (use period)	BS (use period)	Desired result	Shortage periods
Barley	6-9months	12 months	Care+wool+mutton	Winter+autumn+summer
Com. wheat	6-9months	12 months	Care+fat	Winter+ autumn
Bran	6-9months	12 months	Care+milk	Winter+autumn+summer+ spring
Feed importance for breeders %	43.33	93	Essential use	
	6.66	6	Optional use	
	50	0	Moderate use	
Beginning of the use of concentrated feed inputs for flock				
Period		1970	1980	1990
Responders		30.76%	26.92%	42.30%

Source: Collected data from survey of 900 households carried out in the study area, 2017

Generally, daily ration for each animal increased by 45% during years. It depended extremely on desired result: the main objective was to obtain an extra competitive sheep.CFIF scarcity (equivalating to a cycle of the highest demand) occurred in 2 distinct seasons especially in winter where the barley, common wheat, and their bran were scare.

There was only one local agency (Algerian inter-professional office of the cereals (OAIC) that enforced national CFIF policy (table N°4). The prices of the feed goods and sheep extremely disturbed the livestock breeders. For 80% of the producers, livestock nutrition of high quality was without dust and debris, while 20% sought grain of huge volume.

iii) Recapitalizing, destocking animals and trade

This phenomenon was largely widespread in the area and consisted in economic reactions of stockbreeders towards climatic risks and change in prices of CFIF (table 5). During BS, the majority of the producers, who recapitalized or kept stable animal population,

were medium and large stockbreeders, because they had the financial resources to overcome the harmful effects of the risks.

For undesirable damages caused by climatic parameters, lambs were more sensitive during the season marked by a rainfall deficit, that could also explain their proportion in the sheep population. It was noted that the herd composition, in terms of the sex and age, remained almost the same, for all farmers, whatever the climatic risks.

Table 4. Source of sold concentrated feed and purchase places

Purchase places of concentrated feed by stockbreeders (%)		Origin of sold Concentrated feed (%)		High consumption period (%)	
Informal market (Inf mark)	48.27	Mills	33.33	Autumn	20
Algerian interprofessional office of cereals (OAIC)	3.44	Farmers	6.67	Winter	16.67
OAIC + Market	27.58	Importers	33.33	Summer	6.67
OAIC+Market+Inf mark)	10.34	OAIC	26.67	Winter+autu	56.70
Formal market	3.44	Period of high price (%)			
OAIC+Market	3.44	Religious holidays		Autumn	Winter
Informal market+Market	3.44	10		35	55

Source: Results from 900 sampled pastoralists in the 2 local agricultural produce markets, 2017.

Table 5. Animal size manipulation, calendar of high and low prices

Calendar of high and low prices of categories of sheep													
Category	Average Age	Month											
		Jan	Fev	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ewe	≥2 years	◆	◆	◆	◆	□	□	□	□	◆	◆	◆	◆
Lamb	≤1 year	□	□	□	□	□	□	◆	◆	□	□	□	□
Teg	≥1 year	◆	◆	◆	◆	□	□	□	□	◆	◆	◆	◆
Ram	3 years	□	□	□	□	□	◆	◆	◆	□	□	□	□

Animals stocking and destocking (%) by farmers			
	Stocking	Destocking	Stable
Good season	32.14	00	67.85
Bad season	00	85.74	14.28

Legend: High ◆ Low □

Source: Authors' conceptualization from synthesis of collected data, 2017

Lambs were the first category touched by the BS for the pastoralism (56.69 percent), followed by tegs (54.21 percent), but rams, then ewe were saved, because they were the living fixed assets. According to all of the livestock growers, uncertainties persisted in the

local APM through the seasons as well as religious holidays, despite their selfish and rational behavior, combined with the pastoralism policy of the state, to get the best result (tables N°5 and N°6) ; others were entry fee in the markets (tax, 60 DA/head) and handling costs.

2.1.3. Others economic factors of production

In short run, we know that all the factors of production, even in agriculture, are not variable, we therefore distinguished the variables costs that were (seed, fertilizers (forage production), veterinary fees, natural forage, CFIF, wages, transportation, medication, water) and structural costs (sale force, network operating cost, advertising budget, land cost, material, sheds, repair and maintenance). They were not at the same levels for the three pastoral systems and, especially variable according to the GS or the BS (table N°6).

2.2- State anti-volatility instruments

Respondents (85 percent) might not influenced by central administration policy of support to behave rationally. They aren't interested in credit or subsidized credit, and technical assistance which would not operate in APM dominated by the informal operators with strong family solidarity (60%) who observed (90%) a prohibition of interest-bearing loans for religious reasons.

Table n°6. Production costs of sheep categories and average profit

Contains		GS[1]	BS[1]	Variation[2] (%)
Unit cost (DA)	Concentrated Feed	40.75	49.75	18.09
	Water	3.01	3.12	3.52
	Hired pasture	19.26	20.40	5.31
	Medication	4.06	2.30	-76.52
	Transportion	9.27	10.1	8.22
	Salaried worker	21.30	13.10	-62.59
	Various expenses	2.35	1.23	-91.05
Sales unit cost (DA)	Ewe	11450.99	9524	-20.23
	Lamb	7137	5732	-24.51
	Ram	21644	14445	-49.84
	Teg (E)	14497	11287	-28.44
Unit sale Price (DA)	Ewe	18365	11327	-62.13
	Lamb	13077	8404	-55.60
	Ram	31604	21783	-45.08

	Teg (E)	22065	14630	-50.82
Total cost (variable costs + structural costs) (DA)	Ewe	432.08	382.33	-13.01
	Lamb	480.52	446.60	-7.59
	Ram	419.69	1135.46	63.04
	Teg (E)	281.92	394.54	28.54
Average unit profit (DA)	Ewe	533.75	472.29	-13.01
	Lamb	605.94	551.69	-9.84
	Ram	518.44	1402.62	63.04
	Teg (E)	348.25	487.37	28.54

[1]Good season; Bad season; [2](BS-GS)/BS*100

In principle, this State intervention may seek to encourage the 98 percent of the farmers to leave the informal environment, but it appears as much a failure. According to the market logics, subsidized water did not have the same importance for each pastoralism system. They often have not gained the subsidized agricultural water because of its scarcity or geographical distribution. Indigenous knowledge was sometimes used against animal pathologies, therefore veterinary expenses increased in BS.

2.3- EOF and statistical analysis indicating price volatility

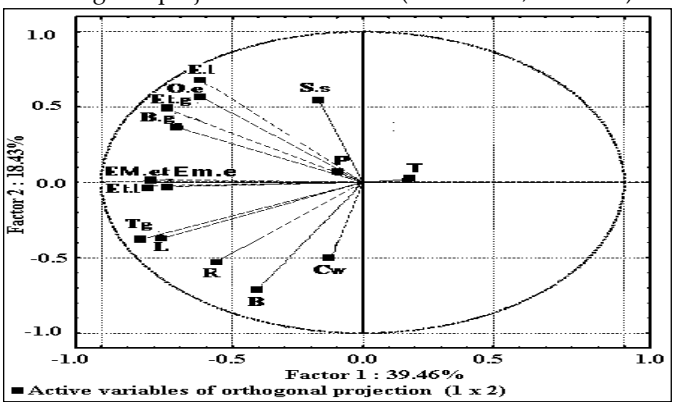
2.3.1. Choice of characteristic value

In the matrix of correlation and variance, the characteristics of the values were calculated on the basis of the combinations between variables and individuals; each appropriate value corresponded to the principal factors 1 and 2 (figure N°2). They represented the first factorial plane; it was the maximum choice of the reference formed by the variances of the two markets extracted from their values (6.32 and 2.95) and cumulated variances: 57.89 percent. By a linear coefficient of correlation of Pearson (r), the correlations between the variables of the EOF were divided into 3 batches according to their link with the values -1 and +1:

- Average positive r established between the barley and several categories of animals, for example, with the lamb (r=0.45), teg (r=0.49) and lamb with common wheat r=0.32.

- Other low positive linear value: between the rainfall and majority of the categories of sheep in the two markets, for instance, pluviometry and teg r=0.05.
  Finally, the last batch was constituted by variables weakly and negatively correlated: generally, the temperature with lamb r= -0.07 and teg r= -0.17.

Figure °1. Orthogonal projection of variables (correlation, variance)



Source: Authors' Calculations from survey of 900 households carried out the 2 local markets

3- DISCUSSON

3.1- Effects of the climatic parameters on the price instability

In the 2 APM, the links between the sheep and climate showed that the animal prices changed, but climatic factors notably rainfall was the only that changed very much with an upward trend of dry seasons and arid climate. Their monthly CV are about 30% and oscillating extremes more than 100% compared to the average (ONMD, 2018). From 2003 to 2017, irregular BS affected many years with cold winter, persistent frosts, hot and dry summer (figure N°2; appendix N°2; 3; 4). A classical saying in climate change is that there is a lot of chaotic dryness years and climatologically criterion which is the frequency episodes with 3 consecutive months of lower precipitations than 50 percent vis-a-vis the normal (Belkhiri et al., 2015; Garnett, 2012). Today, the clear and convincing facts show that the climatic factors of

short-term do not strongly govern the prices of the several categories of sheep; these results confirm those of Atchemdi (2008).

3.2- Effects of central administration measures on price instability

For these APM with large amount of competition, the health rules were defined against epizooties (scab) to avoid public health problems and sanitary effect on the herds. Mortality rate was still important among sheep population (average of 22.66%) and can reach 43.29% in BS; it influenced less strongly supply variation and consequently the price. These free APM were widely traditional for long time. Hence, the 3 categories of state measures were also unfavorable to price stability, in comparison with the tables N° 2; 3; 4 and figure N°2.

However, the results ascertained that the activity is profitable and resilient. The average unit profits were 5940 to 7568 DA in GS and 1803 to 7338 DA (BS), with profit margin for the producer from 31.51 to 45.42 percent (GS) and from 15.92 to 36.69 percent (BS). In reality, in the same year and trough 1 or 2 production cycles of sheep the prices volatility and average profit levels were not the same for pastoralists (Belkhiri et al., 2015). The market operators' statements mentioned at times the fraudulent export of sheep towards the neighboring countries (Tunisia, Morocco) and the red meat import were in small quantities that had no effects on the domestic markets.

Thorough facts showed that CFIF did as much not strongly determine the prices of different categories of sheep. Hard evidences (our findings) showed also that precautionary rules did not prevent the unstable markets to occur; there were not efficient. As far as the three instruments of national policy showed how undesirable results (price volatility) can arise, so they were not efficient too. However, it is the policy imposed by budget-minded finance and agriculture ministers, and the powerful sociopolitical desire for price stability as the direct sign of society's degree of food security. Indeed, supply shocks and demand shocks, in particular income shocks might also transmit into price variability (Krugman & Wells, 2013; Piot-Lepetit & M'Barek, 2011).

It was possible that in these real markets, the agents behaved rationally so as to maximize their own self-interest through the

seasons but could likewise make the wrong decisions. An insufficiently good separation of market driving forces from many others like political logic, natural and bio-events, religious holiday simplied inextricable complexity. Managing uncertainty coupled with complexity, which intervened basically in endogenous, well-functioning APM more than others, was exceedingly difficult. It seemed that systematic expectation mistakes were not made as an adaptive one. They alike went beyond rational expectation as long as the over-optimistic or over-pessimistic mistakes were haphazardly distributed but did not be in equilibrium to the total number of expectations. Whatever by default or excess, the fraction (80% among markets participants) of experiments in which this given rational expectation occurs was very high compared to the total number of expectations so that the probability was often higher for one or the other, this leading to the permanent instability. Submitted to these two constraints, pastoralists made the wrong decisions and adopted not similar economic behavior, but gregarious rational behavior which contributing to the execution of the permanent price disequilibrium. This strengthened the two supplementary assumptions based on the agricultural agonist market approach; supply and demand were the fundamental forces at the back of the production, pricing, and consumption of produces and services, here based on the agonist rational expectation of the APM agents and were series of the pastoralist's actions. Because economics is roughly speaking science of behavior of individual human beings and firms and relating to positive law (Krugman & Wells, 2013; Clément, 2006).

Data of 15 years and their analysis with EOF and statistical methods were the clear and convincing facts to prove it, even if it would suggest more in other situation or the results of EOF can be sensitive to given periodicity and context (Navarra & Simoncini, 2010;Guerrien, 2003). With the state policy tool, the 3 pastoral systems based their rational behavior on the use of CFIF and destocking-recapitalizing, either this last or mobility, but all were sometimes compatible at all these points. However, they did not prevent the risks whom levels were variable from production cycle to another

according to their source and amplitude as calamities related with price volatility (Baritaux et al., 2016; Belkhiri et al., 2015).

In this context, according to Davies et al. (2018) and Leloup & de Haan (2006), trends in pastoral mobility are belonged to two most categories of determinants associated with the persistent complex uncertainties in the local APM across the seasons. The first were settlement of pastoralists (spontaneous settlement due usually to long droughts and several calamites, sometimes supreme authority promoted settlement for intensifying processing and commercializing animal production) (Benadjila, 2017; Benfrid, 1986). Abidi et al. (2013) find that transhumant and nomad are respectively now 29.57 and 17.39% of the rural area of their study; likewise, in 2008, the nomad represents 4.48% among the 1204134 inhabitants in the entire region. The second were reduced mobility of pastoralists.

In short, the underlay causes of the change in pastoral mobility were population growth, erroneous public policies (wrong fit between administrative and ecological units, weak representation at the national level, inadequate land use policies and legislation, biased incentive policies, maximum administrative and bureaucratic input), inadequate and poorly focused research and narrowly focused pastoral development (Davies et al., 2018; Benadjila, 2017; Leloup & de Haan, 2006).

All these strategies were indeed exogenous factors, that did not actually have strong impact on well-operating local APM. Today, many observers recognize that the adequate tools must refer to the sources and attributes of the endogenous risk of the APM (Atchemdi, 2008; Varangis et al., 2002). This consolidated our approach.

Here uncertainty sense was not related to the familiar term of risk, from which it was never been properly separated. Thus, uncertainty led to a marketplace where several possible outcomes were associated with series of coordinated actions linked to the agonist rational expectation, but the assignment of probability to the different outcomes (Piot-Lepetit & M'Barek, 2011). Uncertainty associated to complexity entailed more risks when they were large and could not be predicted and, consequently, implied a highly amplitude of the

changes in the price of the produce; that reduced the effective efforts (pastoralists, state) to understand, manage, and protect what one might see as the resulted benefits. Price trends, such as multifaceted problems, that was not attributed to the *market fundamental forces are also problematic, as they can lead to incorrect decisions* (Westhoff, 2010).

Flexibility unfortunately was not inherent to the crop and rearing, which were alive fixed assets beneath natural conditions. Indeed, in terms of production cycle it took 6 to 9 months to put ram in APM, and in terms of supply, it was not very reactant to price: breeders could only supply which they farmed during the production cycle. Alive flock storing because of low price was almost impossible: it was awfully expensive (feeding, care, ageing, death, eventually due interest) and extremely limited in time (few days to some weeks).

In terms of consumption elasticity-price of demand is rigid: food been essential (incompressible and inextensible), price elasticity is weak (Varangis et al., 2002). But there is also the possibility of deferring sheep or meat demand (luxury good), new composition in shopping basket and if there was change in taste (preferences), there was usually a change in demand too; price changes on other goods like complementary goods and substitute goods (white meat, reduction in meat-based ration). In other words, *consumption varies because of change in incomes, changes in prices of substitutes and shifts in tastes*(Krugman & Wells, 2013). Sheep consumer in these cases does not act instinctively. Since he has ability to give to each satisfaction level "monetary equivalent" and take decision (choice and quantity) in comparison with both, his behavior can change when monetary equivalent and satisfaction are modified (Piot-Lepetit & M'Barek, 2011). Decision to produce is related to APM conditions in moment and ability to accurately predict future of the costs of different produces, notably prices covering production costs by perpetuating activity. Doubt subsisted however about prices and final produced quantities, as result, one must consider forecasting mistakes in making decision by breeders (Galtier, 2009).

Uncertainty and complexity troubled pastoralist behavior, it was choice under complex uncertainty, leading him toagonist rational

expectation in order to maximize its profit. For example, 85% of the livestock enterprise have made their choices for anticipating sheep selling before possible BS in order to reduce nutrition fees without knowing what the outcomes would be. Their clients also, from experience adopted opposite behavior. *Most of the time, producers and consumers could not be certain about which consequences their actions to sell or buy will have, even though they maybe knew which consequence they will probably have* (Krugman & Wells, 2013; Piot-Lepetit & M'Barek, 2011).

CONCLUSIONS

State intervention and pastoralists' strategies for struggling against price volatility become problem and not solution for 2 reasons. First, they are not efficient and not sufficiently based on the endogenous-functioning APM marked by uncertainty, complexity, forecasting mistakes and gregarious rational economic behavior. Then, there is collective inability to face that challenge, which is harder and harder to bring under control, more and more increased and unpredictable. Explanations already show evidence breakup of economist reflections around 2 paradigms: the exogenous model of volatility and endogenous theory of instability stressing inagonist rational expectation.

The study proves vigorously that APM participants create series of the coordinated actions that go in the same direction (incessant drop and rise) or contribute to execution of permanent movement (especially extreme) of prices. During several production cycles of GS and BS, the volatility is related to the same agonist rational phenomena, with their intensity and hazardous combinations. In fact, within the same year and through 1 or 2 production cycles, the price instability and unit profits levels would not be the same for the breeders. Findings suggest resolution pass necessarily through structural understanding changes (assumptions harmonization, new tools for price stability) to achieve the efficiency. Their implications for households are improved measures based on the market fundamental forces for struggling efficiently against price volatility, preventing its destructive outcomes.

Thus, several actors must do more to help ensure long-term sheep price stability. In this respect, the role of policy as tool must be in accordance with adjusting the supply sheep as closely as possible to demand, by yield-enhancing investments and improving market transparency. That requires also from policy makers an alternative means to reinforce the capacity of both producers and consumers to cope with price instability. Therefore, researchers may undertake several studies on these recommendations in order to ensure such measures will be effective in achieving their goals. Another field is to investigate the relationships between trends in income and sheep price, which could drive excessive volatility and hurt households in local place (resilience, food security, or other basic needs). Additional requirements, that may enhance APM stability, must provide stronger evidence on the intensified linkages, and explore the role of fraudulent cross-borders speculation.

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Appendix n°1

Appendix 1.1. Good or bad season and temperature (°C) in the 2 communes

Precipitation													
Good season, Rainfall level >291.1mm/year		1986		1990	1991	2004	2008	2009		2010	2011		
Bad season, Rainfall level < 291.1mm/year		1983		1984	2000	2001	2005	2006		2012	2013-2017		
Temperature													
Area	Month	Jan.	Fe	Mar	Ap.	May	Jun.	Jul.	Aug	Sept	Oct.	Nov.	Dec.
Djelfa	m	00	01	03	6	10	15	19	18	14	10	04	01
	M	09	11	16	18	23	30	34	33	26	21	14	10
	M+m/2	04	06	10	12	17	23	27	25	20	16	09	06
Ain-El Bell	m	01	02	05	7	12	16	20	19	15	11	05	03
	M	12	14	18	21	26	32	37	35	29	24	16	12
	M+m/2	06	08	11	14	19	24	28	27	22	18	11	08
	N F	15	09	04	01	00	00	00	00	00	00	04	10

Source. Synthesis data of Office national météorologique- Djelfa (ONMD), 2018

Appendix 1.2. Animal and feed prices: Unite= DA

Year		Sheep price						Feed price (Common wheat = CW)				
		Jan-Mar	Apr-Jun	Jul-Oct	Nov-Dec	Ave-rage		Jan-Mar	Apr-Jun	Jul-Oct	Nov-Dec	Ave-rage
2003	Lamb	9523	10358	11100	11536	10629	CW	1572	1418	1407	1402	1450
	Teg	14227	12891	12700	13833	13413	Barley	1263	1270	1624	1480	1409
	Ram	21959	21708	21153	20916	21434						
	Ewe	10801	9958	12192	12408	11340						
2004	Lamb	10366	10491	9505	11000	10340	CW	1560	1442	1402	1388	1448
	Teg	16200	15633	16233	16150	16054	Barley	1484	1415	1400	1470	1442
	Ram	21888	23333	21611	21738	22142						
	Ewe	14244	13788	14922	13300	14063						
2005	Lamb	11758	10369	9691	10908	10681	CW	1585	1433	1400	1415	1458
	Teg	16150	14430	13500	13125	14301	Barley	1789	1703	1700	1717	1727
	Ram	24916	22423	21483	22000	22705						
	Ewe	14316	13576	12575	12625	13273						
2006	Lamb	11411	10383	10788	9550	10533	CW	1286	1083	1243	2747	1590
	Teg	14011	11933	12122	12050	12529	Barley	1595	1488	1503	1560	1536
	Ram	21422	21288	22244	21250	21551						
	Ewe	13366	11750	10622	9825	11390						
2007	Lamb	9600	8811	9511	9388	9327	CW	1572	1297	1238	1314	1355
	Teg	142277	11789	10711	11300	12006	Barley	1354	1192	1211	1365	1280
	Ram	21959	22144	22000	19200	21331						
	Ewe	10801	10866	11700	10022	10847						
2008	Lamb	11411	10383	10788	9544	10531	CW	1397	1083	1243	1358	1270

	Teg	14011	11933	12122	14666	13183	Barley	1595	1488	1503	1570	1539
	Ram	21422	21288	22244	24222	22294						
	Ewe	13366	11750	10622	9822	11390						
2009	Lamb	11527	10444	9511	9444	10231	CW	1394	1100	1238	1315	1262
	Teg	14266	14177	12388	11388	13055	Barley	1611	1495	1500	1726	1583
	Ram	21955	22100	22000	19133	21297						
	Ewe	11838	11934	11700	10088	11390						
2010	Lamb	13755	13922	13644	13722	13761	CW	1694	1700	1700	1700	1698
	Teg	18887	19077	19511	19722	19299	Barley	1800	1822	1688	1755	1766
	Ram	29875	29222	31555	33444	31024						
	Ewe	17300	16933	17455	17477	17291						
2011	Lamb	12742	12909	12632	12710	12748	CW	2185	2193	2193	2193	2191
	Teg	13242	13432	13866	14077	13654	Barley	2371	2405	2229	2317	2330
	Ram	27714	27060	28694	30583	28513						
	Ewe	10885	10519	11041	11041	10871						
2012	Lamb	12642	12809	12652	12770	12718	CW	2180	2190	2190	2190	2187
	Teg	13342	13432	13866	14077	13679	Barley	2370	2400	2200	2319	2322
	Ram	27784	27160	28674	30563	28545						
	Ewe	10985	10619	11001	11061	10916						
2013	Lamb	21744	21006	21761	19793	21076	CW	3700	3500	3700	3280	3545
	Teg	22948	22028	23849	21819	22661	Barley	4000	3840	3780	3470	3772
	Ram	47788	44524	49319	47372	47250						
	Ewe	18722	17415	18921	17144	18050						
2014	Lamb	24353	23526	25677	20980	23634	CW	4070	3850	4070	3470	3865
	Teg	25701	58936	28141	23128	33976	Barley	4400	4200	4150	3670	4105

	Ram	53522	49866	58196	50214	52949						
	Ewe	20968	19504	22326	18172	20242						
2015	Lamb	25814	24937	28501	20969	25055	CW	3400	3855	4075	3470	3700
	Teg	24324	23349	31236	23228	24534	Barley	4400	4450	4155	3670	4169
	Ram	56733	52857	64597	50114	56075						
	Ewe	19845	20674	24781	18183	28870						
2016	Lamb	23748	21196	44928	30070	29985	CW	3128	3270	3580	2610	3147
	Teg	22378	19812	26550	23327	23016	Barley	4040	3780	3650	2789	3565
	Ram	52194	48628	54907	50010	51434						
	Ewe	18257	19020	21063	18287	19157						
2017	Lamb	23650	22196	44828	30105	30195	CW	3000	3070	3500	2615	3046
	Teg	22400	19912	26500	23358	23042	Barley	4000	3600	3605	2790	3499
	Ram	53294	49628	55000	50100	52005						
	Ewe	18297	19120	21043	18297	19189						

Source: Synthesis of collected data, 2017

Appendix 1.3. Price, standard deviation, coefficient of variation (CV) of 2 markets

Djelfa	Active N	Average	Minimum	Maximum	Standard deviation	CV (%)	
L	101	11720,76	9200,00	15800,00	1806,64	15,41	
Tg	101	14695,45	10500,00	22366,67	3126,04	21,27	
R	101	23769,70	15533,33	44333,33	5301,93	22,31	
Em.e	101	12533,60	1416,67	17933,33	2855,05	22,78	
E.g	101	14759,57	12333,33	20000,00	1782,24	12,08	
E.l	101	17004,82	9433,33	22333,33	2926,61	17,21	
O.e	101	12478,10	8066,67	21266,67	2417,88	19,38	
Em.et	101	12310,20	7753,33	17966,67	2575,46	20,92	
Et.g	101	13335,97	10500,00	17800,00	1807,75	13,56	
Et.l	101	15063,17	11133,33	24000,00	3033,47	20,14	
S.s	101	7296,04	3433,33	30600,00	3588,60	49,19	
B	101	1690,81	1186,67	2866,67	354,55	20,97	
Cw	101	1545,84	833,33	8766,67	776,43	50,23	
P	101	26,85	0,00	97,40	21,32	79,40	
T	101	14,72	2,75	28,90	7,80	53,00	
Ain Roumia	Active N	Average	Minimum	Maxim.	Stand. d.	CV (%)	CV 2 markets
L	101	10877,16	7286,67	14000,00	1434,54	13,19	14.3
Tg	101	14060,30	10633,33	21333,33	2581,97	18,36	19.81
R	101	23133,20	11550,00	40333,33	3780,25	16,34	19.32
Em.e	101	12685,24	8787,50	17633,33	2328,98	18,36	20.57
E.g	101	14653,77	9973,33	20000,00	2273,36	15,51	13.79
E.l	101	17237,13	9600,00	22666,67	2776,84	16,11	16.66
O.e	101	12375,20	8100,00	17533,33	2232,36	18,04	18.71
Em.et	101	11902,95	7725,00	28992,50	2883,16	24,22	22.57
Et.g	101	13301,29	10400,00	18733,33	1837,27	13,81	13.68
Et.l	101	14661,80	9130,00	20666,67	2888,83	19,70	19.92

S.s	101	6659,89	3100,00	12666,67	2572,25	38,62	43.90
O	101	1568,79	800,00	2403,33	265,47	16,92	18.94
Cw	101	1633,95	933,33	9300,00	1084,32	66,36	58.29
P	101	23,97	0,00	89,03	19,17	79,96	79.67
T	101	16,58	4,64	30,44	7,71	46,52	49.76

Source. Collected data analysis results 2017

Appendix 1.4. Correlations between variables of 2 marketplaces of Djelfa region

	L	Tg	R	Em.e	E.g	E.l	O.e	Em.et	Et.g	Et.l	S.s	O	Bl	P	T
L	1,0	0,85	0,63	0,49	0,39	0,18	0,22	0,68	0,33	0,63	-0,03	0,45	0,32	-0,00	-0,07
Tg	0,85	1,00	0,72	0,51	0,36	0,21	0,30	0,72	0,38	0,80	0,01	0,49	0,24	0,00	-0,17
R	0,63	0,72	1,00	0,39	0,18	-0,02	-0,02	0,43	0,11	0,53	-0,24	0,39	0,10	0,02	0,10
Em.e	0,49	0,51	0,39	1,00	0,60	0,48	0,28	0,49	0,66	0,42	-0,00	0,27	0,20	-0,04	-0,07
E.g	0,39	0,36	0,18	0,60	1,00	0,64	0,70	0,36	0,77	0,42	0,15	0,05	0,02	0,13	-0,00
E.l	0,18	0,21	-0,02	0,48	0,64	1,00	0,72	0,51	0,75	0,50	0,38	-0,19	-0,26	0,07	-0,03
O.e	0,22	0,30	-0,02	0,28	0,70	0,72	1,00	0,45	0,77	0,51	0,39	-0,05	-0,18	0,14	-0,14
Em.et	0,68	0,72	0,43	0,49	0,36	0,51	0,45	1,00	0,45	0,78	0,13	0,33	-0,01	0,10	-0,07
Et.g	0,33	0,38	0,11	0,66	0,77	0,75	0,77	0,45	1,00	0,47	0,34	-0,02	0,00	0,02	-0,12
Et.l	0,63	0,80	0,53	0,42	0,42	0,50	0,51	0,78	0,47	1,00	0,10	0,21	-0,10	-0,03	-0,10
S.s	-0,03	0,01	-0,24	-0,00	0,15	0,38	0,39	0,13	0,34	0,10	1,00	-0,21	-0,13	0,08	-0,31
O	0,45	0,49	0,39	0,27	0,05	-0,19	-0,05	0,33	-0,02	0,21	-0,21	1,00	0,37	0,12	-0,21
Cw	0,32	0,24	0,10	0,20	0,02	-0,26	-0,18	-0,01	0,00	-0,10	-0,13	0,37	1,00	-0,07	-0,11
P	-0,00	0,00	0,02	-0,04	0,13	0,07	0,14	0,10	0,02	-0,03	0,08	0,12	-0,07	1,00	-0,18
T	-0,07	-0,17	0,10	-0,07	-0,00	-0,03	-0,14	-0,07	-0,12	-0,10	-0,31	-0,21	-0,11	-0,18	1,00

Source: Results of data description, 2017

Appendix 2. Main survey questionnaires in the two municipalities

Part 1. Sheep number and breeding practices

Breeding system and sheep number in the two districts

Breeding system	SSF*	MSF**	LSF***
Nomadic			
Transhumant			
Semi-sedentary			

*Small-scale farmer (SSF) **Medium-scale farmer (MSF) ***Large-scale farmer (LSF)

Part 2. Breeding practices

Race of sheep population

Race	Sex	%	Resistance to dryness	Resistance to spatial mobility	Very cheap	Very ex-pensive	Market demand
Rembi							
Ouled d.							
Taadmit							

Breeding system and importance of risk measures

Breeding system	In 2 disticts	Percent
Nomadic		
Transhumant		
Semi-sedentary		
Others		

- Herd size management; Good season (GS); Bad season (BS); Factors of herd size management

Production cost (DA; Case of GS / Case of BS

Catégoriy	Ewe	Lamb	Teg	Ram	Others	Total
Cost/ unit						
Coût/ 3 units						
Coût/ 8 units						
% Variation with number						

- Question about agricultural soil; Irrigated forage / Pasture hiring for their sheep

Production cost

Cost (DA)	Feed	Water	Land hiring	Drugs	Transportation	Tax	Income	Others	Total
GS									
%									
BS									
%									

Spatial migration, pasture, and water access (Percent)

Spatial movement	Access to pasture	Access to water
Yes	Free	Paying and painful
No	Not free	Free water (rivers, dams, wells)

Price variation in bad season	
Breeder	
Price variation	

Sale price (animal) (DA)/ Case of GS and Case of BS

Category	Average Age Market price	Sale price	Average profit /production cost	(by	Market demand	Total
Ewe						
Lamb						
Teg						
Ram						

Profit /category of sheep

Category	Average Age	Average profit
Ewe		
Lamb		
Teg		
Ram		

Part 3. Questions concerning Marketing and Commercial action

Calendar price

Category	Average Age	Months From January to December	Normal price	GS price	BS price
Ewe					
Lamb					
Teg					
Ram					

Part 4. Question about use of Concentrated Animal Feed Input (CAFI)

Animal category	Type of feed	Period	Daily feed ration	Reason
Ewe				
Lamb				
Teg				
Ram				

- Evolution of concentrated animal feeding operations; Importance for each breeding system

Breeding system	SSF	MSF	LSF	Interest	Influencing market fundamentals	Profit of credit facilities	Interest prohibition
Nomadic							
Transhumant							
Semi-sedentary							