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Chain analysis for small ruminant production- An overview of the livestock sector and case study in Maghreb

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Abstract

Chain analysis aims at understanding the variability of food supply and increasing opportunities for income generation through increased trade. Chain analysis should propose trade facilitation measures that would contribute to enhanced competition, to better access to the markets for all sheep and goat producers, and to the development of livestock farming systems and product processing through an increased value added on meat and dairy products of sheep and goats in the region.

Firstly, this paper proposes a desk review of the importance of Small Ruminants (SR) activities in terms of stocks, production, trade and consumption. This desk review shows the particular place of SR production in the region due to agro-climatic conditions (preponderance of arid zones) but also the socio-cultural factors (that condition a high demand). However the trade data (except in Saudi Arabia) don't reflect the dynamic of market in the region and then the constraints and opportunities for the SR herders in the region.

In a second step the paper takes up some of the main results of a past project in Maghreb (FEMISE, ICARDA, 2003-2005). In this project, the chain analysis brought out that:

- less than 15% of SR feed is from pastoral origin
- market structure is favouring competition, low margins, efficiency in transmitting market signals, flexibility but investment, innovation, development are very difficult
- low access to urban markets for SR milk and dairy products
- SR meat is no longer a staple food (substituted by poultry) so the majority of the animals (males) are sold alive for religious occasions

Finally some proposals are attempted for research an development of SR activities in the region.

Introduction

The concepts and methods of "chain analysis" have been used since the 1950's in the framework of "industrial economics" in order to explain the strengths and mechanisms of the relation between stake holders involved in producing, processing, and distributing a product or a group of products. For example, Davis and Goldberg (1957) define **"Agribusiness"** as "*... the sum of all operations related to the production and distribution of farm inputs, to the farm production, to storing, to the transformation and distribution of field products and derived products*". It was used to address the ways of guaranteeing fair supply of food to Third World countries, as L. Malassis (1979) when using the concept of **"Agrifood systems"** defined as "*... the set of activities that contribute to the production, processing and distribution of agrifood products, and therefore to the achievement of the human food supply function in a determined society*". Later on, FAO's involvement in improving the whole system, lead to take in account not only economic and technical problems, but also social problems: "**Agrifood systems"** are seen as (1994): "*... the set of socioeconomic relations that*

influence directly on the processes of primary production, agroindustrial transformation, collection, trade and consumption of agrifood products". (FAO, 1994). More recently, chains are considered as elements of socio-economic networks, for example by Sergio G. Lazzarini, Fabio R. Chaddad, Michael L. Cook (2001) : "*…A "netchain" is a set of networks comprised of horizontal ties between firms within a particular industry or group, which are sequentially arranged based on vertical ties between firms in different layers. "Netchain" analysis interprets supply chain and network perspectives on inter-organisational collaboration with particular emphasis on the value creating and coordination mechanism sources*".

In order to address the capacity of sheep and goat farming systems in the NENA region, it is necessary to considerer these systems as producing commodities aimed at being sold, thus the analysis of the chain of these products is used to better understand their sustainability (technical, economical and social).

The first objective of such studies is to understand the strategies of the actors involved in producing, processing, marketing sheep and goat meat and dairy products. These actors have to be observed in the frame of their networks. The second objective is to understand the mechanisms of price elaboration and of value generation along the chains, considering:

- a chain of products (ex store animal – fattened animal – carcass – cut – dish);
- a chain of activities (ex: rearing – fattening – slaughtering – cutting – cooking - enjoying);
- a set of chains: short – medium – long chains;
- a set of actors: farmers, collectors, wholesalers, retailers.

The third objective will be to identify and characterize the constraints to the valorisation of the products.

Firstly, this paper proposes a brief review on sheep and goat sector in the region. In a second step, the paper presents the main results related to a case study on chain analysis of meat production in Maghreb within an ICARDA project (FEMISE).

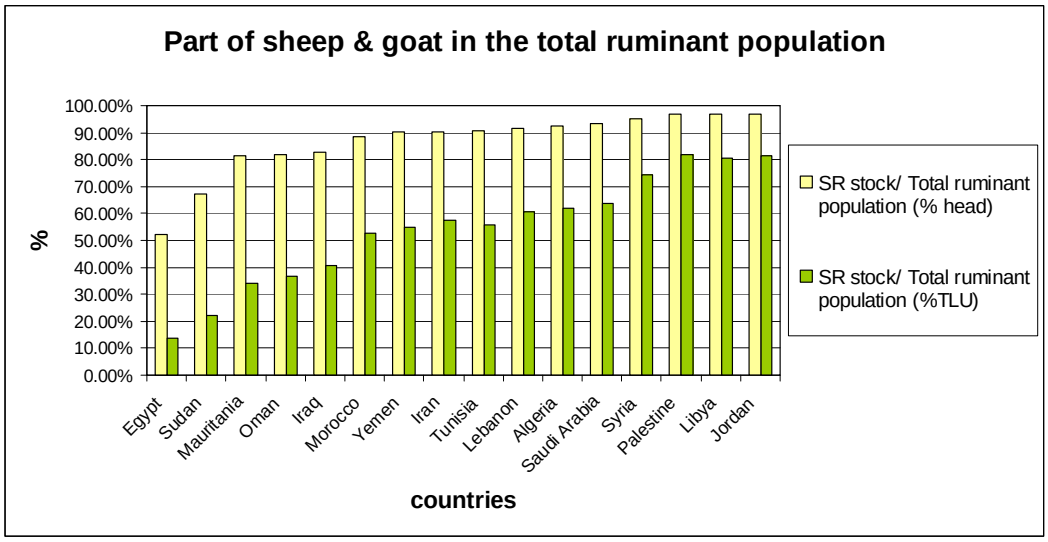
1. Some data on small ruminant production in the sub-region

1.1. Animal stock and land

Small ruminants (SR)' population in North Africa and Western Asia region represents around 17% of the world population and 35.4% of the ruminants' population (TLU) in the region in 2007 (FAOSTAT)[1]. But it is noted a large variability of the part of SR population in the total ruminant population according to each country. From a reduced sample of countries on which it is proposed to limit the study, the part of SR population in the TLU population varied from 13.5% in Egypt to more than 80% in Jordan, Libya and Palestine; this part represents at least 50% of the TLU population in all countries, except Egypt, Iraq, Mauritania, Oman and Sudan where cattle and buffaloes stocks are important.

[1] The region covers North Africa countries (Algeria, Egypt, Libya, Mauritania, Morocco, Sudan and Tunisia) and West Asia countries (Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syria Arab Republic, Turkey, United Arab Emirates and Yemen).

Figure 1: Importance of sheep and goat in the total ruminant population in the region and in 2007 (in head and in TLU, source: FAOSTAT, 2007)



The analysis of the average annual growth of small ruminant stock during the two last decades 1988 to 1997 and 1998 to 2007 shows a positive rate of average annual growth of the SR stock during the two last decades for almost all the countries (except Iraq, Libya and Saudi Arabia that register a decline of the SR stock). But each country let show a particular trend of SR dynamic during the 2 last decades. This various trends could be explain by complex interactions between micro level factors (household and farm adaptation/choices) and macro level factors such as policy changes (mainly with the liberalization and the reduction (sometimes the end) of public support), the climatic changes (the worsening of the frequency and the duration of drought) but also the society changes in these countries. The majority of the young generations in rural areas are attracted by the urban life.

Table 1: Average annual growth of small ruminant stock during the two last decades 1988 to 1997 and 1998 to 2007 (FAO, 2007)

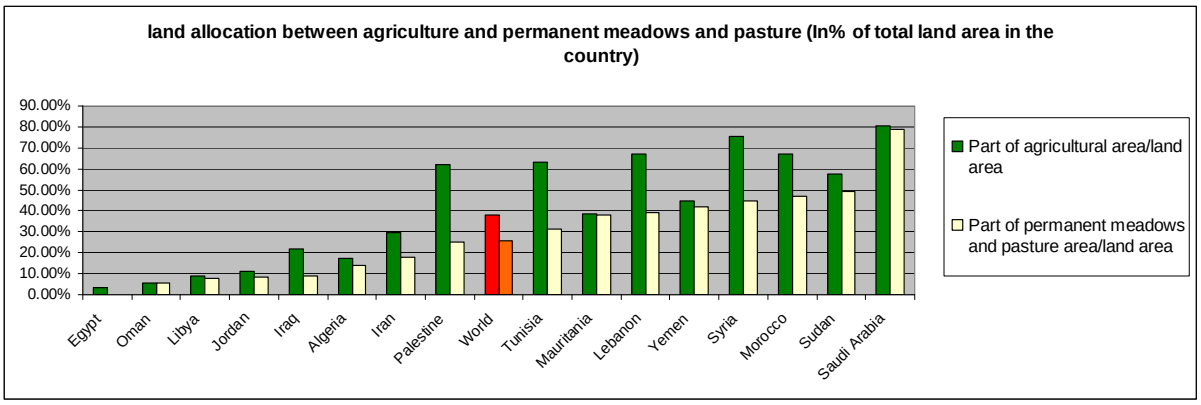
countries	Average annual growth rate 1988-1997	**Average annual growth rate 1998-2007**
Libya	1.70%	-2.27%
Saudi Arabia	2.18%	-1.87%
Iraq	-2.67%	-0.62%
Iran	2.19%	0.04%
Lebanon	3.07%	0.23%
Algeria	0.95%	1.09%
Morocco	1.23%	1.17%
Jordan	5.04%	1.26%
Tunisia	1.24%	1.66%
Sudan	8.55%	1.76%
Egypt	2.66%	2.24%
Mauritania	3.15%	2.41%
Yemen	5.72%	3.03%
Palestine		3.25%
Syria	0.13%	3.98%
Oman	**2.75%**	4.72%

The importance of SR in this part of the world can be mainly explained by the agro-climatic conditions in arid and semi arid areas that represent the majority of land. In North Africa, agricultural

land represents only 29% of land, compared to 39% in average in the world. And permanent meadows and pasture represent 47% of land in western Asia compared to 26% in average in the world (Figure 2). The data on land allocation (FAO, 2007) show large gaps between countries[2]. But globally we can distinguish very arid countries such as Algeria, Egypt, Libya, Jordan or Iraq where desert occupies a large part of the country from the others countries where meadows and pastures represent between 30 to 50% of land.

Egypt constitutes a particular case in the sense that pastoral or agropastoral areas are very limited and the agricultural land are mainly irrigated land devoted to food crops and forages. From Al-Keraby (1997 cited by Dutilly-Diane, 2007), there are about one million sheep and 700,000 goats in the Nile Delta where agriculture is very intensive; 1.5 million sheep and 1.7 million goats in upper Egypt which is characterized by mild, dry winters and very hot summers. In the desert rangelands, 1.4 millions sheep and goats are kept in extensive systems. In Nile Delta, majority of SR stock is raised in farmyard systems. And generally this breeding is limited to poor families that cannot offer large ruminants (cattle or buffaloes) or that attempt to diversify their activities.

Figure 2: Land allocation between agriculture and permanent meadows and pasture (in % of total land area in the country) (Source: FAOSTAT, 2007)



1.2. Slaughtering rate

The percentage of slaughtered heads in the total stock for each type of ruminant gives an idea about the level of off take of the animal stock for each country. The slaughter rate is around 37% and 43%, respectively for goat and sheep in the region. Egypt, Jordan, Mauritania and Sudan register the lowest rates for both goat and sheep. But just with the view of these data it is difficult to attribute this low performance to conjectural effects (due to period of de-stocking or restocking after a drought for example) or structural changes due to long term adjustments of livestock practices. Moreover for goat, the gaps between countries reflect also the various roles of goat breeding according to countries.

Moreover, this slaughter rate reflects only the proportion of animals that follows the official pathways through the abattoirs (or slaughterhouses). Then this slaughter rate is far from the reality, especially for sheep and goats for which a large part is slaughtered in the backyards or at home. Moreover a large proportion of animal trade at the regional or international level concern live animals.

[2] It is noted mistakes in the declaration of land for Lebanon, Morocco, Sudan and Syria. For these countries the agricultural and pastures land exceed the total available land.

Table 2: Slaughter rate respectively for sheep and goat in the region in 2007 and average annual growth rate over the two last decades 1988-1997 and 1998-2007 (FAOSTAT, 2009)

	Slaughtered rate in 2007 (slaughtered animal/animal stock in %)		Goat		Sheep	
	Goat	Sheep	Average annual growth rate 1988-1997	Average annual growth rate 1998-2007	Average annual growth rate 1988-1997	Average annual growth rate 1998-2007
Jordan	21.43%	16.83%	5.30%	-1.61%	0.21%	-4.37%
Sudan	30.90%	18.18%	3.98%	1.77%	-0.39%	-1.33%
Mauritania	17.32%	18.64%	-0.31%	0.78%	1.61%	0.19%
Iraq	41.82%	20.16%	0.94%	-0.84%	0.03%	1.08%
Egypt	24.37%	30.77%	-4.91%	-6.90%	-0.76%	-6.42%
Yemen	31.85%	39.19%	-4.65%	-0.24%	-3.44%	0.10%
Iran	29.57%	40.15%	-0.21%	-0.24%	1.02%	1.03%
Syria	32.72%	49.70%	-0.29%	0.09%	3.25%	-1.11%
Morocco	37.28%	49.84%	0.84%	2.11%	0.80%	1.74%
Algeria	36.83%	54.41%	1.12%	-0.14%	1.06%	1.23%
Palestine	66.95%	55.05%	--	1.19%	--	1.51%
Saudi Arabia	70.45%	57.14%	0.59%	6.54%	-1.42%	1.35%
Tunisia	59.33%	57.76%	0.10%	-0.26%	-0.02%	-0.05%
Oman	33.95%	98.31%	0.79%	7.15%	1.79%	-3.21%
Lebanon	29.29%	191.18%	-0.07%	-3.03%	-7.49%	10.82%

Legend: -- no data/ NB: Av. slaughter rate of SR in the world in 2007: 47.8%

1.3. Animal meat and milk production

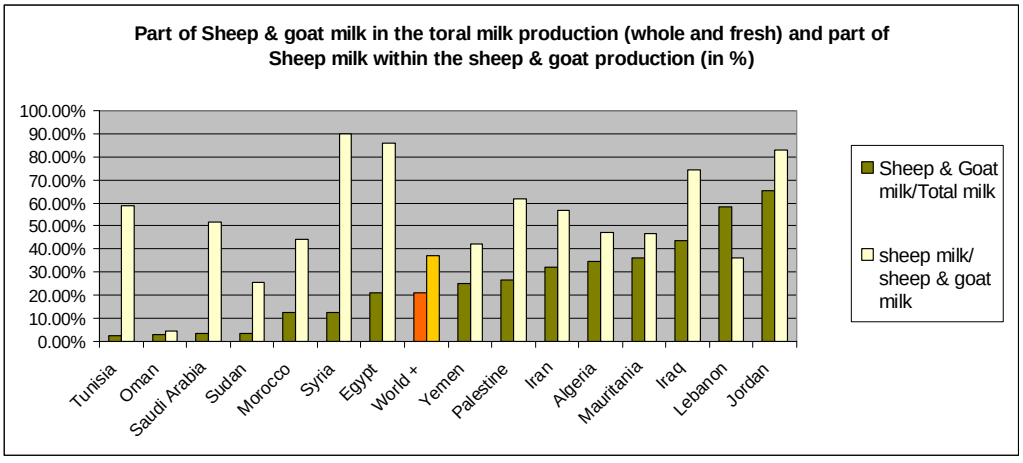
If the average mutton & goat meat production represent near 23.5% of all meat production in the region (compared to 4.8% in the world), Egypt, Jordan and Lebanon present different profiles. In Egypt, mutton and goat meat doesn't exceed 4.2% of total meat production and this part has decreased from an annual growth rate of 5.72% during the last decade (1998-2007). In Lebanon, we can see that the decrease of mutton and goat meat production occurred during the nineties years, compared to Jordan where the decrease is recent (1998-2007). These two countries have known different social changes due to different wars (Lebanon war: 1982…; Iraqi war). But these data don't reflect the meat production and consumption during the Aïd El-Kebir.

Table 3: Part of mutton and goat meat production in the total meat production in 2007 and average annual growth of mutton and goat meat over the last two decades (Source: FAOSTAT, 2007)

	% Mutton and goat meat/ total meat	Av. annual growth of mutton and goat meat production 1988-1997	Av. annual growth of mutton and goat meat production 1998-2007
Egypt	4.21%	-4.98%	-5.72%
World +	4.88%	-0.82%	0.11%
Jordan	4.98%	1.05%	-7.00%
Lebanon	8.49%	-5.69%	2.53%
Saudi Arabia	13.62%	-2.54%	-1.00%
Iraq	15.77%	8.28%	-5.18%
Morocco	18.24%	-1.20%	-3.06%
Palestine	19.10%		4.37%
Iran	21.29%	-2.47%	-2.70%
Yemen	23.12%	1.97%	-2.24%
Tunisia	26.82%	-2.24%	-0.24%
Algeria	33.30%	1.42%	0.02%
Mauritania	41.68%	3.01%	-0.61%
Sudan	42.07%	5.18%	-0.10%
Syrian Arab Republic	46.06%	-0.22%	-1.17%
Oman	68.14%	0.07%	2.08%

Besides sheep and goat milk production represent more than 40% of the total milk production in Iran, Iraq, Jordan and Mauritania. This production is the lowest in Tunisia, Oman, Saudi Arabia and Sudan. But different factors explain this low interest for sheep and goat milk: no milk tradition, others sources of milk such as camel or cattle milk, self-consumption, etc. Sheep milk production is predominant compared to goat milk production except in Algeria, Lebanon, Mauritania, Morocco, Sudan and Yemen.

Figure 3: Part of sheep and goat milk production in the total milk production (whole, fresh) and part of sheep milk production in the total sheep and goat milk production (in %, 2007) (Source: FAO: 2009)



Faced to the increased demand of milk, cow milk production has known the largest rate of annual growth during the last decade. But Algeria, Lebanon and Palestine register a rate superior to 3% during the last decade for goat milk production. The highest rates are observed for sheep milk

production in Jordan, Palestine, Syria and Yemen. In Egypt the main increase of milk production provide from cow and buffaloes species.

Table 4: Annual average growth rate of milk production according to the specie and the country during the last decade 1998-2007 (source: FAO: 2007)

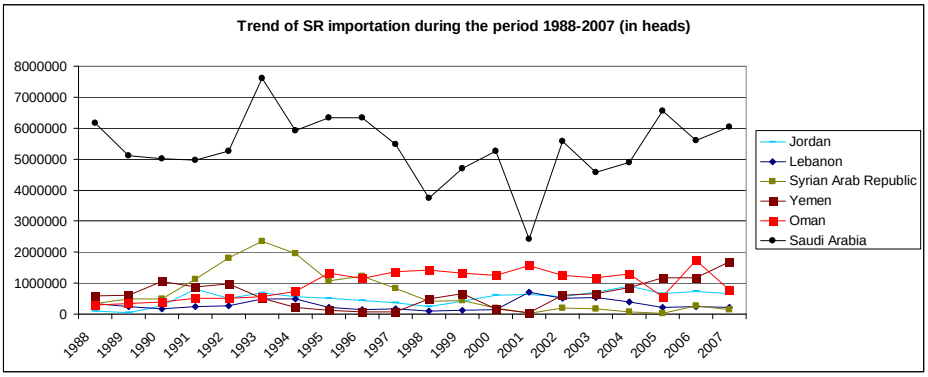
countries	Buffalo milk, whole, fresh	Camel milk, whole, fresh	Cow milk, whole, fresh	Goat milk, whole, fresh	Sheep milk, whole, fresh	Milk,Total +
Iraq	-6.31%	-3.05%	2.42%	-0.23%	-0.39%	0.87%
Mauritania		2.92%	0.91%	1.06%	1.35%	1.22%
Oman			3.06%	0.64%	1.19%	1.43%
World +	3.36%	1.36%	1.78%	1.95%	1.05%	1.96%
Lebanon			2.28%	3.01%	0.37%	2.20%
Tunisia		0.00%	2.87%	0.57%	0.63%	2.79%
Egypt	1.29%		4.99%	0.41%	0.05%	2.84%
Yemen		4.28%	3.28%	2.16%	3.72%	3.22%
Iran	3.63%		4.65%	0.30%	1.44%	4.07%
Morocco		0.00%	4.30%	-0.29%	-0.11%	4.07%
Syria	7.97%		4.31%	2.11%	4.15%	4.17%
Saudi Arabia		0.28%	5.50%	0.66%	1.09%	4.31%
Algeria		4.40%	4.98%	3.70%	1.31%	4.39%
Sudan		4.19%	5.84%	2.38%	1.34%	4.67%
Palestine			7.36%	4.84%	3.86%	5.86%
Jordan			5.24%	1.19%	11.12%	6.26%

1.4. Live animal trade

In Maghreb the importation and exportation of SR are more or less nonexistent in the national statistics although different field study shows important exchanges of SR at the borders between Morocco and Algeria and Algeria and Tunisia (Alary and Boutonnet, 2006). Moreover in Algeria and Morocco, it is mentioned an important flux of animals from Mauritania and Mali (Alary, 2006).

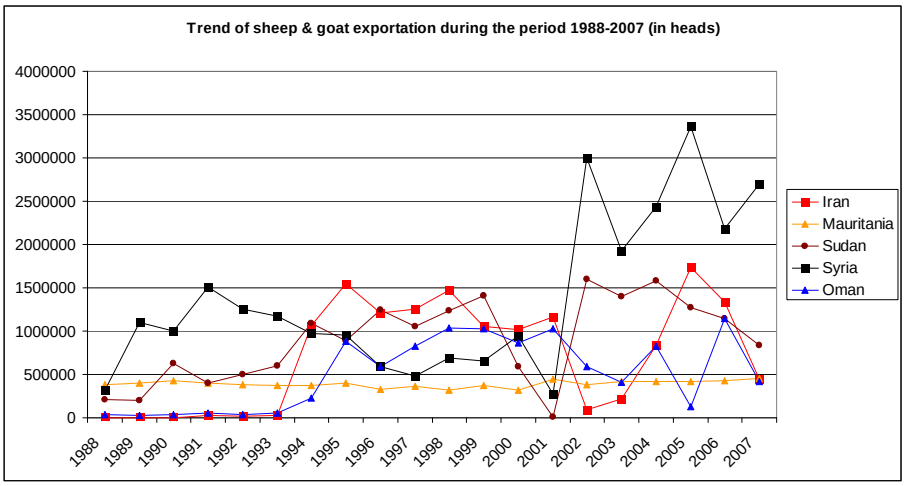
For all the countries represented in the figure 4, it is observed large variations of importation. These variations are explained by various factors. For example, during 2000-2001, the outbreaks of Rift valley fever in Ethiopia and Somalia has stopped the trade of animals from East of Africa to gulf countries through the Yemen. This explained the decrease of importation in Yemen during these two years.

Figure 4: trend of sheep and goat importation during the last two decades (in heads)



Some countries such as Yemen, Syria and Jordan are both importers and exporters of live animals. This is mainly due to their geographical situations between the main producer countries such as Ethiopia, Sudan or Somalia over the red sea and the main importers in the region such as the countries of the Arabia peninsula. Sudan and Mauritania are only exporters of live animals. Sudan registers a breakdown of its exportation in 2000-2001 due to the outbreaks of Rift valley fever in the region. But these data reflect mainly official flux of animals although the majority of live animal marketing use unofficial circuits.

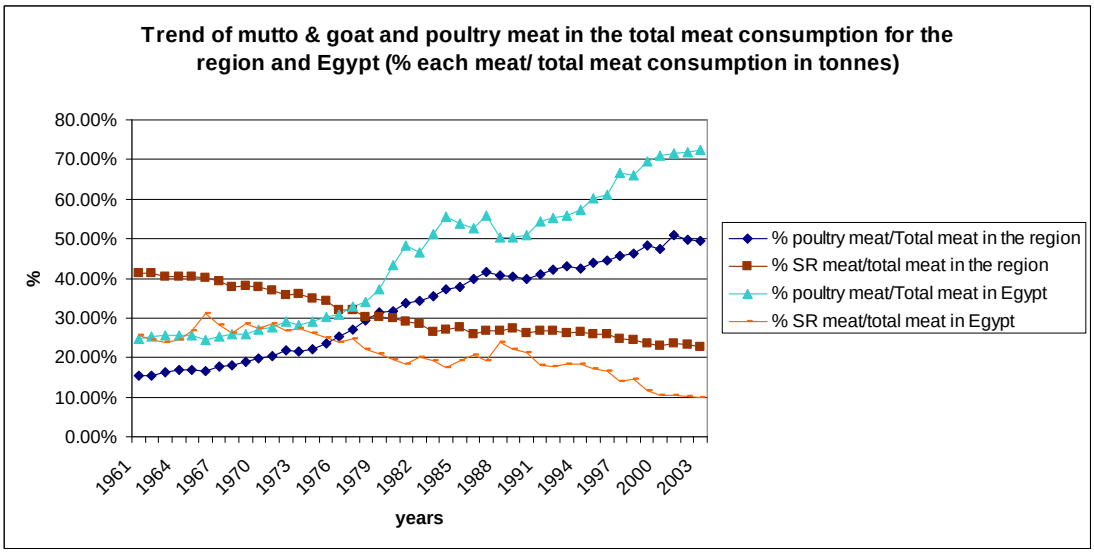
Figure 5: Trend of sheep and goat exportation during the last two decades (in heads) (FAOSTAT, 2009)



1.5. Consumption

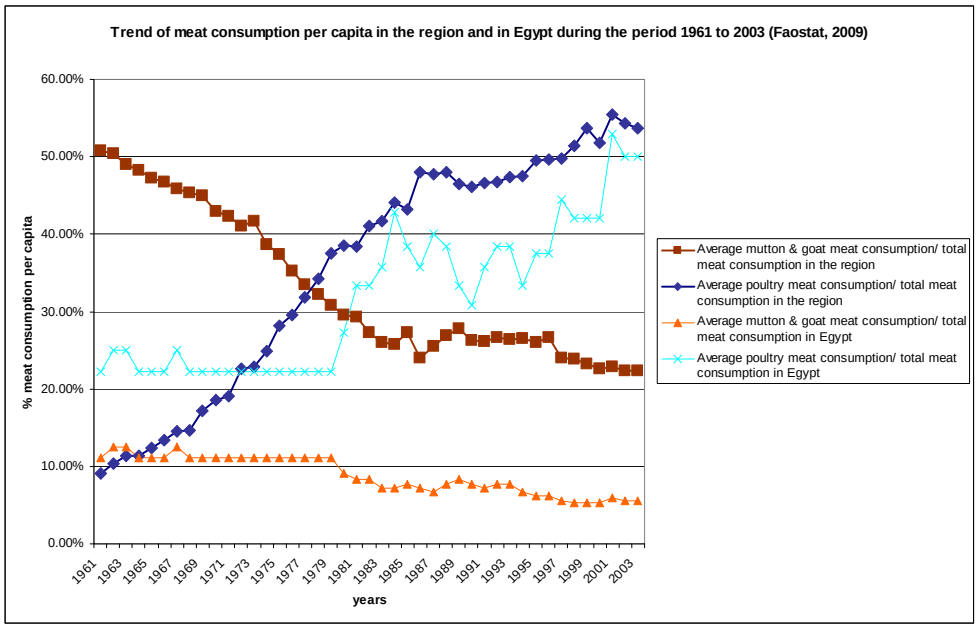
For all the countries, it is observed the same tendency with an increase of the part of poultry meat in the total meat consumption and a slow decrease of mutton and goat meat. If the part of mutton & goat meat consumption in the total meat consumption registers a similar decrease (around 15%), the gap between the percent of poultry and mutton & goat meat in the total meat consumption is around 60% in Egypt, compared to 25-30% in the region. This means that poultry consumption has increased at the detrimental of all other source of meat consumption.

Figure 6: Trend of mutton & goat and poultry meat in the total meat consumption for the region and Egypt (Source: FAOSTAT, 2009)



In the region if we can observe an important substitution of the mutton & goat meat with poultry meat in the per capita diet, the main substitution in Egypt has be done with the bovine meat. The main gap has occurred around the beginning of the 80ies.

Figure 7: Trend of mutton & goat and poultry meat in the total meat consumption per capita for the region and Egypt (Source: FAOSTAT, 2009)



2. An example of study on chain analysis of SR production in Maghreb

2.1. Approach of the marketing channel

The objective of the marketing channel approach is to understand the constraints due to market in the decision process of farmers. Our approach focused on the farmers' marketing strategies and specific surveys were conducted in the sampled population of each community to analyze the decisions of purchase and sale. Besides, in order to capture the role and impacts of other actors for the meat channel, some complementary surveys were conducted in the different animal markets or "souks".

In Algeria, informal surveys were conducted to analyze the impacts of the Algerian-Tunisian border market on the stimulation or not of the livestock activity. This survey attempted to capture the modalities of the transaction, although, the sensitivity of these informal transactions prevents to collect precise data on the exchanged stock and price.

In Morrocco, 24 intermediaries were surveyed. Nine of them were local traders and the others came from different regions, as far as Essaouira. Another 28 herders in the community (around 4-5 farmers for each type of farm representative of the community) were also surveyed. The questionnaire delt with different aspects: the transactions of animals during the year (from February 2003 to January 2004), the modalities of the transaction (period, price, and place), and the origin of the traders. The study of supply/demand was conducted on 5 local markets of the region. To achieve this, information was collected near the tenants of each souk.

In Tunisia, two surveys were conducted during Aïd El Kebir in February 2003 and during Ramadam in October-November 2003. The sample comprised 12 butchers, 50 traders and 49 consumers. This sample is equally distributed between three local markets in the region of Sidi Bouzid and three urban markets in Tunis. The choice of markets was completely related to the places that were visited by the farmers of the community.

The objective of these surveys was to rebuild the different trajectory of animals from the farmers until the consumers and to understand the modalities of transaction. Are there any arrangements or informal conventions on the markets? Who decide on the price? What is the leeway in the negotiation?

It is worth mentioning that there are very few studies on meat channel in the Maghreb. Moreover, in this type of survey, one is faced with the difficulties related to the confidentialities of some information, or to the informalities of the transactions as in the Algerian case study. The lack of time does not allow scaling up the survey at the regional or national level. This prevents the elaboration of supply/demand functions in the model. However, this descriptive analysis allows to understand the transaction modalities and to deepen the knowledge on marketing strategies of the farmers who were included in the different models, especially, the seasons of transaction, the prices, and the margin and prices fluctuations.

2.2. Comparison approach of the meat channel in the three countries

The results of the analysis for each country case study are reported in one report (Alary et al., 2004). Here we mainly focus on common and specific points.

2.2.1. Three distribution channels for the sheep meat

There are three main distribution channels for sheep meat in the three countries (Table 5):

1. Farm slaughtering for the enlarged family self consumption
This way of doing concerns mainly the old female animals that cannot be marketed. This represents around 15 to 20% of the total consumption.

2. The sacrifice of male young animals for Aïd El Kebir or family occasion (marriage, birth, etc...)
This way concerns about half of the animals, mainly male animals (more than 12 months), sold during a period of one week. The lambs are fattened either at the same place of birth or at another place. A network of traders manages the deferment and forwards the animals to the main places of consumption (urban areas). These animals are the most profitable. In Morocco, the price reaches the equivalent of 75 to 80 Dh/Kg carcasses (7.4 to 7.9 US$); this is 30% more expensive than the usual price. In Tunisia, the plus-value reaches 15%. These plus-values are the most profitable to the traders or the farmers who practice the fattening.
The fattening and marketing activities during Aïd El Kebir need an important practical knowledge and a source of funding for several months (between 6 to 8 months) to immobilize the live capital (lambs) plus the expenditure in feed. The small herders are generally forced to sell their lambs earlier in order to have sufficient cash flow to provide feeds for the reproductive flock, and sometimes, to cover social needs. For these groups, a system of credit similar to that for the cropping season should be put in place. Besides, these farmers need some supports for organizing the transport and selling activities around the towns, as it is practiced by traders. Today, many farmers become reluctant to go to the urban markets because of the extremely bad conditions in the souks. The high margin observed in Tunisia in the distribution channel may be considered in the transaction costs due to the risks of robbery, the cost of sheep keeping, and the cost of accommodation

3) Regular supply of households
This distributional channel concerns animals slaughtered in the rural or urban abattoirs, and marketed through the butchers to consumers, restaurants or collective groups. This represents 30 to 40% of the total consumption of red meat. Two circuits may be distinguished:

- Short channel: in the rural abattoirs closed to the souks; the butchers slaughter the purchased animals. The animals come from local herders, but, they are provided either by the herders themselves or the traders or by the herders specialized in the fattening activities.

▪ Long channel: The animals for the urban consumption are slaughtered in the urban abattoirs. The actors are wholesale butchery traders who provide the urban butchers. These traders receive the animals from different regions of the country according to the season and the demand. They buy the animals alive and sell the carcass, the offal and the skin. The return of the offal and skin covers the transportation cost and the slaughtering cost. The sale price of the whole carcass at the butchery is often inferior to the purchase price of the live animals. For the majority of animals, the traders practice themselves the fattening activities or make the animals fattened under their control. According to interviews, the margin from the fattening activity is in average shared between the trader and the supplier (herder).

Therefore, between the herder and the urban butcher, two intermediaries intervene: the first one to buy the animal at the herder and the second to sell to the butchers. Sometimes, the animals can be sold several times. The comfortable herders sell their animals after fattening. But, the small herders or herders in difficulty sell their low-fat animals that are purchased by largest herders.

Table 5: Balance sheet of sheep meat in 2003 (in millions of heads)

	Algeria	Morocco	Tunisia
Number of reproductive female sheep	10,4	9,7	4,0
Number of produced lambs (numeric productivity of 85%)	8,8	8,2	3,4
Number of male lambs	4,4	4,1	1,7
Border commercial balance	-1,0	+0,5	+0,5
Availability on the national market	3,4	4,6	2,2
Estimation of need on the basis of one male per 7 inhabitants.	4,4	4,3	1,4
Number consumed in the national market for the sacrifice	3,4	4,3	1,4
Availability of males for the butcheries	0	0,3	0,8
Old female that are self consumed	1,5	1,5	0,6
Young female sold to the butcheries	2,9	2,6	1,1
Total balance sheet in the channel of butchery			
millions of heads	2,9	2,9	1,9
Thousand ton	43	43	28
kg/habitant/year	1,5	1,5	3
Part of male young for Aïd El Kebir in the total consumption	54%	60%	42%

2.2.2. Preponderance of lamb production for Aïd El Kebir and development of the fattening

For the three countries, the majority of young male animals are kept for the sacrifice of Aïd El Kebir or for the celebration of family events (marriage, return of one member of the family). The increasing demand (related to the demography) and the occurrence of successive drought periods during the last decades explain, then, the stability of the total animal stock and the low increase of productivity. All the productive sheep systems (from husbandry to marketing) are oriented towards male production for Aïd El Kebir. On the basis of national statistics in 2003, only Algeria registered insufficient number of lambs for Aïd El Kebir, because of the border exchanges that were estimated to more than 1.8 millions heads.

The main destination of male lambs to the sacrifice is correlated to the development of the fattening practice of animals, sometimes, in a farm other than the one of birth of the lambs. We noted a sort of specialization in the activities. For example, in Tunisia, following the 5 years of drought, the farmers in the community increased the number of fattened lambs in the farm. These lambs came from the northern part of Tunisia where the drought was less severe or from Algeria. This explains the large diffusion of Algerian species in Tunisia.

This implies a differentiation in the farming systems according to their capital. In Tunisia, the typology according to marketing strategies reveals 4 main groups:

1. «The group of farmers who practice a short term fattening». These farmers buy their animals at the age of 6 to 8 months and fatten them for less than 3 months, just before Aïd El Kebir. The lambs born in the farm are kept to adjust the cash flow during the year. The feeding system is based on local resource.
2. «The group of farmers who practice long term fattening». This group gathers farmers who have more than 20 ha of land. The lambs, less than 6 months old, are bought just after Aid El Kebir and will be sold during the next Aid after 7 to 8 months of fattening. These farmers attempt to fit to the demand. For example, some farmers in the community have changed the race. The lambs born in the farm are used mainly to fund the feed supply for the fattened lambs.
3. «Group of herders who fatten the animals born in the farm». This group gathers agro-pastoralists with more than 50 ewes. In this group, around 83% of the fattened lambs are sold during Ramadan (34.9%) and Aïd El Kebir (48.1%).
4. "Group of treasurers». These herders have less than 18 ewes. They do not have the capital (own or credit) to buy lambs for fattening. So, they practice traditional husbandry with repartition of sales during the year.

In Morocco, the fattening activities concern mainly experienced farmers in the agricultural areas of the community (Osibra fraction). In Algeria, the last droughts (1999-2002) affected all the farmers, and today, we observe few fattening strategies. The majority of these farmers are, now, in the phase of live re-stocking. This example shows that specialization in the fattening is changing according to the climatic conditions.

Farmers who practice themselves the fattening attempt to sell by themselves the animals in the large towns (Tunis in Tunisia or Tanger and Rabat in Morocco) with all the risks encountered (rubbery' risks, transportation costs, etc.). In the Moroccan community, the large farmers have developed closed relations with the traders; the number of traders from other regions explains the dynamism of the local markets and also constitutes an indicator for the period of selling.

2.2.3. Market structure

Livestock markets (souks) are numerous in each country and they are open to all, for a modest entry tax. Free entry is almost ensured. These markets are open to the herders, even if they do not have animals for selling. The transactions are public. Information on the prices seems to be well-known by all according to herders. Moreover, traders who work in different markets make price comparisons for farmers. The products are quite homogeneous and, up to now, there is no segmentation of the market according to the characteristics of the product. In large markets, the actors (buyer and seller) are numerous.

Free entry, transparency, homogeneity, atomicity of the demand and supply: the four conditions of pure and perfect concurrence seem to be there. This system would allow providing the product at lower cost from the producer to the consumer; and, there is also a rapid transmission and adaptation of prices to unforeseen turn of events. But if the absence of national regulation reinforces the variability of prices, the controls of import and export create some rigidity on the supply and, sometimes, explain some speculative prices. If the prices are quite well known by the farmers, they have no guarantee to sell.

The high fluctuations of observed prices in the market are mainly due to erratic climatic conditions that induce an increase or decrease of products' price, a decrease or increase of feeds in good or bad rainy conditions, respectively. Besides, if the predictable events, such as, the increasing demand during Aïd El Kebir and Ramadan, are anticipated by the actors, the absence of information on the supply may create locally some speculative price changes. On the other hand, the low margins do not allow accumulating fund for future investments (development of new products, improvement of the productivity).

2.2.4. Price formation

The sale price in the souk is quite well known at the time and it does not vary according to the quality. For example, in Morocco, the carcass price is around 935 DH (92 US$) for a lamb of 17 kg; it is sold after at 55 DH/kg (5,4 US$) to the last buyer of the live animal. The skin, the head and the offal constitute the charges and the wage of the person in charge of the slaughtering. But, we observe some gaps between the expected price and the maximum price that the traders are willing to pay. This margin varies with the searched model of lambs; in Tunisia, this margin of negotiation is around 34 DT for traders with no preference to 67 DT for traders who are looking for the local race (respectively, 25 and 49 US$). This underlines the margin of negotiation for the farmers between the first price proposed by the trader and the price that the farmer could expect. Table 6 shows the difference between expected margins in the urban and rural markets.

Table 6: Average purchasing and selling price during Aïd El Kebir and out of the period in Tunisia (US$/head)

		Aïd El Kebir				Rest of the year			
		Av. purchase price	Race	Average selling price	Margin	Av. purchase price	Race	Average selling price	Margin
Urban Market (Tunis)	Abattoir	120 [24.6]	Barbarine	180 [24.6]	60	72 [17.3]	Barbarine Indifferent	117 [13.0]	45
	Ariana	127 [26.0]	Barbarine Indifferent	185 [31.7]	58	86 [23.0]	Barbarine	125 [29.6]	39
	Cité Ettadhamen	99 [23.2]	Indifferent	179 [18.5]	80	72 [12.9]	Indifferent	116 [2.6]	44
Rural market	Jelma	129 [27.3]	Barbarine	156 [23.0]	27	85 [25.5]	Barbarine	105 [24.3]	20
	Sidi Bouzid	139 [45.9]	Indifferent	156 [48.2]	17	100 [21.0]	Indifferent	119 [21.6]	19
	Sbeitla	112 [36.5]	Indifferent	161 [28.4]	49	104 [28.3]	Indifferent	136 [24.5]	32

The income of the wholesale butchery traders (purchasing of the animal, slaughtering and selling the carcass) are quite low, around 2% of the carcass price. Without weighting the animals, the buyers take always the risk to pay more if there is an under-estimation of the weight or may be blamed if there is an over-estimation. Generally, this risk is low because of the great experience of these traders who work mostly in the same areas and same production systems. In the other hands, the high concurrency excludes systematic under-estimation on the weight of animals.

The butcher may get more important margins at the time of retail selling of meat, according to the piece, the season, and the place of sales. But, the size of business is generally small, less than one hundred kg per week.

If the last sale price for live animals is with no surprise, it is not the case for the producer sale price for at least two reasons:

- The herder is never sure to find a buyer when the animals are ready for market. If he cannot sell at appropriate time, the animal generally loses its value (due to age, fat content, end of the ceremonies) and it will cost more for its husbandry beyond the optimal moment of selling;
- Sometimes, the herder is obliged to sell his animal before the end of the fattening period because of lack of resource or need of money for urgent social events.

Moreover, the herders who are in charge to produce lambs for fattening feel often misled, and they have the impression to be the losers of the channel.

The herders who are in charge of the fattening are often traders or butchers at the same time with some formal or informal contract with the person in charge of the slaughtering. This high speculative activity can provide important margins with a good expected price on feeds and a good local experience on the purchase of low fat animals. Except for Aïd El Kebir, the expected price for ended animals is not a source of margin due to the low variations. But, the preservation of this fattening activity needs some conditions, either the vertical integration with some more or less fixed modalities or good marketing conditions such as in the Khouribga region (Morocco), which is not the case for remote areas.

2.2.5. Characteristics of traders

Most of the transactions on live animals (low-fat or fattened) or red meat are realized by plenty of intermediaries with a small business (no more than one hundred animals per year). The traders who buy animals from herders are generally themselves small herders who want to complete their income or want to rebuild their flock.
If livestock activities (husbandry, fattening, and trading, slaughtering, retail selling) are well defined, the actors may combine different operations according to their capital (flock and credit), the climatic conditions, and the social needs.

Few intermediaries of large scale act at the national level and they generally benefit of good information throughout the channel. But, their business does not affect the adjustment between the demand and supply. At the opposite, they can accelerate the establishment of segmentation in the market in the first steps.

2.2.6. Change of consumption preferences and distributional channel

The red meat is traditionally consumed stewed, i.e., for a long and humid cooking time. Nowadays, the roasted leg of lamb becomes frequent in wealthy families, as well as, grilled meat in the restaurants. These preparations require nice tender pieces and younger animals. The tenderness varies according to carcass pieces which explain the fine type of cut by butchers. In this regard, the size of carcass which determines the leg of the lamb, the age and the tenderness are the new criteria of quality for both consumers and retailers.

The traditional type of cut does not take into account the distinction between the different parts of the carcass. Now, the type of cut is more anatomic with the distinction between the leg, the chop, the shoulder, the brisket, etc. according to cooking practices. There is also a distinction of prices between these different pieces. The grilled pieces can be sold from 10% (popular markets) to 30% (well-to-do markets) more expensive.

Therefore, we observe a differentiation of price according to the markets, the types of consumers, the social events, the seasons and the distribution channel. In Tunisia, the origin of the lamb and the race are becoming a criterion.

The traditional supply to urban areas consisted of the transport of live animals to urban markets, slaughtering in urban abattoirs, and delivery of the whole carcass to the butchers. Nowadays, the new practices of consumption induce some changes. In wealthy or high-standard urban quarters, the butchers sell more legs of lambs than stewed pieces. In the opposite, in popular quarters, the butchers who have bought the whole carcass sell the legs of lamb at the same price as stewed meat. In the retail places (butchery, supermarkets, restaurants), there is a demand for differentiated pieces of meat in a proportion different of the carcass. Some retailers have different selling points in the town. They can distribute the different meat pieces according to the demand and, by doing so, they can enhance the value of each piece.

Moreover, since the mid-1990's, important supermarkets were developed in the Maghreb countries. The meat departments of these supermarkets registered important success and, in Morocco and Tunisia, the demand is high. Some supermarkets developed free department with packed meat pieces. This new type of retail selling may change the distribution channel; the retailer could establish his enterprise of cutting and packaging out of the urban areas. But, the main obstacle is the abattoir because they need to have a sanitary document and ensure the payment of tax.

Therefore, two changes appear in the meat channel: (1) the meat channel instead of the live animal channel from the production regions to the regions of consumption; (2) the supply of retailers in meat piece and not the whole carcass. These changes imply important changes for the traders in charge of the slaughtering in the urban areas. Until now, they receive live animals, low-fat or fattened, and sell the carcasses to the urban retailers. Their profit comes from the supply management and their local experience in fattening. Now, they need to start specializing in selling meat pieces. Their profit will then come from the capacity to adjust the prices to the different pieces of carcass according to the destination. In rural areas, new intermediaries will buy the live animals and sell the carcass to different wholesalers. Their profit will come from the management of the supply, their knowledge of fattening, and their capacity to adapt the different carcass to the different types of demands according to the season. The criteria of selling also change in the rural areas with new demand according to the breed, the colour, the weight and the anatomical structure.

2.2.7. Implications of the marketing channel for technology adoption

The analysis of the sheep market showed the following common points:

1. The channel is quite short with only 2-3 intermediaries between the farmers and the final buyers; this explains the good information on the prices.

2. The high price of sheep meat. This might be explained by different factors among which: (i) The production is not much flexible and depends mainly on the climatic factors; (ii) the natural protection of the national markets due to the preference of live and local lambs for ceremonies, such as, Aïd El Kebir; (iii) the control of the importations.

3. There is a closed relationship between the average price of the lamb for Aïd El Kebir and the average monthly wage in the country (Table 9).

4. Good information on the prices due to frequent trips to the souks and the mobile phone that helps getting information on distant markets. Moreover, the majority of herders are small ones compared to the past decades when there were larger herders with more than 1000 heads. So now, the risk of cooperation is minor. Finally, a great part of the marketing is controlled by the farmers during Aïd El Kebir and they can travel for long distances.

5. But, if the farmers have good information, a certain variability of prices due to the negotiation process between the farmers and the trader is observed. Moreover, during Aïd El Kebir, the uncertainty remains on the determination of the day with the highest prices. Generally, during this period, the prices increase progressively as Aïd El Kebir gets closer; but, during the last week prior to Aïd El Kebir, the prices may continue to increase or may decrease a little. The determination of the date when the prices fall is really uncertain. There are apparently no definite rules.

Table 9: Comparison of average price of animals, unit feed cost per head and the average minimum monthly wage for each country (in US$)

	Morocco	Algeria	Tunisia
Ewe price	110	200	181
Lamb price	130	161	159
Cost of feed per head	49	69	58
Gross margin per head[3]	81	92	101
Average minimum wage	170	130	160

The differences between the three communities are mainly due to the localization of the community in the country. For example, the particular situation of Sidi Fredj in Algeria (which is close to the border) creates some speculative phenomena. For the Zoghrmar community in Tunisia, the farmers can sell their animals directly in Tunis because of the small distance to the capital.

According to the farmers, the sheep market is functioning quite well and it does not constitute an obstacle for technology adoption. Also, the high prices should favour investments in technological improvement. But, the main source of price variability is mainly due to the prevailing climatic conditions that are unpredictable. The periodic droughts have catastrophic impacts on livestock activities, mainly among the small herders that represent the majority of herders. The consequences are the sale of a part of the flock at low price. Without any insurance systems or credit access, the reconstitution of the flock takes at least 2-3 years. In view of this, the adoption of technologies that allow mitigating the effects of droughts (drought resistance variety such as cactus or Atriplex, feed block, etc.) could reduce these negative impacts. But the experience shows that theses technologies have difficulty to be adopted without institutional support.

3. Discussion and recommendations

The evolution of SR systems has to be considered in the frame of the general context of (i) food demand and (ii) resource management. In urban areas, an important class of high or medium income customers is emerging, whose demand is increasing towards special, identified products, and a better safety. They demand more anatomic cuts of meat, special cheeses, and more traceability of the products in order to certify the origin and guarantee safety. Sheep and goat products are more and more consumed as speciality food, mainly on religious occasions. In this context, the modern retailers (supermarkets) are increasing their market shares and also their requirements to the upper stages of the chains. In rural areas, sheep and goat find more and more hardly their traditional source of feed (range pasture) because of the extension of crops and scarcity of water.

On the production side, research has to be reinforced on the increase of availability of feed, and particularly on livestock farming systems more integrated in mixed crop-livestock systems. But on the marketing side, means have to be found to improve the price of live animals and milk received by farmers. As this region is not price-competitive on the global market for staple meat or milk, it is necessary to investigate on the specificity of the products in this region and the ways special chain organisation can add value to these products. As the present market structure (pure competition) is not favourable to high margins, the capital necessary to these investments has to be found in public sources. Further investigations have to estimate the different ways public support can be efficient for the development of SR husbandry in the region.

[3] This gross margin doesn't integrate the maintenance of the ewe.

A common research and development programme should address the following points:

- Better understand social networks and organisations within the chains (meat and dairy);
- Evaluation of the ways for an improved security of the supply of live rams for the Aïd el Adha;
- Changes in consumption patterns: white meat (poultry) vs red meat (beef-lamb)? Imported/frozen vs local/fresh?
- Competitiveness of sheep and goats meat and dairy products
- Increasing local feed production: improving the efficiency of agro-pastoral systemsAssessment of markets for specific pastoral products in pastoral areas, better document provenance and quality of products
- Changes in the structure of markets (supermarkets) : consequences on small farmers' access to markets

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