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Urban and Peri-urban Milk Producers of Cairo City: an Efficiency Focus

Présenté par

Annabelle DABURON

Réalisé sous la direction de : Veronique ALARY et Jean-François TOURRAND
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Thanks to all the Gazelles! We stick together in the future.

To my father.
To Dr. Jacques Flahaut.

Abstract:

Food supply for the increasing world population within a limited resources planet is one of the main modern challenges. In order to succeed, agricultural systems efficiency needs to be improved. As corollary, resilience of those systems will contribute to insure a sustainable development. Egypt combines a high demographic pressure with limited resources availability and is highly dependent of international market variations. Thus, even if the country as a millennial tradition of milk production, it is not able to respond to his increasing milk demand. Cairo city with 16 million inhabitants shelters traditional dairy producers in the urban and peri-urban area, primarily focused on buffalo milk production, which contributes, for a large part, to the milk supply of the city, but remain an informal sector. 73 dairy producers were interviewed from Cairo urban and peri-urban areas, and distinguish 4 main types of farming systems each with they own strengths and weaknesses. Within those groups, the intensive feeding strategy appears to be less efficient, in terms of valorization of the feed and feed costs, and decrease in the same time the resilience ability of the farms adopting this practice. At the opposite, the integration of cropping and animal production appears to be a good way to increase the ability of those producers to resist to external variations even if their technical practices with a massive use of fertilizers have a very low nitrogenous efficiency. But those consideration needs to be seen at the light of the very high land pressure in Cairo that threats directly those mixed producers and especially the tenant of land who appears highly vulnerable.

Those farmers are able to develop innovative techniques since several centuries to survive in an extreme environment like Cairo, the modern context endanger considerably their activity; building strong independent organizations appear to be the first step among others to help those farmers to enhance their position in the heart of the city in the future.

Keywords: Efficiency, Resilience, Farming System, Dairy production, Cairo

Résumé:

L'approvisionnement alimentaire de la population mondiale croissante mais au sein d'une planète aux ressources finies représente un des défis majeurs de notre époque. Pour le relever, l'efficience des systèmes agricoles doit être améliorée et avec elle leur capacité de résilience. L'Egypte combine une importante pression démographique avec des ressources limitées et se révèle extrêmement dépendante des variations du marché international. Ainsi, même si le pays a une tradition millénaire de production laitière, il demeure incapable de répondre à sa demande intérieure croissante. Le Caire, avec ses 16 millions d'habitants, abrite une importante communauté de producteurs laitiers qui contribuent significativement à l'approvisionnement de la ville mais appartiennent à un secteur informel. 73 producteurs laitiers des zones urbaines et peri-urbaines du Caire ont été interrogés et 4 types de systèmes d'exploitation, chacun avec leurs forces et faiblesses propres, ont été identifiés. Au sein de ces groupes, la stratégie alimentaire intensive semble moins efficiente en matière de valorisation alimentaire et de coûts, diminuant par la même occasion les capacités de résilience des systèmes agricoles adoptant ces pratiques. A l'inverse, l'intégration de cultures et de productions animales semblent être un bon moyen pour accroitre les capacité de ces éleveurs à résister aux changements dans leur environnements même si ces derniers semblent avoir une efficience azoté extrêmement faible. Mais ces éléments doivent être remis dans la perspective de l'extrême pression foncières qui s'abat sur ces producteurs et menace particulièrement les locataires de ces espaces agricoles qui apparaissent malgré tout extrêmement vulnérables.

Pour survivre pendant plusieurs millénaires, ces systèmes d'exploitation ont dû faire preuve de capacités d'adaptation exceptionnelles, mais le contexte moderne menace considérablement leur activité et la construction d'organisations de producteurs, fortes et indépendantes, semble être le premier pas pour aider ces exploitants à assoir leur place au cœur de la ville dans le futur.

Mots-clefs: Efficience, Résilience, Système d'Elevage, Production Laitière, le Caire

Table of Contents

Tables of Abbreviations:

Abbreviations	Full Names
ICARDA	International Center for Agronomic Research in Desertic Area
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement (French Agricultural Research Centre for International Development)
ARIMNet	Network for Agricultural Research In the Mediterranean Area
APRI	Animal Production research Institte
IAV	Agronomic and Veterinary Institue Hassan II
SELMET	Mediterranean and Tropical Livestock Systems
FAO	Food and Agriculture Organization
GDP	Growth Domestic Product
kg	kilogramme
LE	Egyptian Pounds
TDN	Total Digestible Nutrient
CP	Crude Protein
DM	Dry Matter
TLU	Tropical Livestock Unit
N	nitrogen quantity (kg)
DRC	Desert Research Center
AIRD	Agence inter-institutionnelle de recherché pour le developpement
SELMET	Tropical and Mediterranean Livestock Farming Systems
GREEN	Renewable Resources Management and Environment
INRA	Institut national de recherche agronomique

Tables of Figures:

Table of Charts:

Table of Appendix:

1 Introduction

With 7.2 billion in mid-2013, the world population is projected to increase by almost one billion people within the next twelve years, according to official United Nations population estimates. The demand for food is following the same trends and is rapidly increasing. In the same time, the urbanization is a general phenomenon and questions the food supply for those large human communities. Cairo city is not an exception to this phenomenon. The largest city of Africa is confronted to a major challenge: how to feed more than 16 millions of people?

For centuries (even for millennia) Cairo city is sheltering milk producers. They take advantage of very short supply chains, from producer to consumer (or with 1 intermediary), to develop agricultural activities within or around the city. Those producers are not very well known even if they contribute for a large part to the milk supply of Cairo city. They are confronted to many issues: arriving of large private dairy companies, availability of resources, new requirement of milk quality, political instability…

After a presentation of the general context where those producers have to develop their activity, we will try to understand those farming systems by creating a typology. Then we will confront those systems with some efficiency indicators to identify their strengths and weaknesses in each system, and approach their resilience capacity.

2 General context of the study

2.1 World milk context

2.1.1 Milk demand

Global food patterns are undergoing major mutations. Developing countries represent the major driver of the food demand because of their population growth and urbanization. The gap regarding the food intake per capita between developed and developing countries remains important but it's filling up slowly (from 1861 kcal/person/day in 1961 it reached 2651kcal kcal/person/day in 2007 in developing countries) (Gerosa and Skoet, 2012) . This global trend is followed by a significant increasing of the livestock products consumption when the cereal and tuber consumption remains stable (Appendix 1). In this context, milk products are not an exception and the global demand is rapidly increasing.

In many developing countries, even if lots of people are excluded from the general tendency, incomes are rising up. This situation opens new access to certain products (including dairy products) for a large amount of consumers. From an economical point of view, it appears that the dairy products consumption increase with the income per capita (Appendix 2) (Gerosa and Skoet, 2012).

Demographic and social factors are also playing a large part in this global pattern change. The tendencies in developing countries combine a demographic growth and a migration of the population from rural to urban environment. It creates major changes in the lifestyle of the population. Those new lifestyles create new alimentary patterns that include a large part of livestock products, especially dairy products in the daily intakes.

2.1.2 Milk production

Increasing of the demand is followed by the increasing of the production. During the past century, this global growth in the milk production has been supported, mostly, by the developed countries where several combined factors (improvement of the technologies, intensification, better sanitary conditions…)

allowed them to increase the production. Today, the world milk production reached 760 million tons in 2012 with a global growth rate of 3% over the year 2011-2012 (FAO, 2012).

However the gap between developed and developing countries is rapidly filled up. In developing countries, the major leader in this production growth are South-Asia countries (mainly India) and Latin America (Appendix 3) when North Africa remain quite small contributors to the world market with 39.1 million tons in 2011 and an average annual growth rate of 3.1% in the milk production (FAO, 2012).

It is essential to precise that dairy products constitute a general appellation for a large variety of production with several animal origins. If cow milk is the major production in the world, the second rank is attributed to the buffalo milk with 11% of the global production. It increases to 23% for the milk production in developing countries and overrate the cow milk production in specific part of the world like South-Asia in link with the consumers preferences (FAO-STAT, 2012).

The perspectives of the livestock sector and more specifically on the milk sector are quite "bright" especially in developing countries. Because the population will continue to grow and because there is a large possibility of grow for the income per capita, the milk demand will continue to increase driving the milk production.

2.2 Egyptian context

2.2.1 Egyptian general consideration:

Egypt belongs to the Mediterranean countries. It covers 1,001,450 square kilometer (World Bank, 2011). The country is located in the north-eastern corner of Africa, bordered by the Red Sea and the Mediterranean Sea (Appendix 4). The rangeland is predominantly desert, arid and semi-arid and the rainfalls are extremely low. The country depends mostly of the Nile River for its water supply. Several countries of the region are in the same situation creating tensions for the resource. The water supply is currently ruled by the *Nile Basin Initiative*. This agreement between several countries crossed by the Nile River organizes the repartition of the Nile resources in the area by cooperative agreement (Mekonnen, 2010) but the subject remains highly sensitive.

The actual population of Egypt is estimated around 80 millions of people with a growth rate still high around 1.7% in July 2013 (World Bank, 2012). The climate forces the population to mainly concentrate around the Nile River and in the Delta area.

Egypt counts around 44% (35 277 235 persons) (World Bank, 2012) of this population located in urban areas within this desert boundaries, mainly in large cities like Cairo, Alexandria, Port Saïd and Louxor. However the rural population is increasing but in the same time his ratio on the general population keeps decreasing to the profit of the urban areas.

According to the World Bank (2012), 25.3% of the population is still living under the national poverty line[1] and this number is increasing since the last years in link with the economical crisis that the country have to face.

After a long period of socialism, Egypt applied a liberalization of its economy mostly during the 90's. The private sector takes a large part in the economic. If this lead the country in an economical raise, inequality raise in the same time in the population. Since the revolution of 2011, the country is falling in a major economical crisis that M. Morsi hasn't been able to stop and the current political situation offers only a very long term hope to find a way to reverse the phenomenon.

[1] National poverty line: fixed at LE 56 per person per month or LE8.5 per day from the Central Agency for Public Mobilization and Statistics.

Because of the very dry climate and the large desert areas, agricultural land availability is limited to 3, 5% of the total area of the country (around 3.5 million ha =8.4 million feddan2) mostly concentrate along the Nile Basin and Delta. With this limited agricultural lands, the country is struggled to fill his needs for agricultural products and import massively agricultural goods and remain dependant of the international market; thus, Egypt is the first importer of wheat in the world with 11.7 million tons in 2012 (GIEWS, 2012) which represents major expenses for the country.

Cairo is the historical heart of the Middle East since several centuries. It's one of the largest cities in the world with around 16 millions (with a large variability linked to the definition of the Cairo borders take into account) (Sims, 2003). The city is crossed by the Nile River and is inserted between the desert and the beginning of the Delta. Because the city population keeps increasing, the city borders continue to be repelled at the detrimental of the agricultural land especially since the revolution (2011) due to the lower control of state.

2.2.2 Egyptian agricultural policies

As we have seen, Egypt is not an exception to the general increasing of the demand for animal products. In a context of globalization the country will become more and more dependant to the international market for his food supply. One of the priorities of the politics is to develop the national food production to win in autonomy and limit the dependency of the country to the international market fluctuation.

To reduce the gap between the needs and the national production, Egypt has developed his own strategy: "Agricultural sustainable development strategy 2030".

The goal of the strategy is synthesize in: "modernizing Egyptian agriculture based on achieving food security and improving the livelihood of the rural inhabitants, through the efficient use of development resources, utilization of geopolitical and environmental comparative advantage of the different agro-ecological regions" (Abul-Naga , 2009). Several main objectives were fixed to reach this general goal:

- promoting sustainable use of resources.
- improving the national production by increasing the land availability and the productivity per hectare.
- increasing the competitiveness of agricultural products in local and international markets
- improving the agricultural investment.
- improving the livelihood of rural inhabitants, and reducing poverty rates in rural areas.

Even if this strategy is the main document to guide the general agricultural policies in Egypt, the political and economical context can't provide a favorable environment to promote strong agricultural reforms. Because of the rare resources (agricultural lands, water...) in Egypt, the competition between food and feed production is a central question in the strategy of the country. The question of efficiency of those production systems raise from those constraints.

2.2.3 Dairy sector in Egypt

The agricultural sector even if it's decreasing rapidly since the last decades remains an important provider of employment (more than 28% of the employment) (World Bank, 2011). Dairy activity represents a major activity with a national milk production reaching 5, 8 million tons in 2011 with an almost equal distribution between cow and buffalo milk (FAO-STAT, 2011).

[2] *The feddan unit:* Egypt has its own units for several fields. The feddan is the current unit of land measurement; 1 feddan = 24 kirat = 60 metre x 70 meter = 4200 square metres (m²) = 0.42 hectares.

Egyptian milk market represents an enormous emerging market. Traditionally, Egyptian people consume a large amount of dairy product (around 60kg/capita/year in 2009) (FAO-STAT, 2009). This consumption is still provided, for a very large part, by small-scale dairy farms with very short supply chains but without any quality control (unpasteurized milk, unrefrigerated…).

In the future, the growing of income per capita, even if it's slowing down with the recent political and economical crisis, will lead to new consumption patterns. The demand for high quality dairy products is growing and it's a major challenge for the country to answer to those new requirements.

Currently the high quality milk market is supplied by large dairy companies. Those companies use for a large part milk powder (imported) or implant large farm units in the country[3]. Even if the quantity produced by those large scale farms remains under the amount of milk produced by small-scale farms and the informal sector; it's a major challenge for those small units to adapt their production to this new high quality milk market.

Cairo city is not an exception to this pattern and the city is still supplied for a large part by those small-scale farming system localized in peri-urban or urban areas. Knowing this, we propose to focus on the efficiency of the urban and peri-urban dairy production units to approach their strengths and weakness.

2.2.4 Specificity of Egyptian dairy animal

- Buffalo (*Bubalus bubalis)* (Appendix 6) :

Buffalo national herd represents approximately 5.317 million heads (Ibrahim, 2012). The Egyptian buffalo belongs to the river buffalo subspecies (larger and heavier than the swamp buffalo) (Borghese, 2005). This animal is the traditional breed in all Egyptian agricultural area in Egypt. It is particularly well adapted to the very hard conditions. It was used as a draft animal for the cropping. They are now mostly used for their milk production with high fat ratio (around 7%) and calves are used to produce meat. One of the precious qualities of the buffalo comparing to cows is his ability to better use rough fodders and to have a high intake capacity. The Egyptian buffalo weight around 350 to 600kg for the female when the male reach 700-800kg (and can reach one ton in good feeding conditions). The milk production average is around 1600 to kg/lactation. The literacy considers only one breed of buffalo in Egypt but there is a lot of variation between the regions in the country.

- Baladi cattle (*Bos Taurus*) (Appendix 5Appendix 5):

Baladi cattle is mostly produced for his meat and the national herd reach 4.38 million (Ibrahim, 2012). The traditional breed is called baladi which mean 'local' in Egyptian language. The *Baladi* weight around 450kg for the female and 600kg for the male. This cow was mostly used for the meat production because the demand for the local cow milk (with a lower fat ratio than buffalo milk) stayed low in the Egyptian market until a recent times, but this demand raise up since a few decades. Like everywhere in the world, Holstein genetic is arriving massively in the country, mostly as crossbred with the *Baladi* cow in the small scale farms but as pure breed too in the large scale farming.

2.3 The intersection between DAIRY Project and CLIMED Project

This research allowed crossing the field of two projects of CIRAD in Egypt and includes the participation of several institutions. I will firstly present both of the projects where our research take place and the objectives of our work.

[3] For example, Dina Farms is the biggest dairy company in Egypt with a herd of 15,000 animals, including 9,000 milking cows, they declare producing 60,000 tons per annum in 2012.

2.3.1 DAIRY Project: "Interdisciplinary Approach of the Urban and Peri-urban Traditional Dairy Chain"

The DAIRY Project had started in 2012. It is an interdisciplinary project aiming to improve the knowledge on the traditional milk supply in Cairo city.

First goal is to understand the historical and social context of the traditional dairy chain. The second part of the project focuses on the description of the small dairy farming units that contributes for a large part to the supply of the city and the key factors of their viability.

To complete the diagnosis of the milk supply in Cairo, investigations of the milk chain supply and the link between the several stakeholders are integrated in the objectives of the project. Regarding too the scientific objectives of the project, the major goals are to build an interdisciplinary team and to develop a systemic approach at several scales of the supply chain (farm scale, to dairy chain).

The project is a partnership between Egyptian and French institutions including:

- *Faculty of agriculture from the University of Ain Shams*
- *Animal Production Research Institute* (APRI): national institute focusing on animal production.
- *Desert Research Center* (DRC)
- *Cirad* (French Agricultural centre for development), SELMET (Tropical and Mediterranean Livestock Farming Systems) and GREEN (Renewable Resources Management and Environment).
- *AIRD* (Agence inter-institutionnelle de recherché pour le developpement) : the agency provide the funding of the DAIRY Project, within the program "AIRD Young Team" that support specially the innovative research project conducted by young researchers.

The project, funded by AIRD young team, is coordinated by Ain Shams University and CIRAD (SELMET). The team is a pluri-disciplinary team and welcomes two PhD students: one from Ain shams university and the second one from Cairo University.

2.3.2 CLIMED Project (2012-2014)

Because of the major challenges that the Mediterranean agriculture have to face (demographic growth, resources competitions, climate changes…), the European Union create the ARIMNet program (Agricultural Research In the Mediterranean Network). It aims to coordinate research projects in the Mediterranean area related to the agricultural fields and try to promote innovative initiatives both in the south and in the north of the Mediterranean Sea.

Within this global ARIMNet project funded by the European Union, the SELMET team is leading with several partners the CLIMED Project (Crop-Livestock Integration in Mediterranean area). Initiated in 2012, it gathers 3 Mediterranean countries (Egypt, France, Morocco) and several institutions:

- *APRI*
- *IAV* (Institut agronomique et vétérinaire Hassan II)
- *DRC*
- *ICARDA* (International Center for Agricultural Research in the Dry Areas)
- *Cirad*
- *Inra* (Institut national de recherche agronomique)

With observation of the emergence of new issues within the Mediterranean context, related to the past and to the present history of the zone, it has appeared the need to better understand the modern dynamics of the livestock systems in several context of the Mediterranean area.

CLIMED Project focused on the livestock systems and will try to produce a socio-economic and environmental diagnosis of the viability, the efficiency and sustainability of the livestock farming systems in the Mediterranean context at several scales (from the farm to the regional scale). It aims to help all the actors of the agricultural field, farmers, local communities, decision makers…by producing knowledge to

face the modern challenges of the agricultural production (demographic pressure, increasing of the demand for high quality products, international competition, decreasing of the available resources).

In Egypt, the project will be conducted in the New Reclaimed Land in the West Delta region. This very specific zone is related to the national Egyptian strategy and the national goal to enhance the food security with an extension of agricultural land on desert area.

It concentrates both a geographical interest (intersection of the pastoral area, the desert and the delta region); socio-economical specifics patterns because of the recent improvement of the agricultural activity and technical innovative techniques.

2.3.1 Where the DAIRY and CLIMED meet

Our project is developed at the intersection of those two projects. By combining the field of the DAIRY Project and the main goals of the CLIMED Project, we will try to understand the ability of those producers to face modern issues.

How to fill in, in a most efficient way, the growing demand for milk products with quality standards in a context of low resources availability and what is the efficiency at a national level? Is it only about economical and technical aspects? How to take into account the social and environmental efficiency having a role to play in the Egyptian strategy choices?

3 Main concept use in the project and hypothesis

3.1 Socio-ecological system, vulnerability and resilience concept

Within the general framework that is sustainability where the main goal is to understand how human society can meet their needs while sustaining the life support systems of the planet (Kates, 2000), two core concepts are developed to reach the general goal of sustainable development of human society and directly focus on the general topic that is the response of a system to a stress: vulnerability and resilience. Despite the fact that those two concepts in direct link with our approach are very close (Miller, 2010) we will quickly present them.

The concept of resilience has been mainly developed by Holling (Holling, 1973) and his colleagues during the 70's. It's based on social-ecological system (SES) where nature and human society can't be separated and have to be considered as two integrated system to fully understand the complexity of their interactions. Within this frame, the resilience concept merges (even if it was used previously in several disciplines physics or psychology) and is defined as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks"(Walker, 2004). In a limited resources environment as Egypt field, it's essential to understand the mechanisms that allowed this farming activity to survive in this environment since several centuries.

There are many way to understand and to use the vulnerability concept but we will use the Adger definition (Adger, 2006). For him, vulnerability is "the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt". We will mainly focus on social aspects of vulnerability because farmers are exposed to many threats (land pressure, resources availability, political context…) and appear pretty vulnerable in the present days.

3.2 Efficiency

The concept of efficiency traduces the idea of the ratio between inputs and outputs in a process (Figure 1: Efficiency concept diagram).

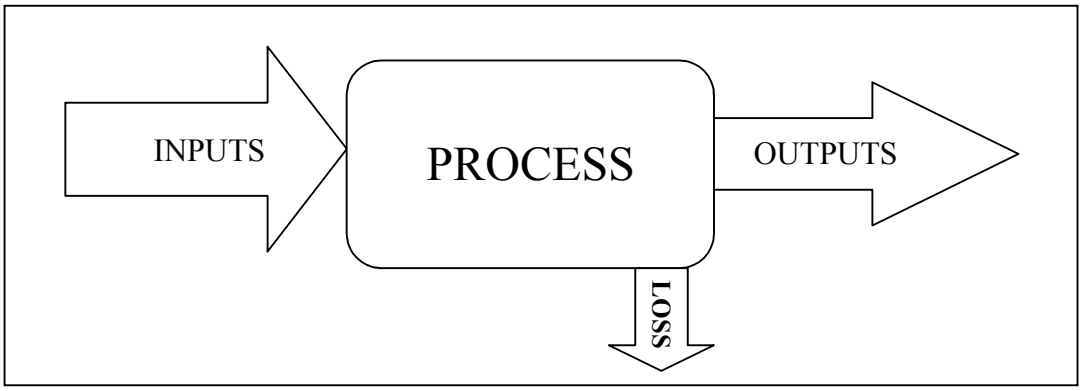

Figure 1: Efficiency concept diagram

To be more efficient, a process has to maximize output while keeping input stable or decreasing them. This principle is used in several domain and can be applied the agricultural fields.

As we've seen previously, within the Mediterranean context, the agriculture needs to deal with limited resources, especially in Egypt but with an increasing of the demand for food. In this context, the question is not only to produce enough but to produce in the more efficient way; to find a way to increase the production by using fewer resources and decreasing the impact of the production on the environment what is called a sustainable intensification (Matson and al., 1997).

3.2.1 Technical and economical efficiency

In agriculture, the efficiency concept can be applied both for animal and vegetal productions but in this case we will mainly focus on animal efficiency. Farrell (1957) describes the technical efficiency in 2 ways:

- the ability of a farm to produce the maximum feasible outputs with a given bundle of inputs or,
- the ability of a farm to use a minimum inputs to produce a given level of outputs.

As inputs, we will focus on feed in the production process knowing that feed represents a large part of the total cost of milk production, and is the cornerstone to maintain health in the herd. It's a necessity to ensure an optimized ratio both to reach an economical and a technical efficiency (Bach, 2012).

Regarding the outputs we can distinguish (B. Faye, 2012):

- Renewable animal products like milk, manure, eggs…
- Terminal products which need the slaughtering of the animal: meat, skins…

We will focus on the milk production in our cases to estimate the efficiency performance of each producer.

The challenges for those producers are: (i) to ensure the supply of animal nutritional requirements and to maintain a high production and (ii) in the same time to decrease the cost of the feed.

To estimate the feed efficiency, we estimated the Total Digestible Nutrient (TDN), Crude Protein (CP) and the Dry Matter (DM) intake (Bach, 2012) of each ration based on standard values for each component (Appendix 52: Feed table; average price in Cairo market during the study, percentage of: (i) Total Digestible Nutrient (TDN); (ii) Crude Protein (CP), (iii) Dry Matter.). Then we've compared

those amounts with the daily standard requirements of a 550 kg buffalo producing 7 kg of milk per day with a fat ratio 7.2% (Thomas, 2008).

Regarding to the DM voluntary intake, it's estimated around 3% of his live weight, thus for a 550 kg buffalo, average DM intake requirement can be estimated around 16.5 kg per day (Table 1: Requirement of a dairy buffalo weighting 550 kg and producing).

Table 1: Requirement of a dairy buffalo weighting 550 kg and producing 7kg of milk per day with a fat ratio of 7.2%.

Total Digestible Nutrient (TDN) kg	Crude Protein CP kg	Dry Matter DM kg
7.32	1.32	16.5

The DM intake was reported on the daily average milk production of a buffalo in each farm. By comparing this index between farms, we can have an idea of the more efficient feeding system that better valorized the feed intake.

In the same idea, we created an index to estimate the economical efficiency of the feeding system. We calculated the average feed cost per year of a dairy animal in each farm (taking into account the production and purchasing costs of feed and the variation of ration during the drying period) and report it on a daily basis. The ratio between this daily feed cost and the average milk production per day give an idea of the most economically efficient system.

3.2.2 Environmental efficiency

In a limited resources world, decision makers need to receive key elements to optimize the balance of resources attribution between feed and food. If the productivity remains often the main concern, several dimensions need to be taking into account to organize the resources attribution: the greenhouse gases emission, land use competition, cereal availability, water availability and contribution to the Nitrogen cycle (Gill et al., 2010) to reach the sustainability goal.

In this context of very high pressure resources and high population density, environmental concerns seem to remain a marginal consideration in Egypt. However if agriculture can be associated with pollution (manure, odor, noise, soil and water contamination…), pollution affects agriculture too (water quality, feed quality, garbage contamination…) and directly impacts the quality of the animal production (Wild, 2003) and by this, human health.

We focused on this work on the nitrogen flow at the farm scale. We choose to use the apparent nitrogen balance (Simon, le Corre, 1992) to obtain a global idea of the flow of nitrogen in each farm. This estimation remains quite large according that it didn't take into account the atmospheric and soil flow (fixation by leguminous and especially berseem (*Trifolium alexandrinum*), neither the precipitations of N, nor the leaching of the soil or the atmospheric volatilization). To approach those quantities, we use several standard values found in the literacy for the manure flow and presented in Table 2 .

The several components of this nitrogen efficiency indicator are presented in Table 3: Components take into account for the nitrogenous balance. N= nitrogen quantity in kg.

Table 2: Manure standard use in the calculation of manure Nitrogen emission and economical value of it.

Manure Standard	Value	Source
Quantity of manure production kg/TLU/y	1200	FAO: Livestock and environment toolbox[4]
Selling price of manure (LE/m3) to trader in Cairo	25	Interviews
Purchasing price of manure (LE/m3) to traders (outside Cairo)	80	Interviews
Manure density (kg/m3)	710	Alberta Agriculture, Food and Rural Development, 2004
Moisture content (%)	79	Alberta Agriculture, Food and Rural Development, 2004
Nitrogen content (kg/m3)	2	Faugno, 2012

Table 3: Components take into account for the nitrogenous balance. N= nitrogen quantity in kg.

N input	N feed	N fodders purchased per farm per year
		N concentrate purchased per farm per year
	N animal	N animal purchased per farm per year
	N total fertilizers	Sum of the N quantity for each crop used per year
N output	N milk	N Total milk quantity production per year per farm
	N manure	N quantity of manure exports (sold or donation) not used on the land used by the farm
	N animal	N from sold animals per year per farm
	N dead animal	N from dead animals per year per farm
	N crop export	N quantity from fodders sold (not used for animal feed in the farm)
		N quantity of all the non fodders (sold or used for home consumption)

[4] FAO: Livestock and environment toolbox
http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Mixed1/LCroplR.htm

3.2.3 Social efficiency

Because social aspects are essential in the understanding of a farming system in the global framework of SES and because the improvement of social aspects can be directly related to the dairy activity (schooling of children, women empowerment…) we planned to investigate this subject but the very particular context didn't allowed us to have proper answer and reliable data. Thus the subject of the female work is very sensitive in Egypt. It's not socially well accepted for women to work in the farm (at least to confess it) even they have a central role in the milk activity (feeding, milking processing) (Ibrahim, 2006).

3.3 Hypothesis:

Egyptian context is quite unique: 80millions people on a limited arable land, with a complete dependency towards the Nile for the water supply. Food supply is a major challenge for this country and the ability to meet the increasing demand within the sustainable frame work will be one of the conditions of stability in this high social tensions environment.

First hypothesis: Technical and economical feeding efficiency increase the resilience ability of the small farming systems integrating agriculture and livestock activities.

Second hypothesis: Those integrative systems have, in the Cairo context, a very low efficiency regarding to the nitrogenous balance.

4 Materials and Methods

4.1 Questionnaire

Our research is based on interviews. We created a questionnaire (Appendix 53: Questionnaire used with during interviewAppendix 53) with 45 main questions to investigate the several topics of interest in our case. We can divide it into 5 parts:

- Family general considerations (management, history of the farm, education, composition of the family…)
- Land
- Crop production
- Animal production
- Representation of the main constraints and future of their activity

Within those several topics, we try to have a global understanding of the farming system of each family, by collecting qualitative and quantitative data based on the farmer's perception. The questionnaire has been tested and modified after a first test round with 9 farmers. We chose to lighten it and make it more adapted to the urban population (Appendix 53).

We targeted the last year or the last production cycle. The condition to be included in the study was too own at least one dairy animal. The core team of interviewer was compound by: Mohammed El Srougi (PhD student), Achmed Ali (APRI researcher) and we.

We collected GPS-point at every interview but, because we don't always visit directly all the farms, and because the farmer were coming to us sometimes, we can't complete a precise mapping of all the farms included in the study (Appendix 51).

4.2 Sampling

Within 3 months (from the 18 March to the 14 June 2013) we conduct 73 interviews.
Several areas were selected on the few data available on the dairy production and with researchers of APRI (Appendix 51):

- 3 peri-urban areas:
  - Manshiat El Bakary (1)
  - Saft El Leban (2)
  - Shalakan (3)
- 3 urban areas:
  - El Marg (4)
  - Omrania (5)
  - Dar es Salam (6)

- Sampling: "Snow ball sampling"

We interviewed 12 breeders in each area. Even if there is an official registration for farmers to the ministry of agriculture to benefit of theoretical support (veterinary support, insurance), most of the farmers are not declared to the authorities. They don't see any interest by acquiring an official status. This situation leads to a lack of inventory of the farms and especially in the urban environment.

Thus we choose to use the "snowball sampling" technique (Goodman, 1960). This technique of sampling is mostly used for exploratory investigation or "hidden population". It's based on social network of the subject that will guide the researcher to his next subject. In our cases, the only way to meet our interlocutor was to be introduced by some resource people well known by the farmers of the area. After we were introduced to 1 or 2 breeders and when they understand our goals they often accept to give us the contact of some other farmers of the area and so on, until we can found 12 breeders for each area.

4.3 Data analysis tools

We used several software to interpret data collected:

- *Microsoft Office Access*: it's a database management system from Microsoft Office allowing treatment on a large set of data. Thus we've create variables based on rough data collected on field (Appendix 48; Appendix 49; Appendix 50).
- *R and R-studio*: it's an open-access software developed for statistical and graphical analysis. We principally use the package ade4 to perform factorial analysis and the hierarchical clustering.

4.4 Typology

Typology approach is a tool used since the 70's to classify farming systems in groups with similarities and to offer a global understanding of those (Landais, 1996).

In our cases we worked with the data collected during interviews. Multivariate factorial analysis was used to produce a grid of lecture, which characterizes the main factors that distinguish farms and allowed us to class them. The Hill and Smith (Hill and Smith, 1976) analysis appears to be relevant in our cases to explore in the same time qualitative and quantitative data.

On those analyses we performed a hierarchical clustering (Anderberg, 1973) to isolate similar farming systems on their factorial analysis position.

The v.test function (from the tdisplay package) was used to interpret the hierarchical clustering and to characterize the relative contribution of each variable between groups. This function represents by graphic test-values for each variable. This technique was developed by Morineau (Morineau, 1984), test values represent the contribution of a variable to distinguish a class. They are measurements of the distance between the within-class value and the overall value.

5 Results

We choose to exclude three farms from the analysis; their extreme value (large herd size or large land size) didn't allow us to compare them with the rest of the sample.

5.1 Contribution of the variable to the factorial axes:

Hill and Smith analysis allowed us to identify several determinant variables that characterized the variability inside the sample of farms. The variability is well represented by two axes (**Error! Reference source not found.**).

If we observe the contribution of each variable on the factorial axes, two global tendencies can be described.

The first factor which is the most discriminating represents mostly the dairy production. Several economical and structural variables in direct link with the herd have a high contribution in this first factorial axis (dairy cash flow, dairy net income, average total milk production per year or the size of the herd in Tropical Livestock Unit, TLU) (Appendix 7**Error! Reference source not found.**). We can conclude that the variability of the farm is directly linked with the herd size and the dairy activity of the farm.

The second factor is mainly composed by variables in link with the crop production and the land availability (total area, total cultivated area). A second pool of variable contributes to this second axis construction related to the feed cost. There is a net opposition between the costs and the quantity of purchased feed versus the "land variable" (area available for the family) (**Error! Reference source not found.**).

However, the combination of the variables that contributes to the construction of theses axes are independent (perpendicularity) (Appendix 7).

5.2 Typology:

By performing a hierarchical clustering (**Error! Reference source not found.**) on the distance in the factorial plane of each farm (obtained with the Hill and Smith technique) we created 4 groups (Table 4: Name of the several group identifiedTable 4), described in the next section (Table 5).

Table 4: Name of the several group identified

Group number	Group label	Number used in the analysis
Group 1 (G1)	Small agro-breeders	15
Group 2 (G2)	Micro agro-breeders	23
Group 3 (G3)	Micro breeders	20
Group 4 (G4)	Small breeders	12

Projection of each farm on the factorial plane (Appendix 8**Error! Reference source not found.**) shows two homogenous (G2, G3) groups and two with more variability inside their cluster. The first axis (in link with the dairy animal production) clearly isolates G4 from the other groups in direct link with the general animal activity of the farm (Appendix 10**Error! Reference source not found.**). On the second axis, G3 appears clearly separated of other groups; this position is related to the land availability and (as consequences) the feed cost of those farmers (Appendix 11).

Table 5: Simplification of several characteristics of the typological groups and their relative efficiency in the fields investigate:

	G1	G2	G3	G4
Main goal of the production (crop and livestock)	Commercial	Home consumption	Commercial	Commercial
Large ruminant average head in the herd	5-6	1-2	5-6	>20
Average agricultural land cultivated (feddan) (own or rent)	3	1	0	0
Highly intensive feeding system	YES	NO	YES	YES

5.2.1 Several general considerations:

Several practices didn't differ between groups and need to be presented as previous results.

All farmers that we interviewed bought their concentrates. Even if they have the opportunity, they only produce fodders for their animals. We can assume that the concentrate cost for one dairy animal per day is the reflection of the intensification of the dairy production considering that the price of the concentrate doesn't differs enough to be significant between the several zone investigated. The main green fodders produced are the clover berseem (*Trifolium alexandrinum*) in winter and some maize fodder (Zea mays) in summer (several variety are produced more or less productive).

All farmers that own animal and practice cropping are using the animal manure to fertilize their land in addition of chemical fertilizers.

Qualitative variables didn't appear to be determinant in the creation of those clusters.

We didn't find a strong tendency for the selling of the milk. The global pattern is a direct selling. The consumers come at the farm gate to purchase two times per day raw milk. Even for large farms counting between 20 and 25 lactating buffalo, this system is working. Some of the producers own milk shops with refrigerating equipment in the farm or in another location in the city and transform a part of their production in butter, cheese or yogurt. Regarding the home consumption, the milk is transformed by the women in those same milk products and rarely consume as raw milk.

The large majority of farmers that we met inherit their activity from their parents. They inherit the land when it belongs to the family. When the family didn't own the land, most of the farmers rent the same land than their fathers. The main difference is in the contract between the owners and the farmer. Since 10 to 15 years, farmers have annual contract when the traditional agreement was signed for 10 to 20 years.

Today the average price for 1 feddan is around 4000 LE per year according to our data (with a standard deviation =1761LE) with the possibility to be expelled from the land every year. Within those annual contracts there is a large variability related to the sociological aspect and the history between the family and the owner that requires more investigation to be fully understand. For a large majority, even if the rent cost increases, they keep the same activity than their parents. Regarding the animal production,

farmers inherit their herd from their parents. The sharing between several brothers and sisters require again more investigation

Veterinary costs have not been taken into account in the global cost calculation because of the low reliability collected on field on those subjects. This cost was supposed to cover the expenses for medicines and veterinary visit. It was very hard for the farmers to estimate those costs. There is an important variability within the sample; from farms where none veterinary come (mostly small farms) to a high veterinary monitoring of the herd (1 visit per week) for some large commercial farms.

Data related to the reproductive performance of their animals wasn't reliable. Those data consider long term information that requires some registration to estimate properly an average on the herd. Yet this registration is not operational in the Egyptian context (no animal identification, illiteracy…) at the exception of 2 or3 farmers that we met thus they were not used.

5.2.2 Small agro-breeders (G1)

This cluster regroups the farms with a mixed activity (animal and crop production) but with a high capital (herd or land).

Animal incomes represent 63% of the annual farm net income (Appendix 34). Within this animal production, milk product represents 61%, of the annual animal products (Appendix 37).

Those farmers usually own 5 to 6 dairy buffalos (Appendix 20). The dairy herd produces around 20,800 kg (Appendix 23) of milk per year creating a high dairy net income that reaches 58 039LE (Appendix 32) per year. The proximity between the dairy cash flow (47129LE per year) (Appendix 31) with the dairy net income traduces the selling strategy adopted by those producers. The other animal incomes provide from the fattening activity, with an average of 6 fattening animal's (Appendix 22), number quite high if we compare it to the dairy buffalo number.

Those producers combine with their animal production often a large (comparing to the rest of the sample) cultivated area (rent or owned) with a median of 3 feddans (Appendix 24) but with some large variations. Most of the time all the land is used for crops with a variety of cereals (maize, wheat, rice), fodders (berseem clover in winter or fodder maize in summer to feed their herd) and truck crops.

This fodder production gives them the opportunity to decrease their feed cost. The median of a daily ration cost for a dairy animal is around 23.3LE (Appendix 40) with a fodder cost of 6.2LE (**Error! Reference source not found.**) (which represents for a large part the production cost of this fodder) versus a concentrate cost 16.5LE (Appendix 39).

Those two activities create a rather high farm net income (median reach 91386 LE/year) (Appendix 30) comparing to the rest of the sample.

The majority of those farm didn't receive any complementary income from external family members that work outside even if the large heterogeneity of this sample doesn't allowed us to generalized this consideration. (Appendix 28; Appendix 29)

Figure 2: Pictures of typical G1 characteristics

5.2.3 Micro agro-breeders (G2)

Those farmers are principally crop producers but they produce some milk for the home consumption and sell sometime the extra amount of milk production.

Animal productions constitute around 40 to 50% (median=44%) (Appendix 34) of the annual net income of the family. The herd is often composed by only one or two buffalos (Appendix 20: Variability within and between classes for the number of dairy buffalo and average milk production per year is around 4 702kg (Appendix 23) per farm creating a negative dairy cash flow (Appendix 31) but a slightly positive dairy net income. This difference can be explained by the large amount of the milk production consumed by the family and take into account only in the net income (Appendix 32). Like the rest of those farmers, they practice some fattening but this activity remains quite small in the economy of the farm.

Those farmers to complete their revenue have the opportunity to produce some crops on small size area (median=1 feddan) (Appendix 24). Like the previous groups they plant several cultivations, mostly for home consumption: cereal (maize, wheat), fodders (berseem clover in winter or fodder maize in summer to feed their herd), truck crop for home and selling. Within this group we can distinguish farm owning their land and farmers renting the land that they cultivate. The fodder production allowed them to decrease their feed cost to17.8LE per day for a dairy animal (Appendix 40), the lowest of the typology. The production of the fodder contributes to this “low cost feed” but it is not the only explanation. The average concentrate cost for one dairy animal within this group also appears to be the lowest (Appendix 39) which traduce the low intensive feeding system.

This combined activity of cropping and animal production allowed them to have a positive family net income which remain quite small (28 806LE/year) (Appendix 30).

Approximately one member of the family is employed on the farm but some members 1 to 2 are working outside (Appendix 27) which complete the global income of the family and allowed them to have a positive balance (average 60 156LE per year).

Figure 3: Pictures of typical G2 characteristics

5.2.4 Micro breeders (G3)

This group is oriented on animal production only (100% of their incomes come from animal production (Appendix 34). Those families don't own any land and need to create all of their incomes with the animal production.

They usually own small sized herd; the average is around 6 dairy buffalos per farm (Appendix 20) and produce an average of 12 589 kg of milk per year (Appendix 23). The dairy product created with the milk activity represents almost 70% of the animal product of the farm (Appendix 37). We can conclude that the rest come from fattening activity even if the median number of animal in fattening the day of the visit was around 1.5 fattening animals (Appendix 22).

The average family income of this group is the lowest of the typology with a negative net income of -6 431LE per year (Appendix 30). We can link this negative net income with high feed cost: the cost to feed one dairy animal (buffalo or cow) is around 30 LE (Appendix 40) with the highest cost for the fodder per dairy animal per day (12.9LE per day) (**Error! Reference source not found.**) and in addition a high concentrate cost Appendix (Appendix 39) too that we can explain by the intensive production technique they are using.

Those kind of farms employed one or two people of the family in farming activity (Appendix 28). For most of those producers the working force is not employed outside of the farm (Appendix 27) to create some complementary revenue and increase the global economical balance of the farm.

Figure 4: Pictures of typical G3 characteristics

5.2.5 Small breeders (G4)

All the economy of those families is focused on intensive milk production. All of their incomes provide from the animal production (Appendix 34). Those farms raise the biggest herds with an average of 26 dairy buffalos (one of the farm held 120 dairy Buffalo inside the city). They produce an average of 143 433 kg of milk per year and create a very high dairy cash flow if we compare to the other (average=370 209 LE) (Appendix 31); the dairy net income is as consequences very high and with a similar value.

The dairy products represent almost more than 80% of the animal farm products (Appendix 37). Even if it's not their main activity, they own the biggest fattening heard (median around 7 animals).

Those intensive farms are (one farm is an exception to this pattern) devoid of land (Appendix 24) thus they don't produce any feed for their animals but still adopt an intensive strategy. This leads to the highest average feed costs. For one dairy animal the median feed price reaches 37LE per day (Appendix 20) mostly composed by the concentrate cost (Appendix 21).

They create the highest farm net incomes of the several groups of the sample with an average of 372 200 LE per year (Appendix 30). On the fields of human resources, they have the highest numbers of family workers in the structure (Appendix 28).

Figure 5: Pictures of typical G4 characteristics (on the top right position: a cowshed entrance under building).

5.3 Typological group distribution within the several areas investigated.

Distribution of the several groups is directly linked to the area (Figure 6: Distribution of the several groups of farm within the 6 area investigated**Error! Reference source not found.**). We can see that the peri-urban zone (1, 2, 3) shelter mostly micro agro-breeders due to the land availability. At the opposite pattern the fifth and the sixth count mostly micro-breeders when in El-Marg area (4) we find more than 50% of small breeders.

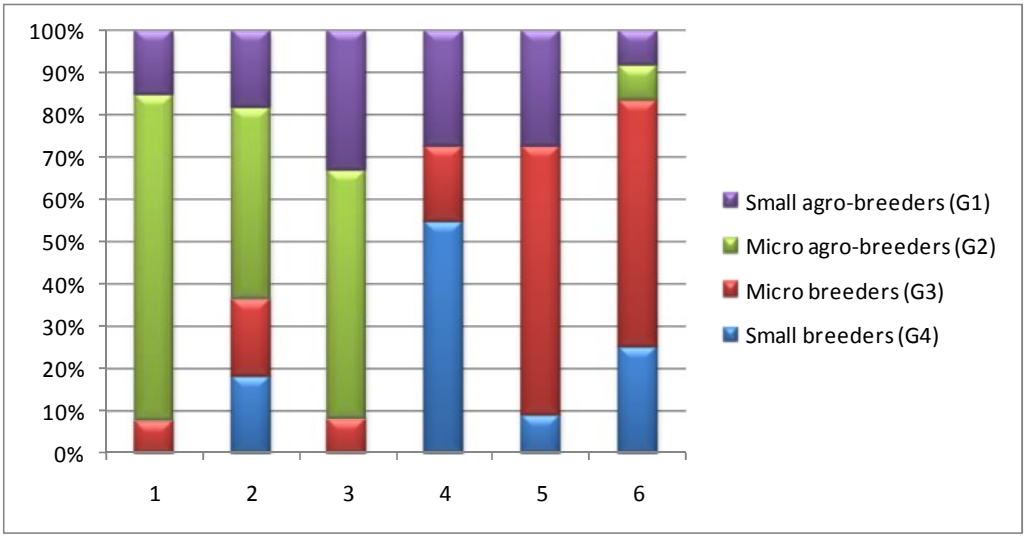

Figure 6: Distribution of the several groups of farm within the 6 area investigated

5.4 Farmers struggles

Farmers were asked to class problems they are facing in their activity. The most recurrent complain is the feed prices (Figure 7). Veterinary services access appears to be the second most recurrent struggle for them. A lot of farmers accused the Foot and Mouth disease to be responsible of almost all of their animal mortality and most of them were complaining against their veterinary services (training of the veterinary and prices). Rest of the answer is more specific to each farmer but several of them they evoke the soil fertility problems, the inputs prices, the land use pressure and their vulnerability in link to their rent cost and annual contract.

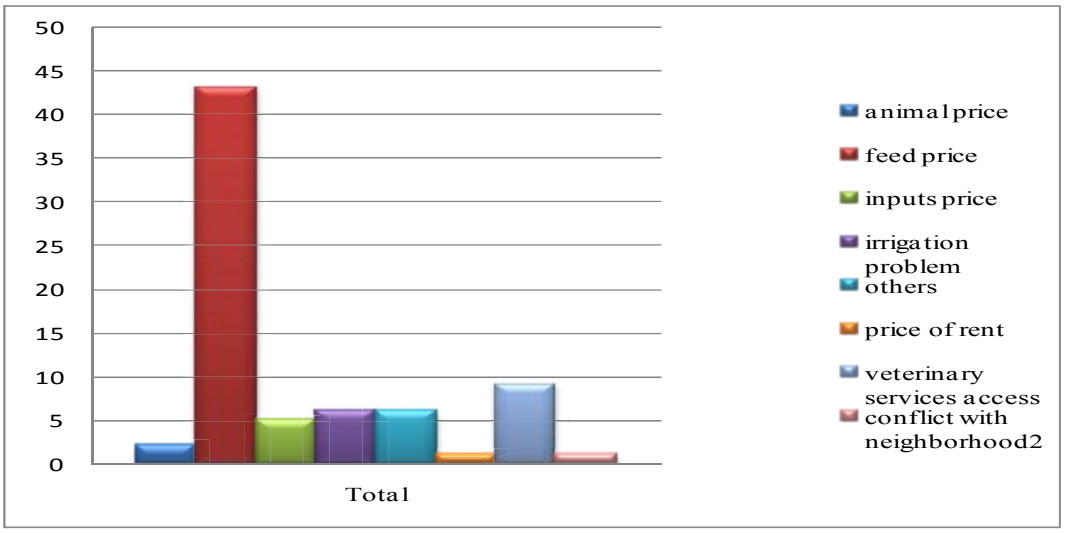

Figure 7: Major struggles from the farmer point of view

5.5 Efficiency

Now that we describe those groups we will focus on the efficiency of those groups to describe general trends.

5.5.1 Feed efficiency: technical efficiency

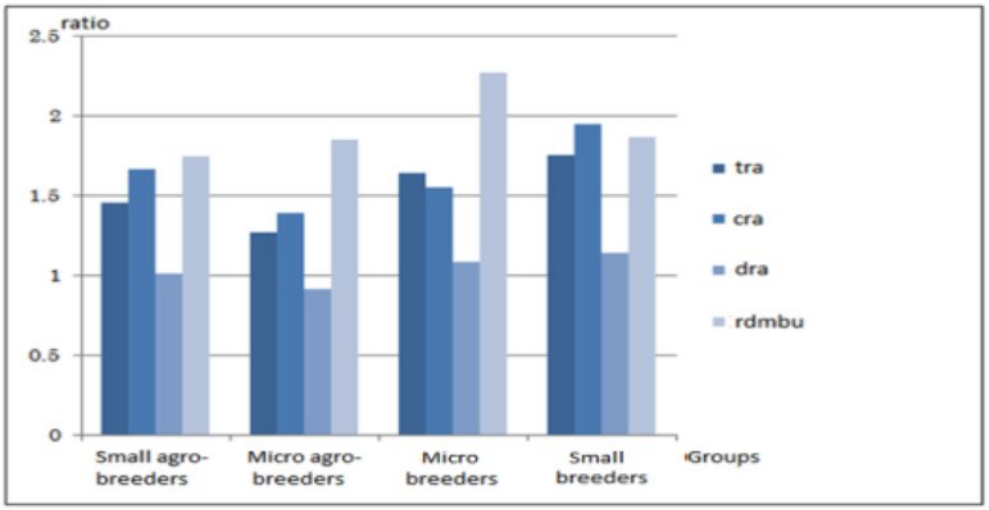

Figure 8: Technical feed efficiency by groups

- TDN, CP, DM (Figure 8)(Appendix 43,44,45)

As we have seen previously we try to approach the quantity of TDN, CP and DM ingested by a lactating animal on the base of their daily ration. Thus with compare it with standards requirement of a dairy buffalo.

Second group is the closest to the norm for the TDN and the CP quantity that they give to their animals but the DM quantity is slightly under the norm. In the first group we can see that the average feeding per day covers the DM matter requirement however the ratio for the TDN and CP is higher than the norm. The third and the fourth have quite similar values; above norms for all the parameters. Differences between groups remain slight; those values can be used as tendencies.

- Ratio DM on the average milk quantity per day(Figure 8)

Test value don't appear to be extremely different between groups identified which allowed us to say that there is no significant difference between those groups and the way their animals optimized their DM intake to produce higher quantity of milk even if agro-breeders appear to be more efficient in this field.

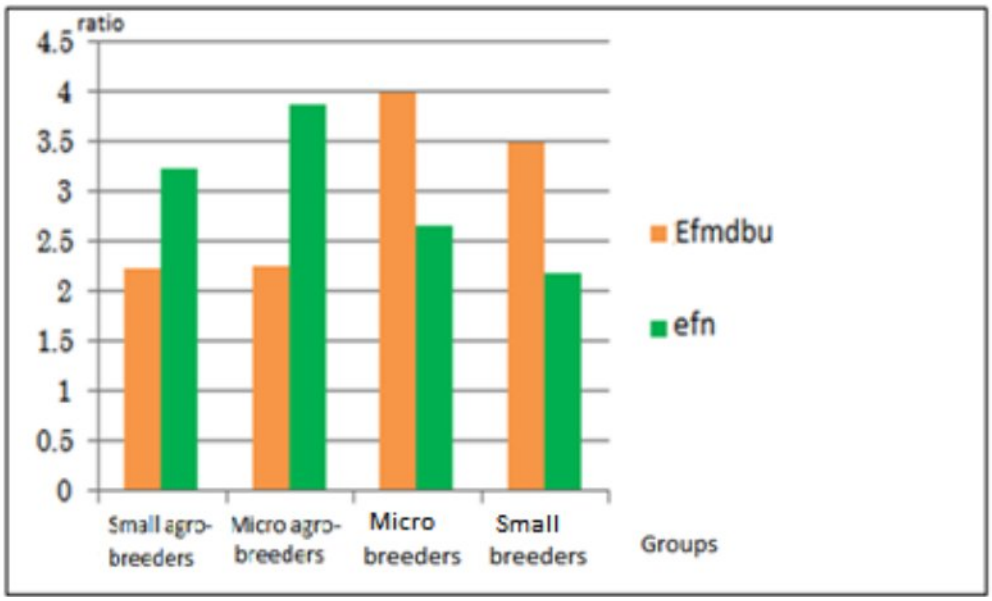

Figure 9: Economical and environmental feed efficiency between groups

Feed efficiency: economical efficiency (Error! Reference source not found.)

This parameter is the ratio between the daily feed costs for a dairy buffalo and the average milk production per day of a dairy buffalo. To be more efficient, this milk production process needs to be as small as possible (by decreasing the feed cost and keeping the same milk production or increasing the milk production without changing the feed cost).

We can visualize on the test value that the agro-breeders (G1, G2) are emerging from the other groups with the lowest value (Appendix 41 : Test values on variables related to the efficiency by typoligical groups Appendix 42) which mean that on an economical point of view they have the more efficient feeding system. This is confirmed by the global pattern of the median of the economical efficiency and the variability between groups (Appendix 46). Breeders (G3, G4) are at the opposite; it appears that they are the less efficient regarding to the feed cost.

5.5.2 Environmental efficiency (Error! Reference source not found.

This efficiency represents the ratio between the global N-outputs and the global N-inputs at the farm scale level on one year.

Small breeders (G4) appear to be more efficient than all the other farming systems (Appendix 41; Appendix 42). The micro breeders (G3) are less efficient but they remain quite similar (Appendix 47). The two remaining groups (G1, G2) have almost four times more N-input than N-output.

6 Discussion

6.1 Biases of the study:

Several biases having an influence on the collected data and the quality of the results can be pointed:

- Snowball sampling biases:

It is a non random sample technique with a major influence of the first interlocutor. Indeed this first subject in an area is determinant to meet the rest of subject within an area because he introduces us to the other. We try to orientate towards a higher diversity during the sampling to be as much as possible representative of the several systems inside and around Cairo city.

- Biases of interviewer :

Like every process that requiring interviewing, the interviewer includes some disturbance and influence the quality of the answer of the interviewed.

- Biases from farmers (consequences of sociological aspects):

The political context and the general mistrust towards governmental institution combine to the fact that it is quite a secret activity; considerably impact the ability of farmer to answer to us.

There is very complex interaction inside the family because of the intimate relation between farm and family activity. By entering in the farm activity we were entering within the family intimacy and it sometimes create some reticence to answer.

- Quantity assessment:

Data quality is directly influenced by the sampling technique, interviewers or the reluctance of some farmers to speak frankly (in direct link with the political context). One of the main difficulties for them was also the ability to estimate a quantity. In fact, it is not easy to estimate a quantity of green fodder without any weight and the variability can be quite important. To optimize the quality of those answers, we confront them with literature (for the quantity of fodder and from our observation on the field). The best way would have to weight those quantities (feed quantity, milk quantity…) to obtain objective data but it was not conceivable within this project. After the calculation of our several parameters we strive to confront it with our observations and with the farmer's declaration to make sure that it corresponds to their reality.

- Cost and product estimation:

Costs estimation was sometimes very hard to obtain especially feed prices. Most of the time those producers evolved in a rapid dynamic environment with many variations and perturbations (feed prices, animal prices…). During interviews, questions treating of synthesis on 1 year activity were very hard within this context (variation during the time of the number of animals thus of the quantity of feed purchased…).

The "average value" (feed quantity purchased, the number of animal sold in large farm) was very hard to synthesize for them when there is no registration of all those events. Due to this phenomenon we avoided using data related to veterinary cost. Beside of this we did not take into account several long terms expanses (credit, taxes …) thus it is a possibility that the total charges pressuring the farm were underestimated. In the same way, we did not take into account the fact that some of the milk is used for the growing of the calf, at least until the weaning in the product calculation which increases the real amount of milk available for selling.

Thus results need to be used as a global estimation, especially on the economical field.

- Family and work force

The "nuclear family" as it is understood in occidental countries is hard to transpose in the Egyptian context. Families are often seen as large entities with a common goal and interaction. The cash flow and retribution of the work within this entity appears to be very complex. Thus the cost and level of employment was hard to approach. The general structure of the family work force (which represents the majority of the work force in the farm) can be presented as follow:

- Full time farming activity
- Part time farming activity with or without external jobs
- Extrafarming activity without direct retribution (no salary)

In addition to those family workers; external workers with a salary can be employed. Estimation of the number and global cost of those external workers is hard to get because it is dependent on family members availability. This consideration impacts principally the estimation of labor employment cost for the cropping. We tried to consider an average cost based on similar farming systems of an area to approach this value when it was impossible to obtain the external work force cost.

This complex family entity impacts the income estimation too. In several families, a capital (land, animal) is entrusted to a family member in exchange of retribution (money or goods) but this dimension within the family requires further investigation to be fully understood.

To conclude on the family subject, we need to mention that women employment is a very sensitive topic. It appears that woman are key resources in the milk production process (feeding and milking) (Ibrahim, 2012) and transformation but also in the cropping activity (from our observations). The phenomenon of "informal" women work is very common in Egypt (Gowayed, 2011). Thus, if male farmers (only 2 women were in charge of farms were met) mentioned easily the woman's role in the milk processing activity, they are rarely mentioned for other activities. Child labor is very hard to discuss during a first meeting. Most farmers claimed that children are schooled and are sometime helping in the farm[5].
While child labor was witnessed during this study, it remains hard to estimate their real importance.

[5] Children schooling: according to World Bank, in 2011 the schooling of children in primary school reached 95.6% of the Egyptian child population.

6.2 Technical and economical feed efficiency: an asset towards resilience for small farmers.

The political crisis drives the country in dangerous economical crisis. Even if the situation began to be instable before the first revolution; since three years the country plunged into a dramatically situation. Inflation explodes the national debt increase due to the diminution of country's incomes (decreasing of the tourism activity and international investment).The country is more and more dependent on international funding and the Egyptian pounds (LE) value is rapidly decreasing in the international market.

Within this context it appears essential for producers to limit the impact of this national crisis on their activity and to "survive" during those dark times. The major impact of this economic crisis on the agricultural level is the global increase of the input cost. Both in animal and cropping activity, prices of inputs (imported and locally produced) rose up and exposed producers to extreme charges. Tendency confirmed by the general opinion of farmers: feed costs represent their major struggle (Figure 7).

The dependency of farmers on external production factors will directly impact their ability to go through this crisis. Thus if those producers are able to decrease inputs required without decreasing their production (output), which represent an improvement of their efficiency, they will improve their resilience ability.

- Technical feed efficiency and resilience

Technical efficiency confirms the link between efficiency and resilience. By reducing the amount of dry matter required to produce one kg of milk, farmers decrease their dependency towards inputs.

In our cases, micro agro-breeders (G2) which own small herd appear to be the more efficient in their ability to valorize the feed that they use. Their low intensive ration with a high amount of fodder allowed their animals to optimize their daily intake. At the opposite situation, intensives farms deprived of land appear to have a lowest efficiency feeding system (G3, G4). By using lowest amount of fodder and large amount of concentrate they provide more than the theoretical requirement which represent a waste of nutrient and animals aren't able to valorize their dry matter intakes as animals in the small mixed farming systems.

This low efficiency of high intensive feeding system can find his origin in the rumination phenomenon. Buffalos and cows are ruminant animals which require large amount of fodder in the feed composition to provide an optimal activity of the rumen. A lot of producers, focus in the concentrate feed to the detriment of fodders thinking that dairy animals will increase their milk production. But a large amount of highly energetic feeds (concentrate) lead to a suboptimal valorization of the intake (sub-optimal ruminal fermentation due to the lake of fiber) and can even lead to a chronic acidosis. This situation has thin and long term consequences on the animal health (mammitis, low reproductive performances …) which impact deeply the global efficiency of the intensive feeding system (ENEMARK J., 2008).

- Economical feed efficiency and resilience

The ability of a farmer (and of a farming system) to decrease the price of his feed costs can help him to better resist to the external variation of the feed prices. Determinant of this efficiency can be separated in two independent factors.

The first component is the strategy adopted by the farm towards the concentrate feed. As we have seen previously, all farmers investigated use concentrate. Thus for all those farms, concentrate represent between 60% and 80% of the global feed cost (Appendix 39). This concentrate is never produce inside the farm but purchased to local traders. Most of the time, farmers use bran, maize, soya been…a variety of feed

providing from Egypt or international market. The national inflation combined with the increasing of the international prices of those goods lead to a direct increase of the prices on the local market.

. Because the concentrate prices didn't differ enough within Cairo city to be taking into account; the intensification level (the proportion of concentrate within the daily ration) appears to be directly linked with this economical feed efficiency and resilience ability. Thus micro agro-breeders (G2) appear to be in better place than the rest of the farming system because there are less dependent of those market variations to produce a kg of milk than more intensive farms.

On the other hand, the fodder cost component influences the global feed cost and by this the economical efficiency of the farm. As we have seen, fodders are essential in the feed of a ruminant. Farmers with land to cultivate (own or rent) have the opportunity to produce green fodders for their herd. This production cost, even if it is dependant of the fertilizer and crop's inputs market, remains lower than fodder's prices in Cairo. Fodder's prices are rising up since several years due to the increasing of the production cost (land availability, input price, decreasing of the soil fertility). Micro agro-breeders (G2) often separate their land in two: half of the land for fodders, half of the land for human consumption (cereal, truck crops). By producing their own fodders for their herd they are able be more efficient regarding their feed costs. Thus they are less dependent on the feed market and by this their resilience ability is increased. Small agro-breeders (G1) applied the same system: producing enough fodders for their herd when the rest of the land is used for cash cropping (cereal and truck crop) and win in economical efficiency too by comparisons of farms deprived of land access. Those have to purchase their fodders which represent a major expense in the economy of those farms.

Farmers without land access appear to have a low efficiency in their economical feeding system due to: the amount of concentrate used (intensive feeding system) and their inability to produce fodders. They appear highly exposed to the variability of the market prices both for concentrates feed and for fodders and their resilience ability is directly impacted by this dependency. Small agro-breeders (G1) represent an intermediate situation. By producing some fodders, they increase their economical efficiency but their intensive feeding system negatively impacts this efficiency so as their resilience ability. Micro agro-breeders (G2) appear to be more efficient by combining a lower intensive strategy with the opportunity to produce their fodders.

The higher efficiency both in the feed utilization and in the feed costs field, of micro agro-breeders (G2) that have the opportunity to produce some fodders allowed us to conclude that those farmers with a low intensive strategy appear to be the more resilient to the external variability of the market prices.

At the other hand the micro breeders (G3) seems extremely exposed to variations of the feed market. Their actual economical results (negative average) confirm this tendency and the decreasing number of those farming systems (reported by farmers) support this theory.

The two largest scale farm with or without land (G1, G4) are in intermediate situation. Small agro-breeders (G1) take advantage of their fodders production but remain highly dependent of external market due to their intensive feeding strategy. Small breeders (G4) appear to have extremely low resilient capacity concerning their feed supply.

6.3 Cropping activity and Nitrogenous efficency:

If groups with land are more efficient than the rest of typological groups in term of feed cost and technical feed efficiency, it's the opposite regarding the nitrogenous efficiency.

Efficiency can be linked with the management of the manure and fertilizer within those farming systems. In systems without land (G3, G4), most of the N output are removed from the farm (milk, animal, manure). Manure can't be valorized inside the farm and need to be rapidly removed to avoid sanitary troubles in the herd and complaints from the neighborhood in this (often) urban environment. Thus the

manure management is well structured to organize the flow of manure outside the city. It's mostly the competence of traders. Those operators own the equipment (pick-up) to remove this manure from urban area. It is important to mention that most of them didn't pay farmers to obtain manure; taking advantage of the impossibility of those farmers to remove it by themselves. Traders sell manure outside the city where organic matter is highly valuable (New Reclaimed Land for example). The nitrogen flow within those land deprived farms thus is quite efficient.

Concerning farms that cultivate land (G2, G1) N input is much higher than N outputs. The crop technical itineraries are directly involved in this phenomenon. In addition of their animal manure that they spread on land in winter after a composting time, they use large amount of urea in field especially on truck crops. The productivity of those truck crops respond rapidly to large amount of nitrogen. Actually there is not any control regarding the nitrogen utilization in Egypt which offers to farmers the possibility to use those large amounts of fertilizers but which represent a potential waste of inputs and represent a potential pollution for the water quality (eutrophication). N quantity fixed by berseem (leguminous) was not taken into account. This quantity comes in addition of all the several source of N (manure, fertilizers).

6.4 Land availability

The opportunity to cultivate a land appears to be determinant to reach economical and technical efficiency in the dairy activity. Farmer's in this situation (G1, G2) are not equally armed to face land pressure. As we have seen, Cairo city is rapidly growing and conversion of the agricultural land is a major concern of the country and at farm level this phenomenon has direct implications.

Development of the city generates two major phenomenons that impact directly those mixed producers.

- Price of the land increase and farmer can be in two situations. If they own the cultivated land, they are sitting on a gold mine taking into account that the price of a square meter in Cairo is extremely high. But for farmers renting their land to produce, the situation appears to be dramatic. With one year contract and the major increasing of the rent prices since last decades, they appear to be extremely vulnerable towards land's owners. Their global feeding system efficiency and his resilience corollary towards the feed prices variability need to be confronted to this dramatic situation that several farmers are facing. Every year, owner can decide to sell their agricultural land to convert it into buildings without any option for the tenant.
- Decreasing of the soil fertility seems to be a real problem at the gate of the city. With buildings comes the impossibility to drain properly the soil. Thus water and salt ration slowly increase leading to a dramatic decreasing of the soil fertility until those producers have to stop their production. We have the opportunity to meet several farmers in this case: they were possessing land but weren't able to produce on it because of the very low fertility of it.

6.5 Farm incomes diversity:

Selling components of those farming systems need to be evoking because it contributes to resilience capacity. By diversifying their production, mixed farms have the opportunity to find multiple sources of incomes. For examples a typical farm of the first group with 3 feddans and a small herd of 4 to 5 dairy animals will sell: milk, animal, cereals, trucks and sometimes fodders. Diversification represents a major security in the economy of the farm. Thus if the price of one of those components decrease because of market variations, they would be able to balance it by finding incomes from the rest of their activities and this will moderately impact the global income of the farm. At the opposite side the commercial farms only focused on animal production (G3 or G4) and especially on milk activity are totally submitted to this

incomes source and appear less resilient to external factors. If the Egyptian milk price didn't seem to fallow a decreasing tendency the situation remain concerning in a market open to external goods.

Another major concern for producers is the milk quality assessment. With the arriving of new major companies the quality control which is not yet established in the informal milk supply chain can be a new exigency which would require new costs and put new pressure on those exclusive producers.

The way towards sustainability (national agricultural strategy) of Egyptian agriculture requires taking into account economical, technical, environmental and social efficiency with a high resilience capacity of farming systems. This resilience ability offers to those farming systems the ability to resists to several stresses that a farm can cross in time. We have seen that micro agro-breeders (G2) integrating animal and crop production appear to be more resilient to external feed prices variability but have a large margin of progression regarding the environmental efficiency. Again renters of land; even if their able to better face the variability of feeding prices are extremely exposed to the land pressure. By multiplying their sources of incomes out of agriculture, they enhance their resilience ability to market variations.

Now that we evoked the current situation, we will review in next points the possibility of improvement of the resilience ability of those several farming systems.

6.6 Towards an improvement of resilience and sustainability of those Egyptian farming systems

6.6.1 From the farmer's initiative:

Because they are confronted every day to stresses (feed and meat prices variability, sanitary crisis…) Cairo farmers develop innovative strategies to increase their efficiency both in technical and economical fields. Thus they increase their capacity to maintain an animal production within the border of this giant city.

- Feeding system

Farmers to survive in this high feed prices environment developed innovative feeding strategies. They use the great adaptive capacities of Buffalos to use rough fodder and their tolerance to receive changing ration compared to cows to use a large variety of feed types. 22 types of feed during the study (Appendix 52: Feed table; average price in Cairo market during the study, percentage of: (i) Total Digestible Nutrient (TDN); (ii) Crude Protein (CP), (iii) Dry Matter.were distinguished. Among classic feed components (berseem, maize fodder, wheat, grain maize, soya been) we can find several by-products stemming from food-processing industry and cereal by-products coming from the local market.

Let's review some of them:

- Sugar cane straw: it offers a great opportunity to valorize the by-product of the numerous juice shops in Cairo and to offer dry fodders in order to increase the fiber proportion in the daily ration.
- Bean straw: was previously mostly used for small ruminant is used in large ruminant too.
- Rice straw: used to compensate the high prices of wheat straw, some farmers have very interesting technical results with this dry fodder.
- Biscuits: farmers use it to feed their animals as a concentrate component. They supply themselves in biscuits industry or in school restaurants.
- Bread: unused bread is collected by traders in bakery and in families.
- Fruit residue from the juice companies that can be use after silage.

But because of the recent increasing of the demand, the prices of those "new feeds" began to increase and to slowly lose their major advantage: their low prices.

- Management of the herd:

Several farmers fully oriented on the milk production choose to held only lactating buffalos. Thus at the end of the lactating period, the dairy buffalo is sold and a new female is bought with her calf. Objective is to keep in the farm only producing dairy animals without feeding any dry buffalo (or cow). It allowed avoiding risks related to the calving in addition to spare money by feeding only animal that provide direct income to the farm. This practice is mostly found in micro breeders (G3), other farming systems prefer to control the selection of the herd. In lots of cases in this kind of management, replacement animals have high milking potential and provide from outside of the city (other governorate famous for their dairy activity).

This very short turn over can explain the very highly intensive feeding system that those farmers use. Because animals will not stay in the farm for a long time (6 to 7 months), the consequences of a chronic acidosis, create by the high amount of concentrate, which appear in middle-long term will not necessarily impact the production process within the farm. They try to take the maximum milking potential of an animal within a short lactation without long term health considerations.

Some of those farmers avoid to raise their calves after the weaning period in order to spare the money invest to grow those calves. To renew their herd they bought adult buffalos at the beginning of their lactating period (with their calves). They also bought animals around one year to make some fattening (mostly cow calves) and take advantage of the highest growth rate potential of those animals at this age.

- Milk sale

If buffalo's milk is highly valorized, cow's milk, because of his lowest fat content, is depreciated in Egyptian traditional market. Some farmers, to take advantage of the high production of Baladi-Holstein crossbreds, own within a buffalo herd one or two cows. Two strategies can be adopted:

- Cow's milk is mixed with buffalo's milk and sale at the buffalo milk price.
- Buffalo's calf after a short time (around 10 days) under his mother is raised with cow's milk which allowed an increasing of the amount of buffalo milk available for sale.

- Housing

Animal housing has to be mentioned in this urban environment. Cowsheds are often inserted in the first floor of the family's building. Animal are attached during the all day and can drink two times a day after each milking. In this confined environment and in order to maintain a low moisture of the soil, some farmers use wood litter. Carpentry shops (concentrates in several streets within an area) and farms investigated were often in the same location. One of the farm investigated even integrate the all chain: family owns a large herd (40 dairy buffalos and 50 fattening calves), carpentry and a bakery. All the by–products of the other activity are used for the herd.

When the family can use some land, animals are often taken in the field in the morning in small animal's house (mostly wood construction) to avoid the fodder transport inside the city (where the animal spend the night) under the family building.

All those several techniques show the capacity of those famers to innovate and to take advantage of their environment to be more efficient in their production process.

6.6.2 Improvement of the resilience capacity in the future

- Organization

First step to promote and preserve this activity is to help this professional community to be organized. Actually there is no effective organization to defend the breeder's interests. For several reasons, like the disappointment towards previous organizations of governmental cooperatives or the intimate character of this breeding activity, it's very hard for lots of farmers, at the exception of young breeders, to visualize the interest to promote a strong independent breeder's organization.

But because of this division and of the absence of visibility of their activity it's hard for them to have an access to any consideration by politics or researchers.

Once a form of organization will be born several fields can be improved. Organizations are essential in order to help producers to support the increasing pressure on their activity in the future (arriving majors companies, new quality requirement…) and to develop the efficiency of those farming systems.

- Sanitary:

Sanitary troubles generate important direct losses in the herd. They are one of the major struggles of farmers and questioned the quality of animal products. Several actions can be considered in order to improve those sanitary aspects to help those farms to reach a higher global efficiency level:

- Sanitary training appears to be crucial. Lack of veterinary close to farmers or the inability of very small sized farm (G2, G3) to afford veterinary services require the training of farmers in animal health basic skills. Thus they would be able to treat common disorders (diarrhea on calves, parasitic management…) and to recognize major diseases in their herd. Those trainings by approaching feeding requirement of a ruminant can improve the use of several feed available on the market by farmers and limiting the nutrient waste observed mostly in the highly intensive farms.
- Veterinary and researchers have an important role to play in partnership with APRI to protect those farmers against major herd diseases. In this context of high proximity between animal and human population, zoonotic risks has to be considered too. Identification of the herd will be an essential requirement at the national scale to improve the national sanitary level.
- Milk quality concept need to be taking into account at the same level than the milk quantity (which is actually the main goal). Training of those farmers on the milk quality concept (organic contamination, medicines residue…) will be an obligation in a close future to respond to the new requirement of consumers and will help them to respond to future consumer requirement. Organization of the milk quality assessment chain can be a great opportunity for those organizations to evolve towards the new market and win some professional credit.

- Technical crop training

N inputs highly overpass N outputs on farms with land to cultivate (G1, G2) even if it is a rough estimation. Important environmental efficiency gains can be expected in the future to reach the sustainability goal. Major driver of the low nitrogenous efficiency is the large amount of inputs used on land. Those producers, in cooperation with state and research services, will have to find ways to improve their environmental efficiency (mostly by decreasing their chemical fertilizers utilization) in order to decrease their dependency to inputs market. By this they will increase their resilience and in the same time evolved towards a more sustainable system.

- Optimization of manure utilization with new reclaimed lands

Manure management can be a great opportunity for breeders of the Cairo area especially indoors farm (G3, G4).

There is a great opportunity for those farmers to better valorize their manure and create a new source of incomes. The country is trying to improve the total national arable area in several places in the country. Those New Reclaimed Land are sandy soil land where government is trying to develop agricultural activity. Increasing of the organic matter in those soils is crucial and animal manure appears to be a great opportunity to help into this process. Until now in most of the farms without lands traders take out the manure of the farm for free (breeders cannot negotiate prices because they are inside the city and need to decrease the disturbance for their neighbor), those traders are the only chain to get rid of this manure. The challenge will be to organize a flow of manure between the city and areas in demand that can directly profit to farmers. Again the only way to structure those kinds of large scale transfers requires a strong breeder's organization.

- Feed prices

Trough organizations, farmers can decrease their feed prices by grouping purchase of inputs. Until now there are dependant on small retailers or on black market; at the end of a long inputs supply chain. Thus prices at the end of those long chains are important because every link of the chain need to improve slithgly the price. Organizations can offer opportunity to negociate wigh? higher level and to reach better prices by buying important quantity in the same time to wholesalers.

Research can improve with farmers their feed efficiency by testing new feeding technics or new crop varieties which can improve animal technical efficiency (better valorization of dry matter) to decrease feed costs

- Political weight

It is essential for those farmers to gain in visibility and in political weight. Egypt is facing a major political and economical crisis. If those farmers were waiting for some considerations from politics and for some financial help, it seems that this possibility is disappearing from their expectations.. Trough organizations they need to enhance their political strenght to be able to :

- be represented to influence future land policies, to protect small scale farming systems in peri-urban areas against the land pressure, or on the natural ressources attributions…with their government
- be able to face arriving of new international companies in the milk market of Cairo. Demand will continue to increase and major companies are massively arriving to take advantage of this situation. To survive in the urban and peri-urban environment and continue to provide milk with very short supply chain, they will have to be competitive with those large companies in term of quality and prices. Development of a quality label can be a good way to join the high quality market and valorize their ancestral skills.

7 Conclusion:

Egypt imports a large proportion of its food requirements due to its high demographic pressure and limited resources availability. This leaves the country extremely exposed to the international variability of these goods.

At the producers level this situation has direct implications because they directly suffer from those changes. Four main farming systems may now be identified. For each their alimentary efficiency has been estimated too. This study has also explored one component of their environmental efficiency: the Nitrogen balance. Several points emerge from this research within this particular context:

- Intensive feeding strategy decrease farmer's resilience.
- Opportunity to have access to agricultural land increases their resilience.
- Land pressure threats all those farmers but farmers renting land appear to be more vulnerable.

Since millennia those farming systems have had to find innovative strategies to exist in the extreme environment of Cairo city. It is likely that they will have to find a way to adapt their activity to the highly changing market and to find a way to resist the arrival of large dairy companies in the countries.

Unfortunately, the political and economical crisis in which Egypt is actually diving does not allow them to expect major help from their authorities. Solutions may be found in the cooperation of stakeholders involved: producers, consumers and researchers.

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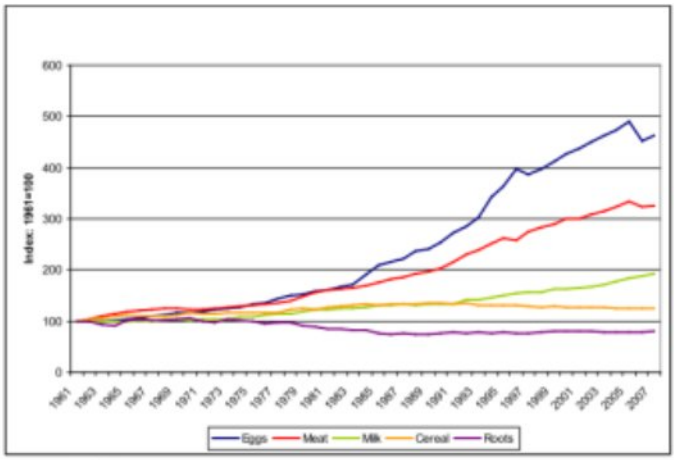
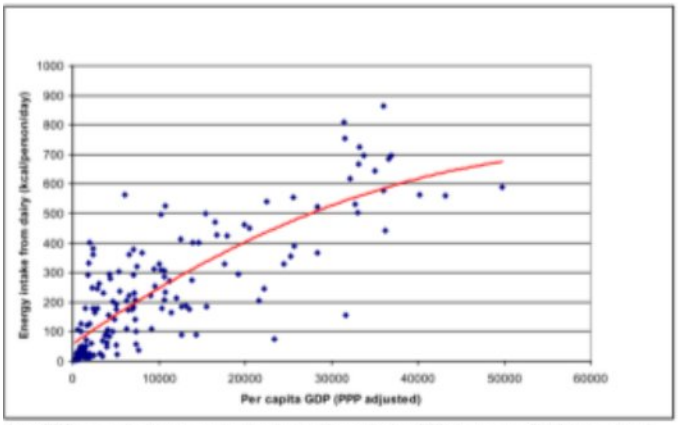
Appendix



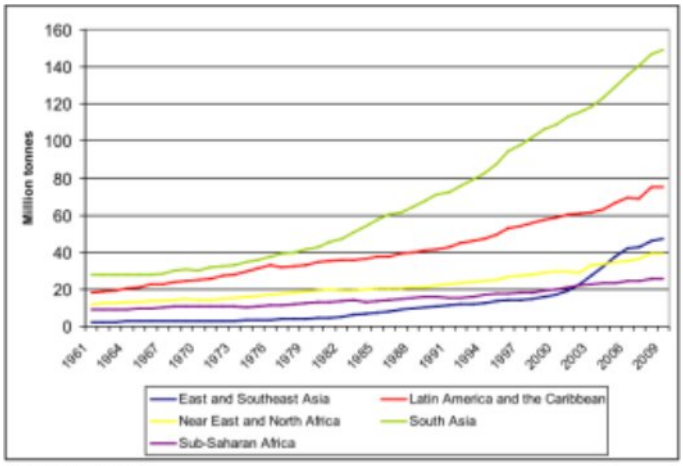
Source: FAOSTAT

Appendix 1: Per caput consumption of major food commodities in developing countries (index 1961=100)



Note: GDP per capita is measured at Purchasing Power Parity (PPP) in constant 2005 international US$.
Source: Elaboration on the basis data from FAOSTAT for per caput meat consumption and the World Bank for per caput GDP.

Appendix 2 : Per caput income and dietary intake from dairy 2007



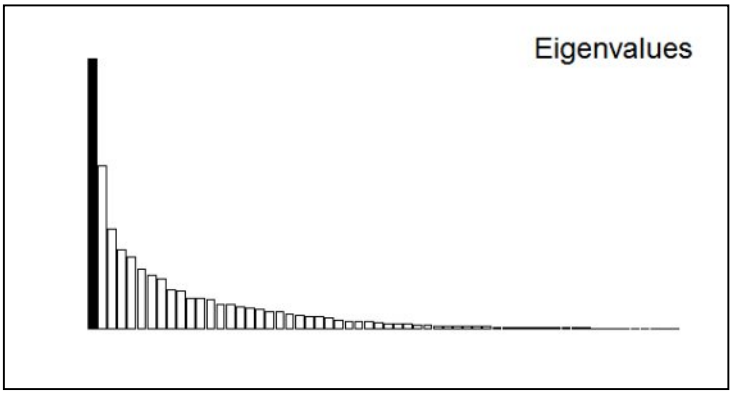
Source: FAOSTAT

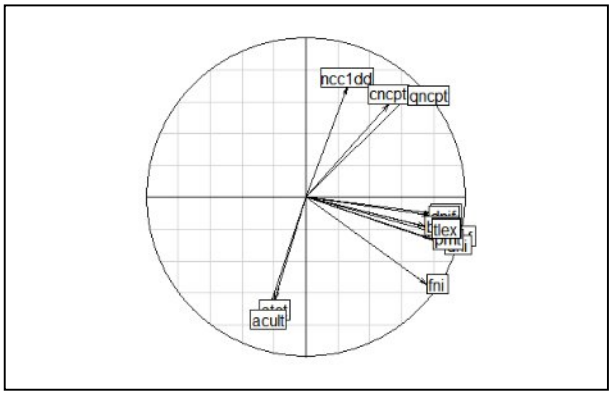
Appendix 3: Milk production-developing country regions

Appendix 4: Egypt map

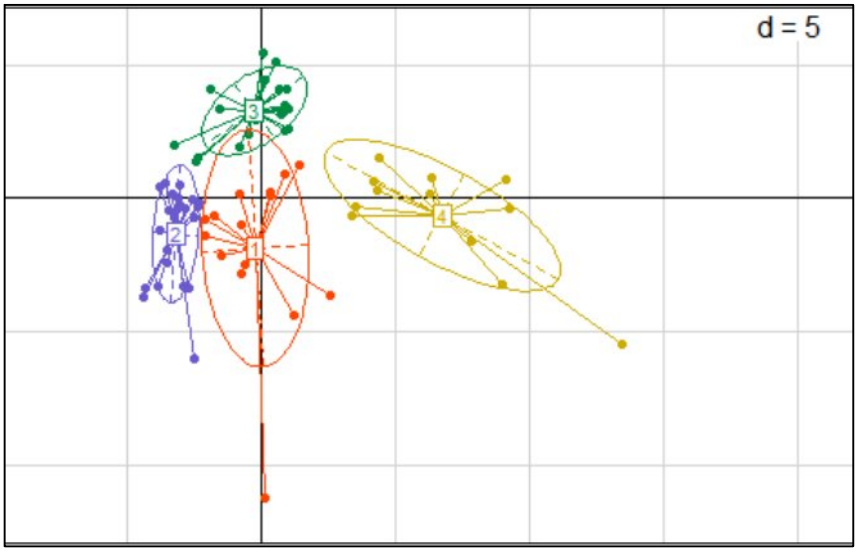
Appendix 6: Egyptian dairy buffalo

Appendix 5: Baladi calve during the fattening period

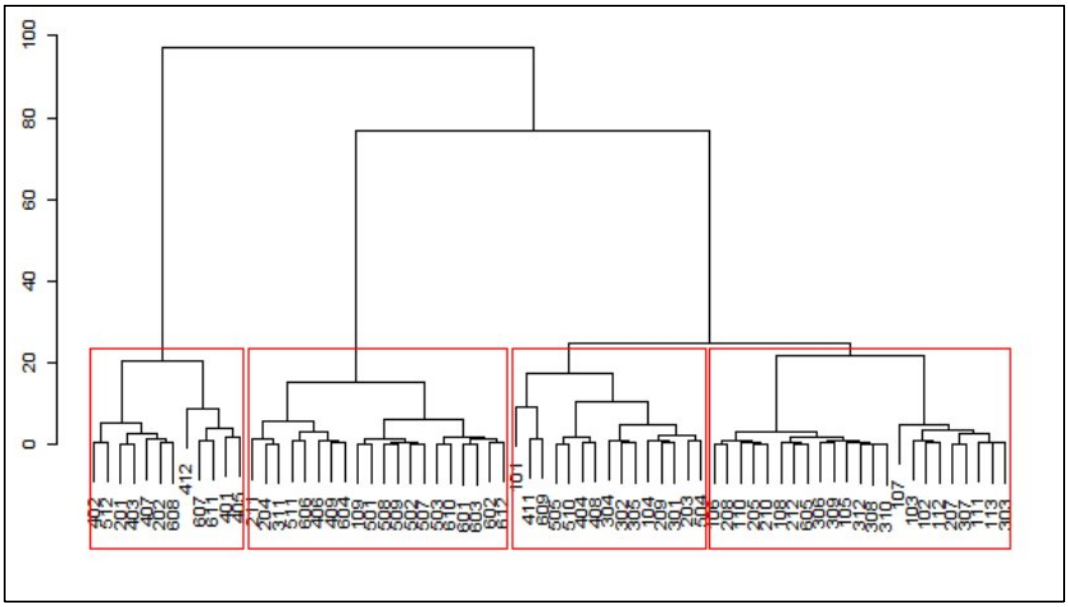




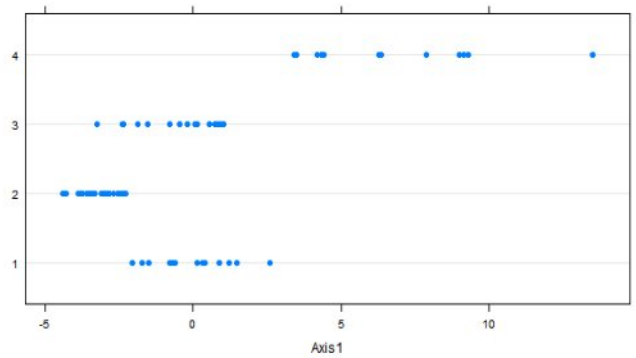
Appendix 7 Eigenvalues diagram and representation of the most representative variables



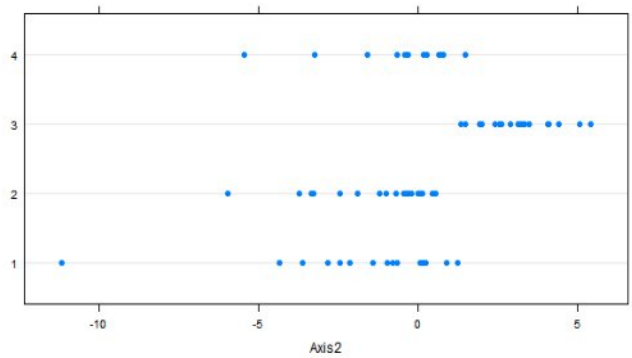
Appendix 8: Projection on factorial axes of groups



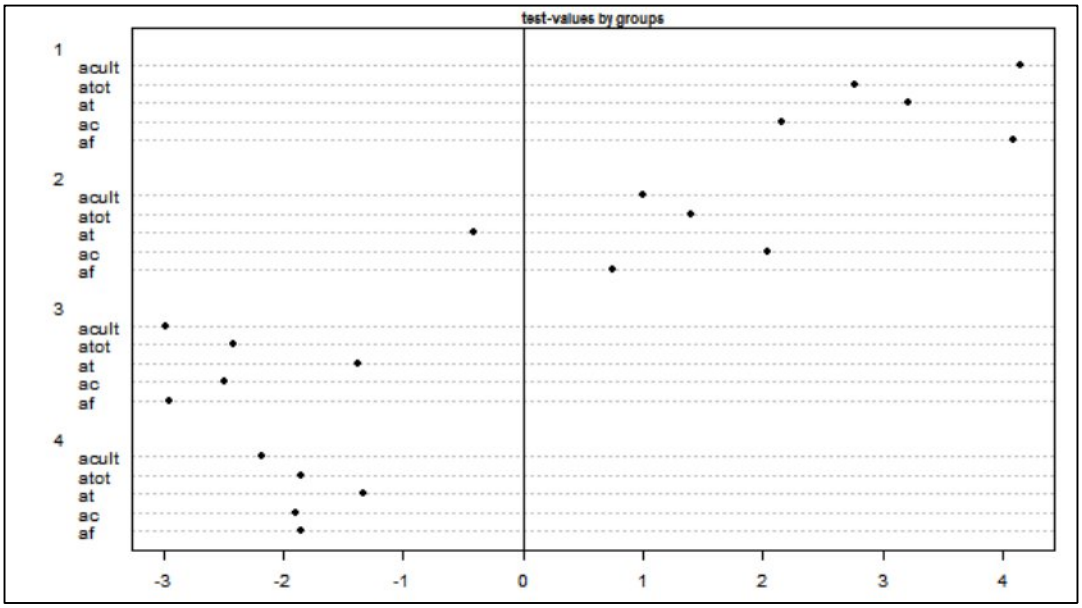
Appendix 9: Cluster dendrogram with the representation of the four groups



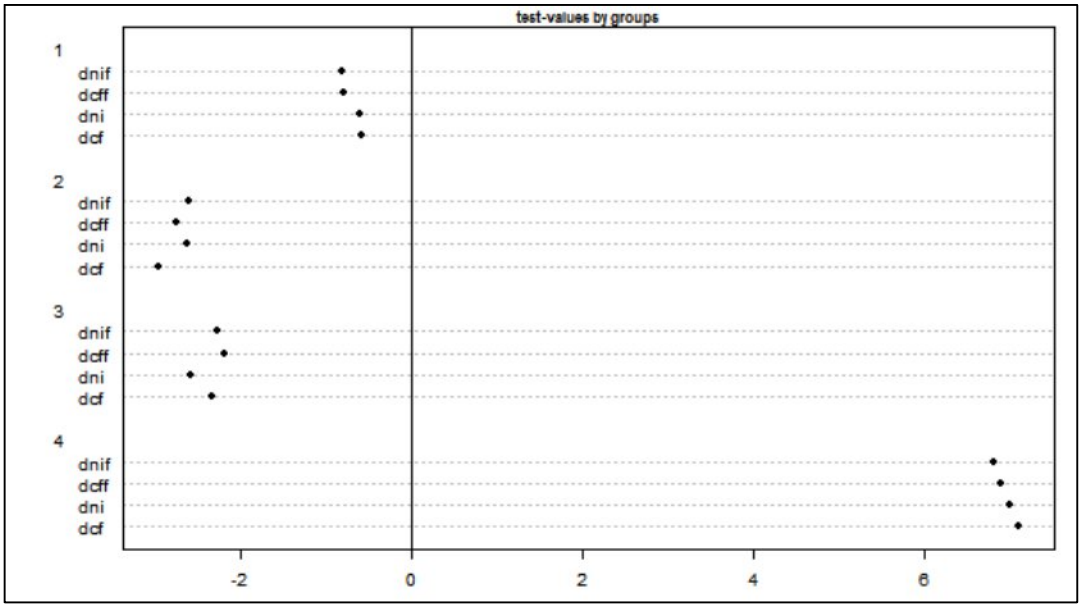
Appendix 10: Projection on the first factorial axis of the position of each farm in the factorial plane by group



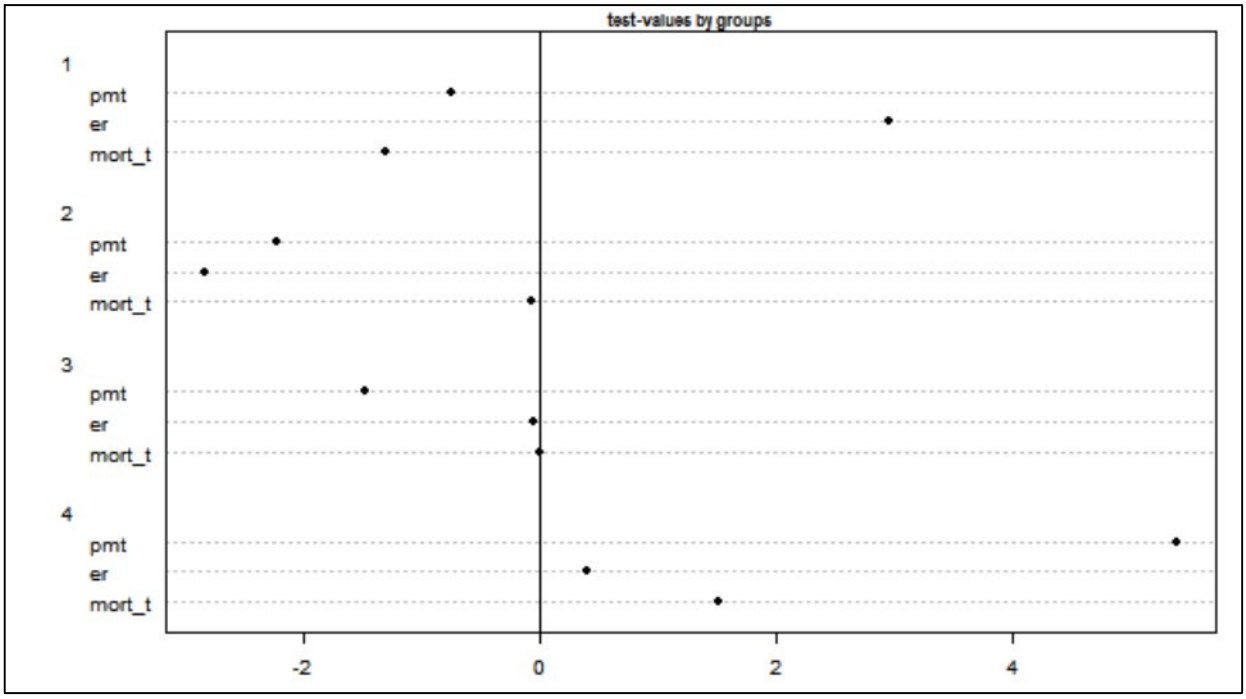
Appendix 11: Projection on the second factorial axis of the position of each farm in the factorial plane by group



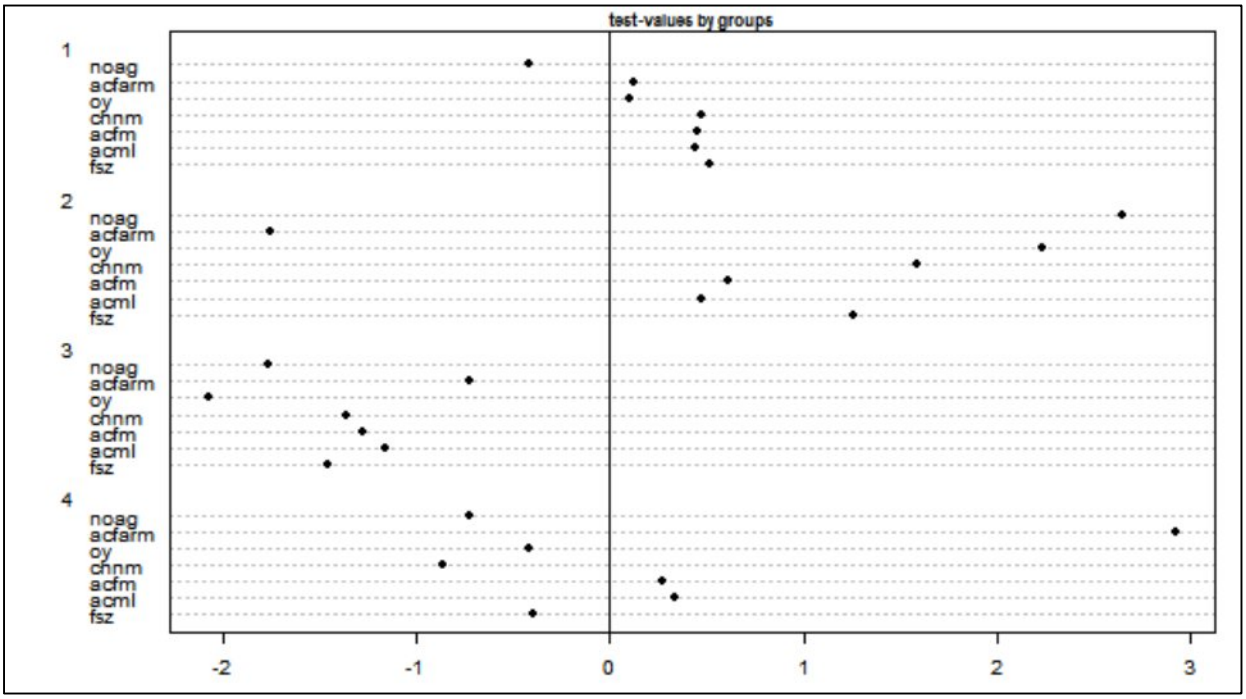
Appendix 12: Test values on variables related to the crop and the land availability



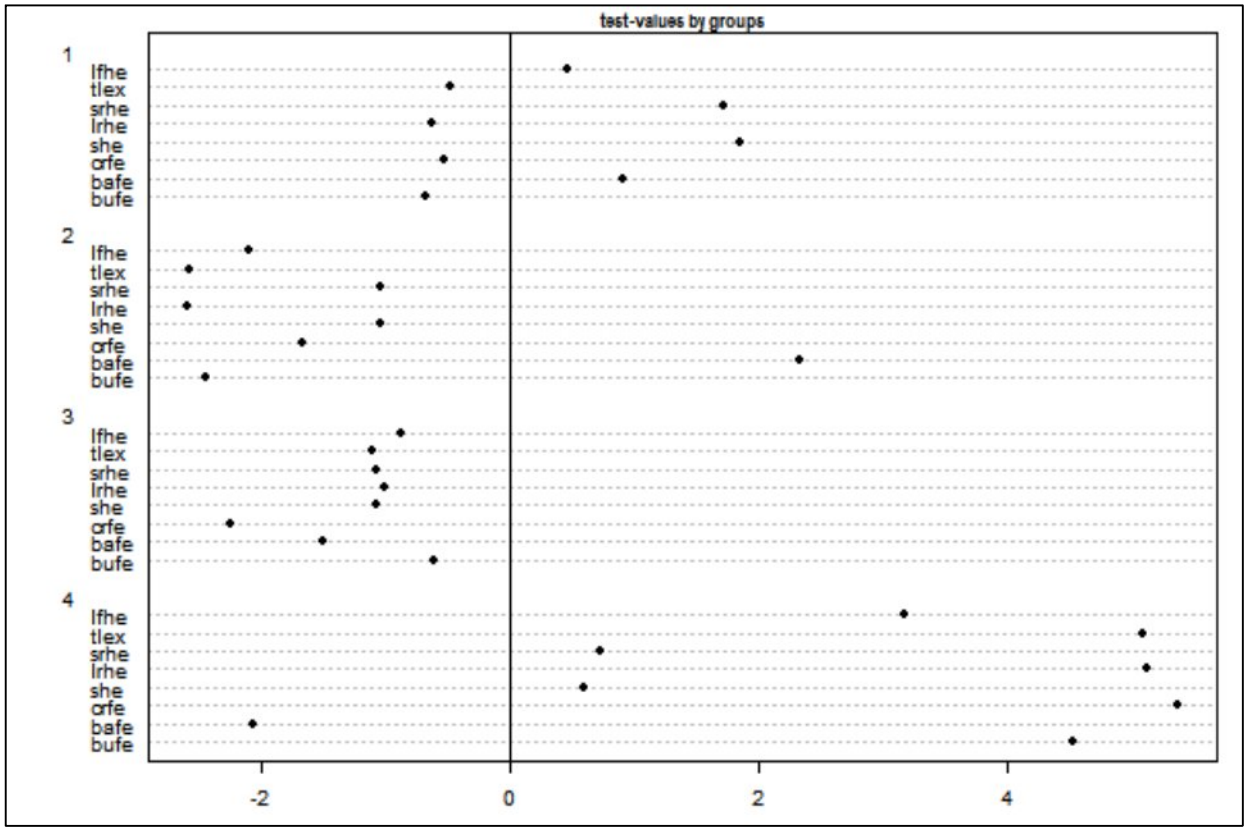
Appendix 13: Test values on variables related to the dairy incomes.



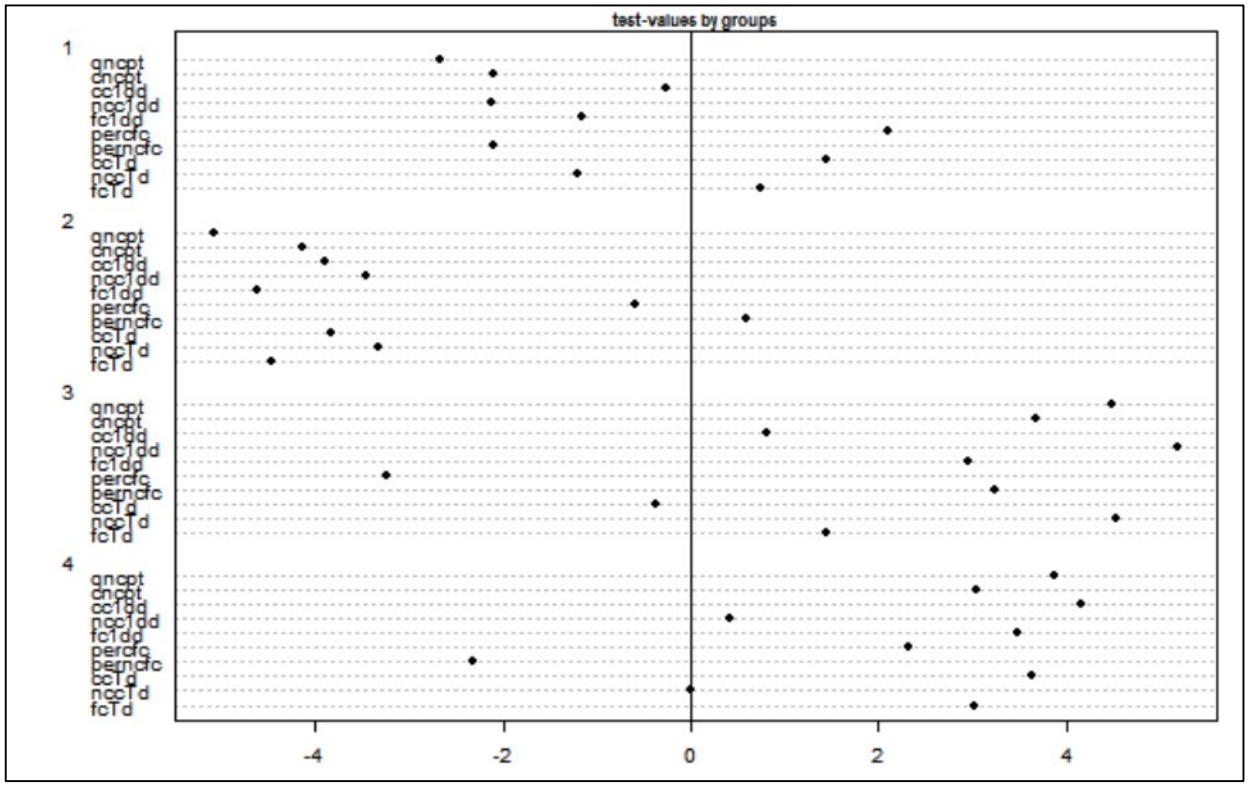
Appendix 14: Test values on variables related to the animal production.



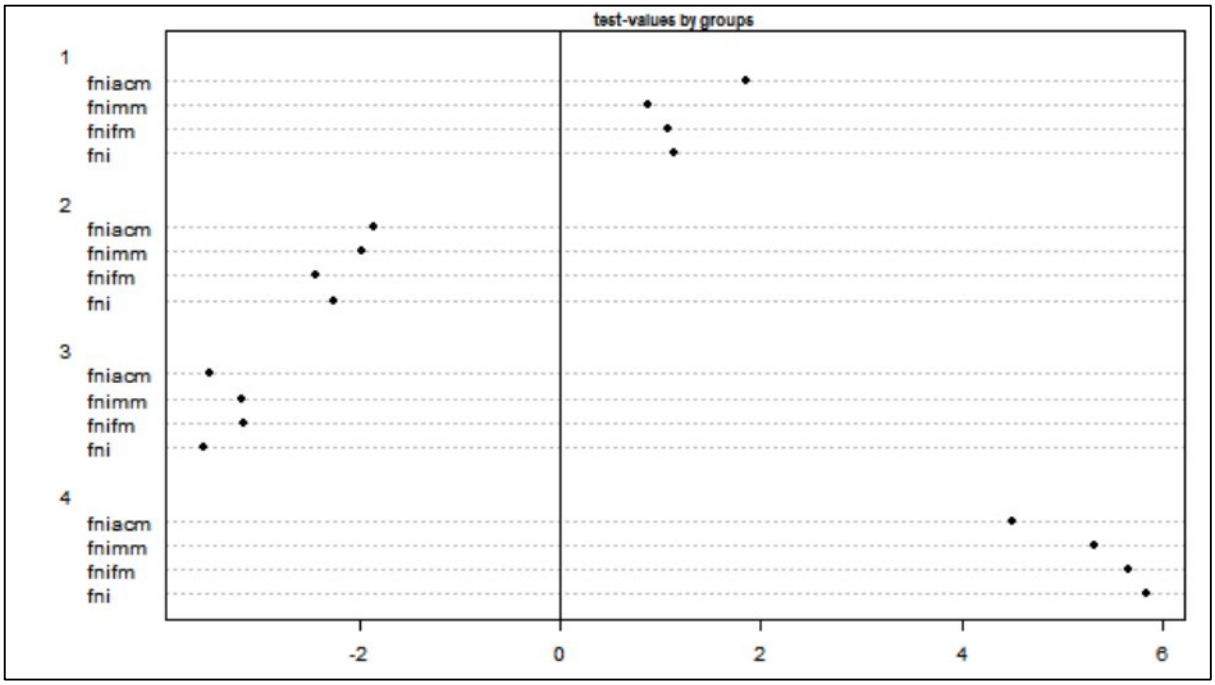
Appendix 15: Test values on variables related to the animal production.



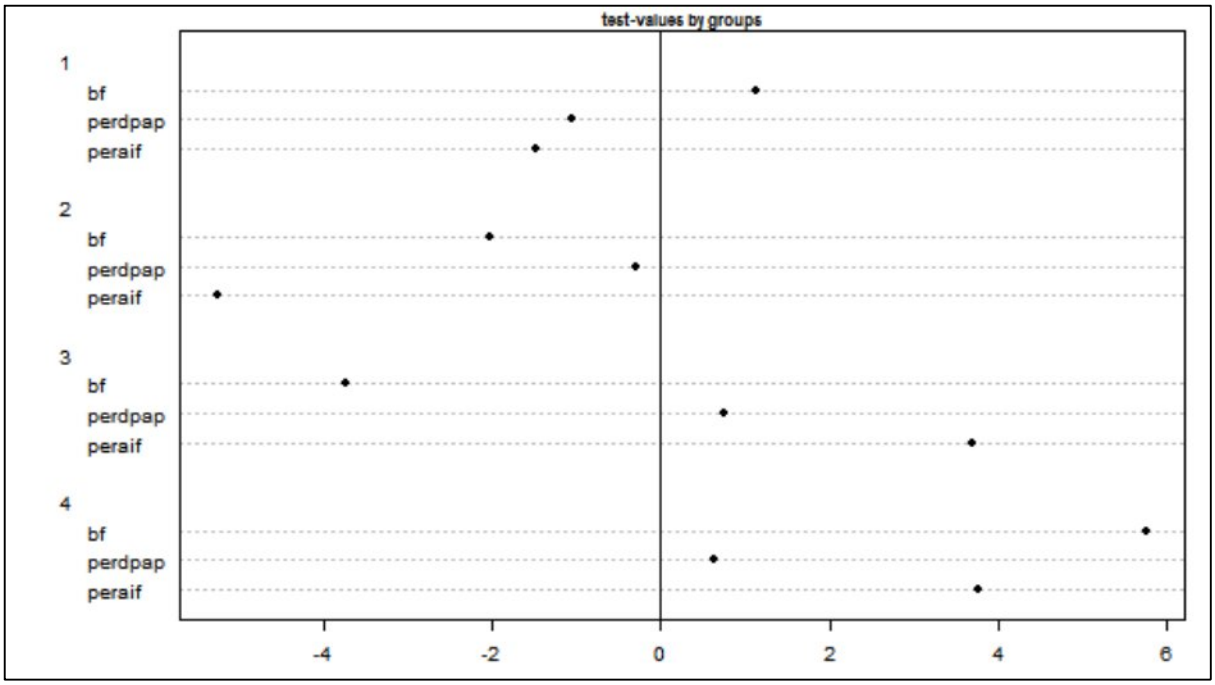
Appendix 16: Test values on variables related to the herd structure



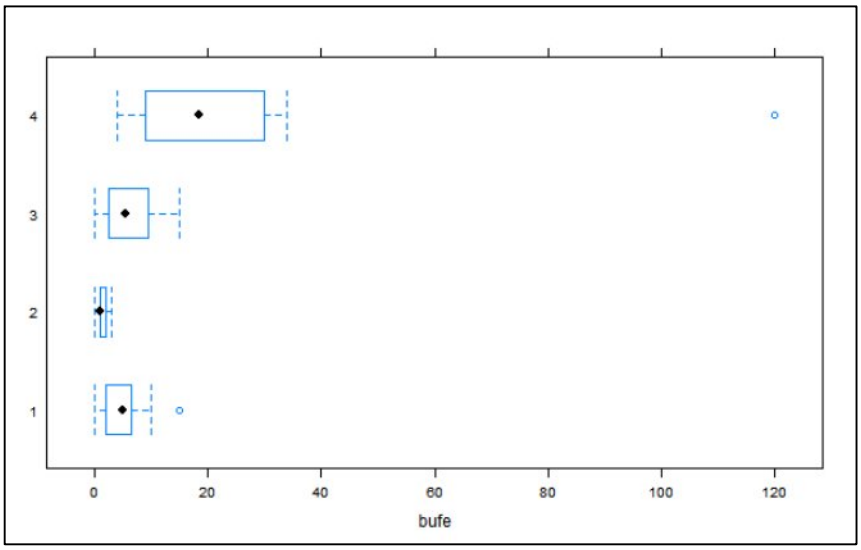
Appendix 17: Test values on variables related to the feed.



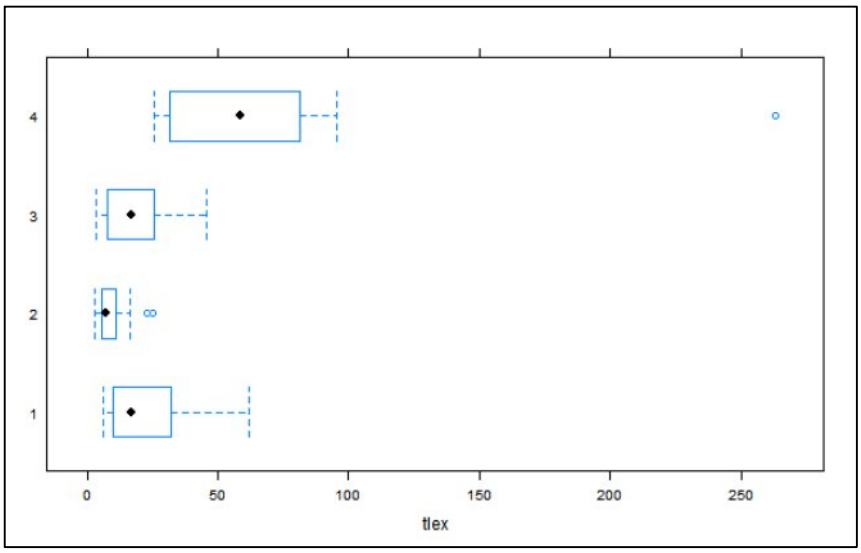
Appendix 18: Test values on variables related to the family income.



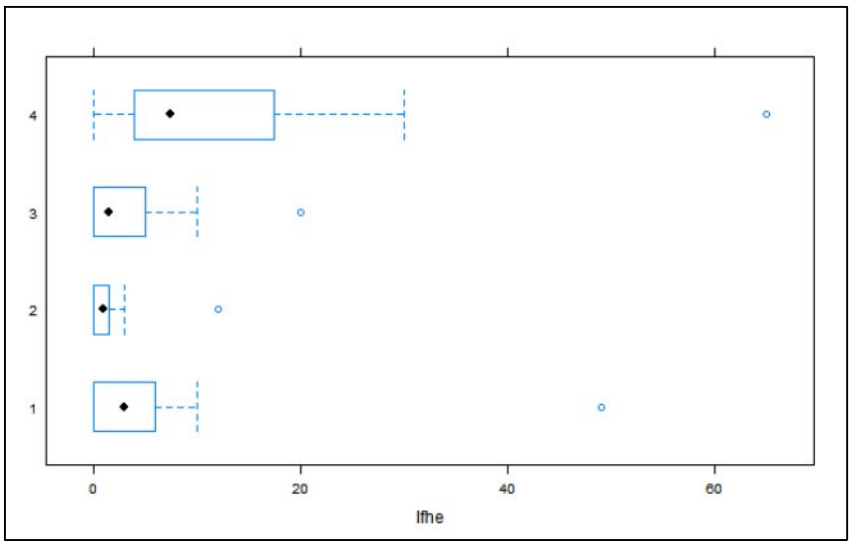
Appendix 19: Test values on variables related to the activity of the farm.



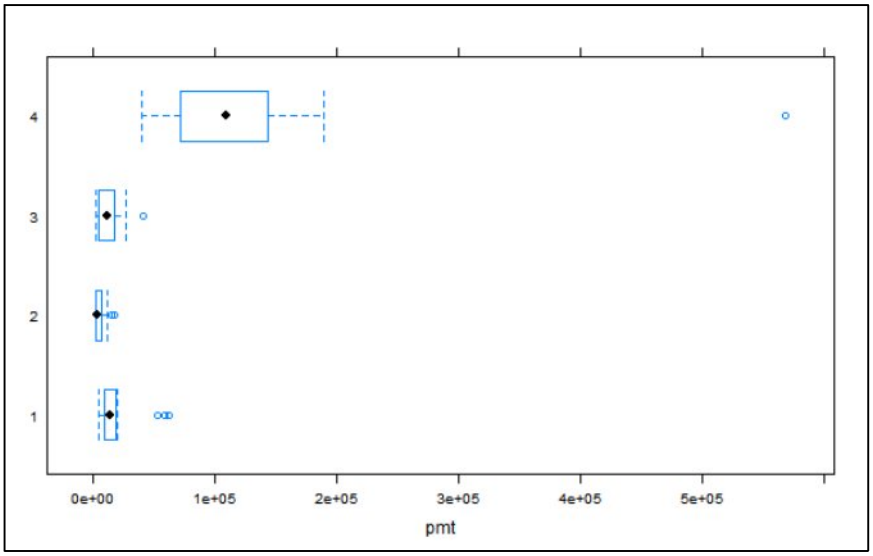
Appendix 20: Variability within and between classes for the number of dairy buffalo



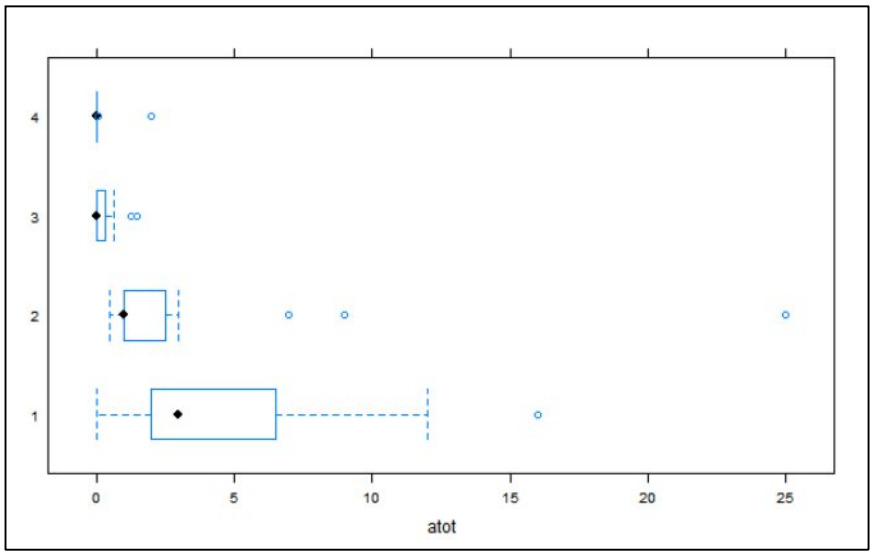
Appendix 21Variability within and between classes for the TLU per farm



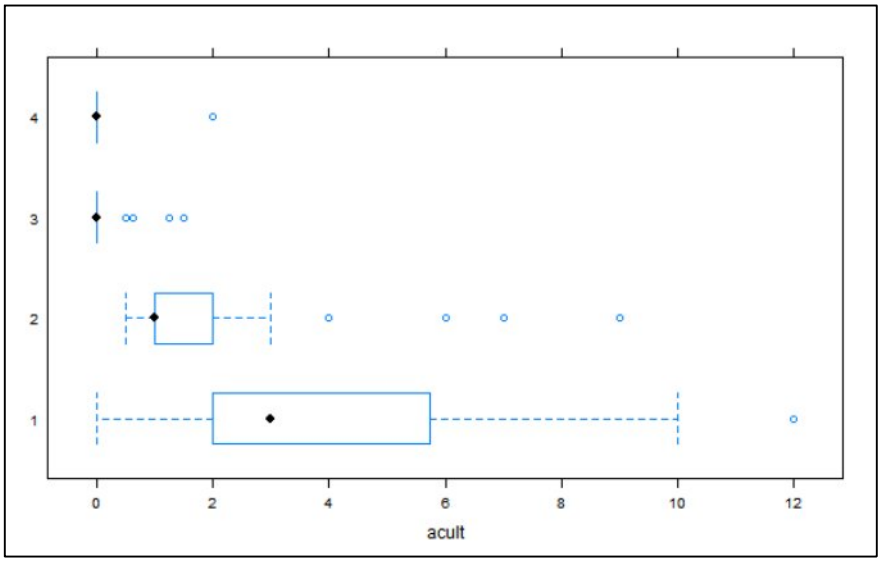
Appendix 22 : Variability within and between classes for the number of large ruminant in fattening per farm



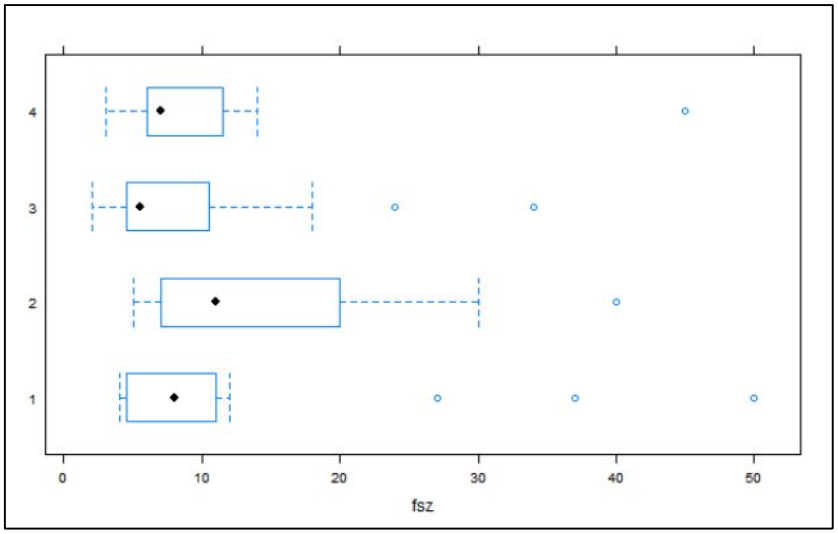
Appendix 23: Variability within and between classes for the average buffalo milk production per animal per year



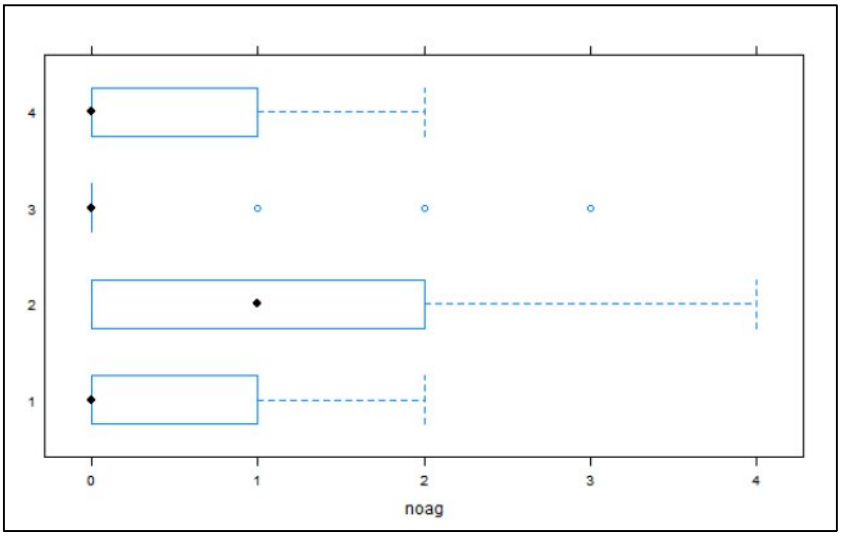
Appendix 24: Variability within and between classes for the total area



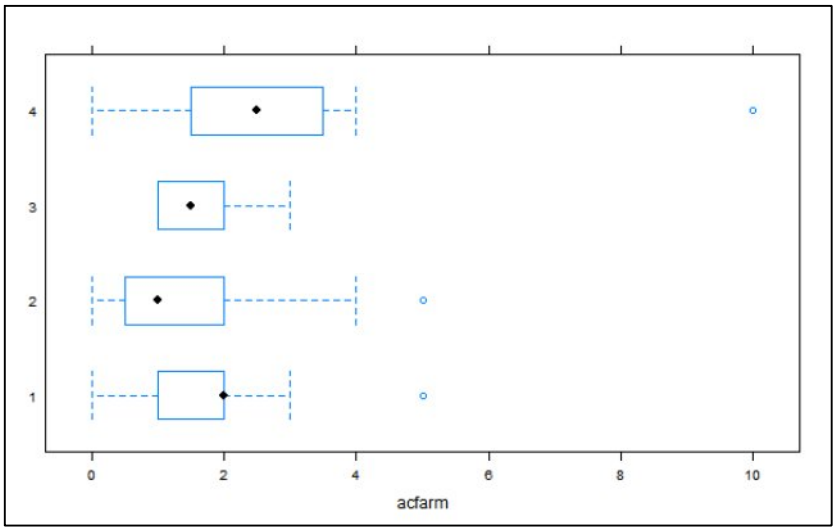
Appendix 25: Variability within and between classes for the cultivated area



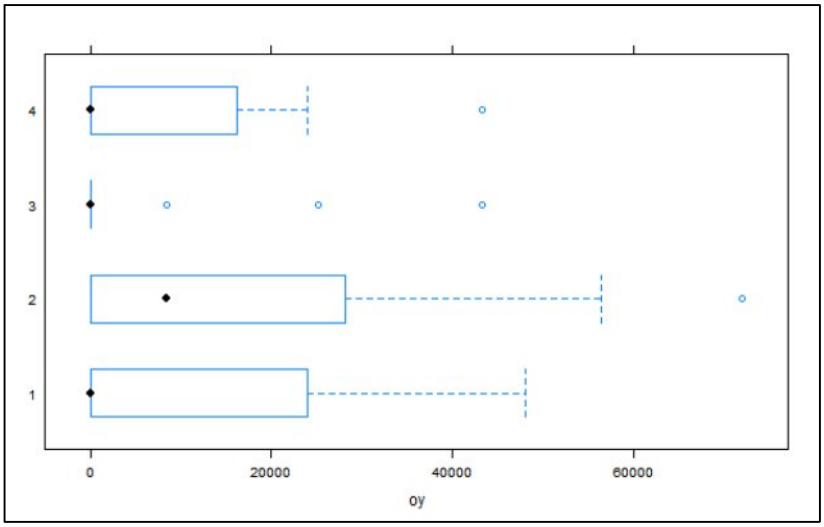
Appendix 26: Variability within and between classes for the family size



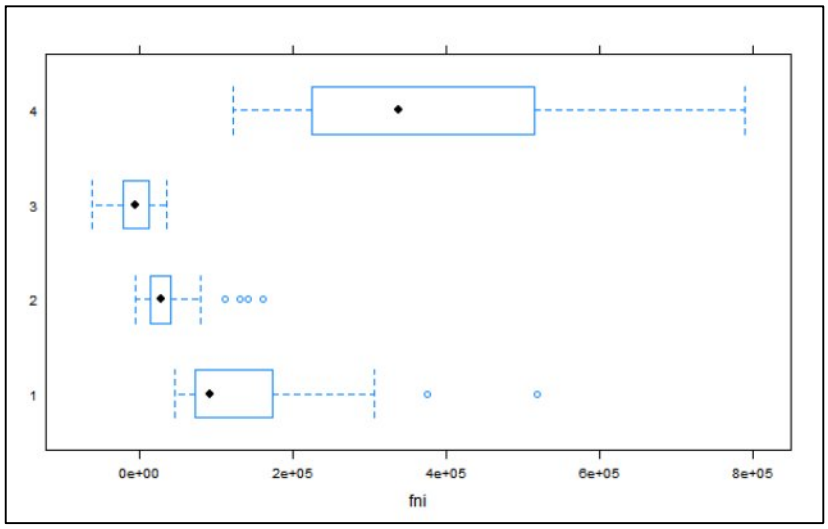
Appendix 27: Variability within and between classes for the number of the family's worker working outside the farm



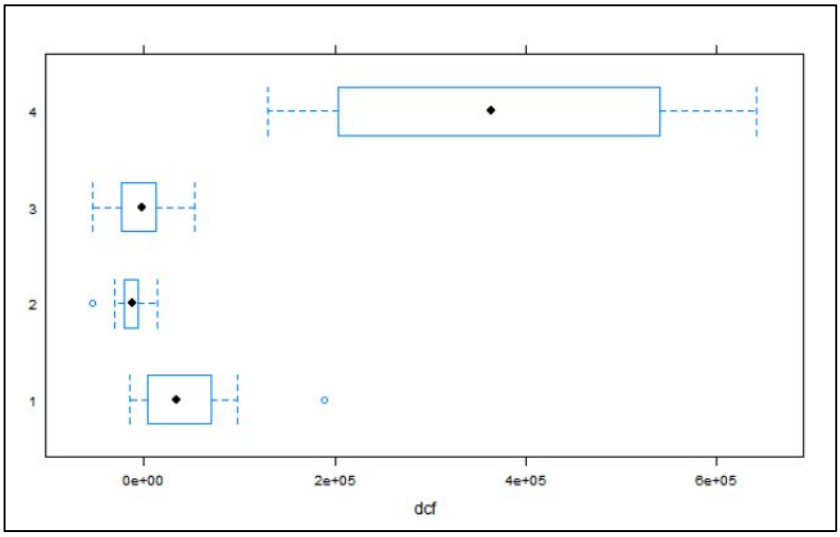
Appendix 28: Variability within and between classes for the number of family members working in the farm



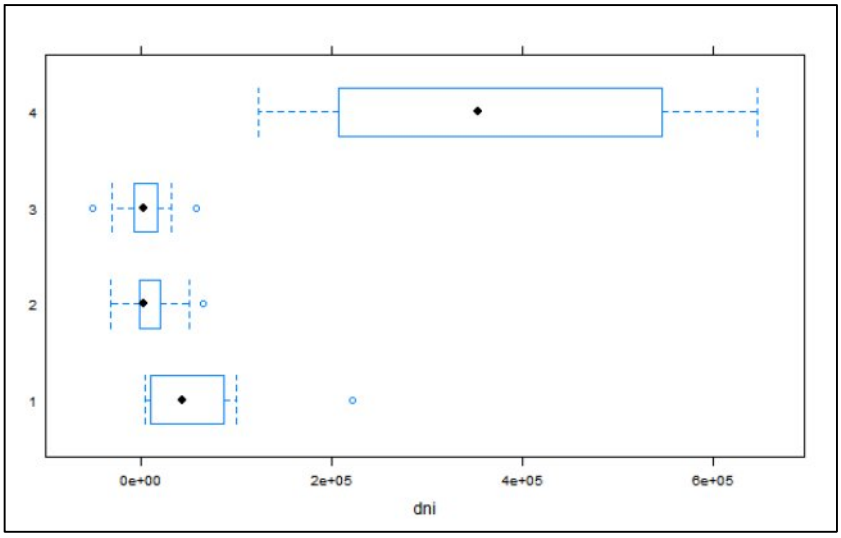
Appendix 29: Variability within and between classes for the total offarm incomes per year



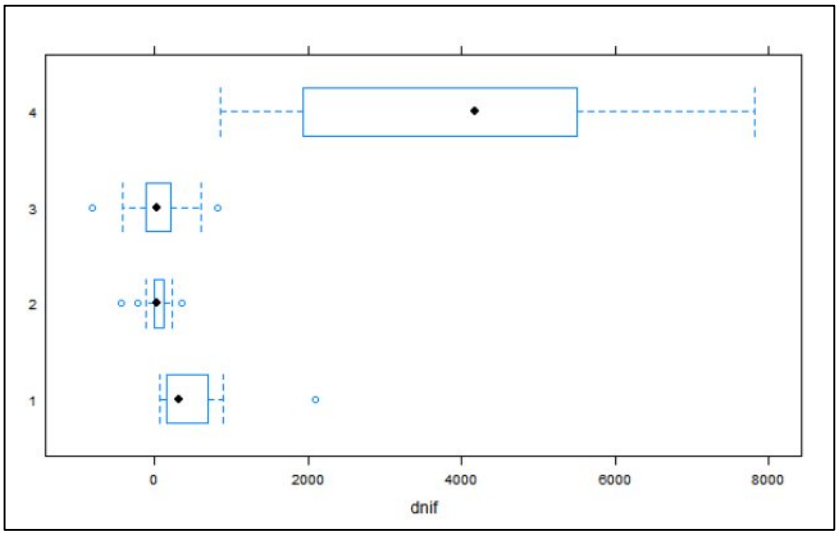
Appendix 30: Variability within and between classes for the average net income of the family



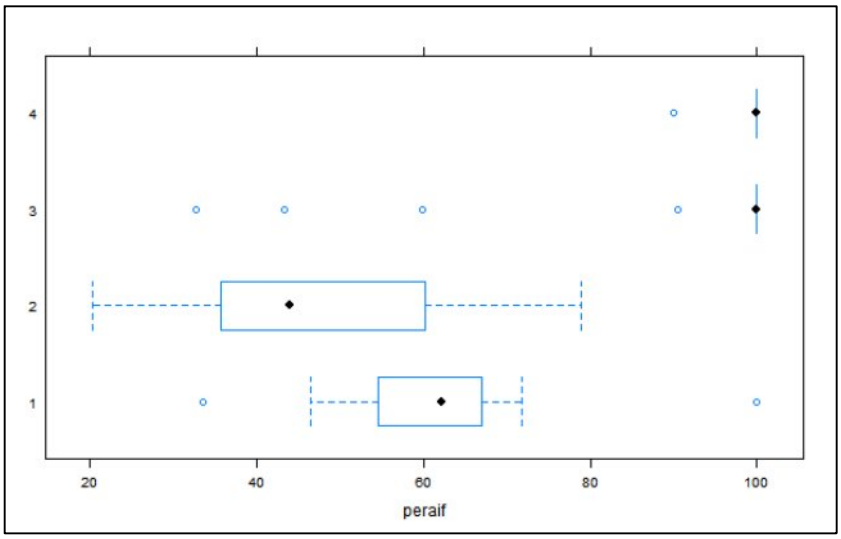
Appendix 31: Variability within and between classes for the dairy cash flow



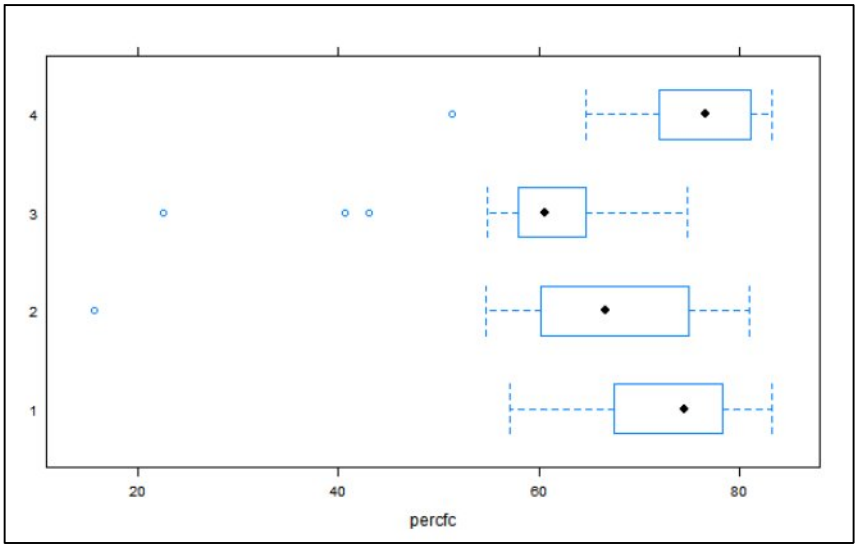
Appendix 32: Variability within and between classes for the dairy net income



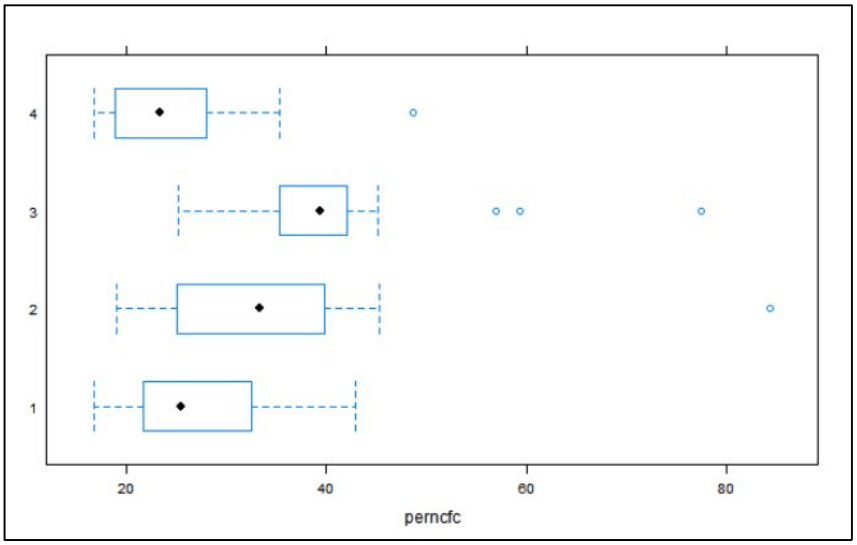
Appendix 33: Variability within and between classes for the dairy net income per member of the family



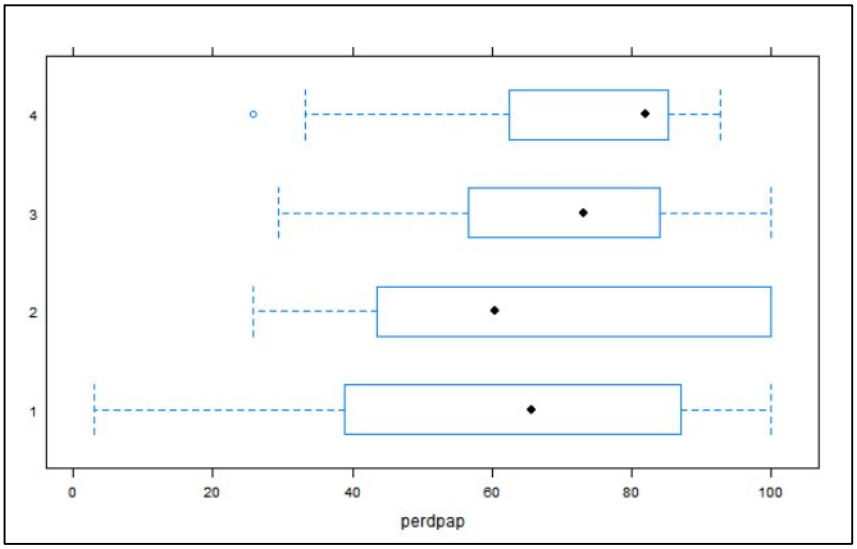
Appendix 34: variability within and between classes for the percentage of animal income on the total incomes of the farm



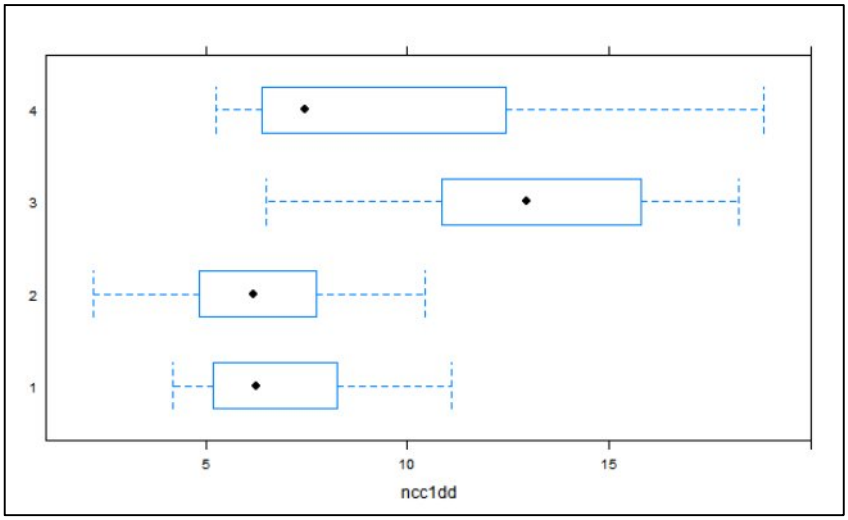
Appendix 35: Variability within and between classes for the percentage of concentrate cost in the global feed cost of the farm



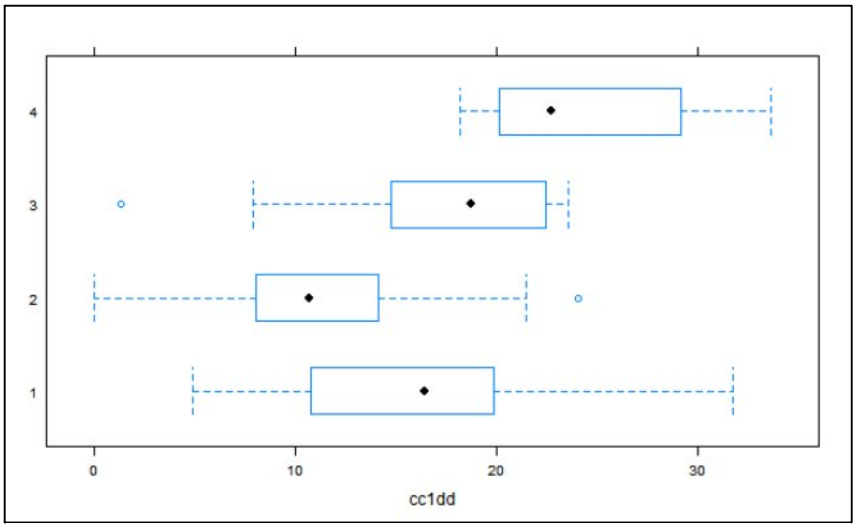
Appendix 36: Variability within and between classes for the percentage of fodder cost in the global feed cost of the farm



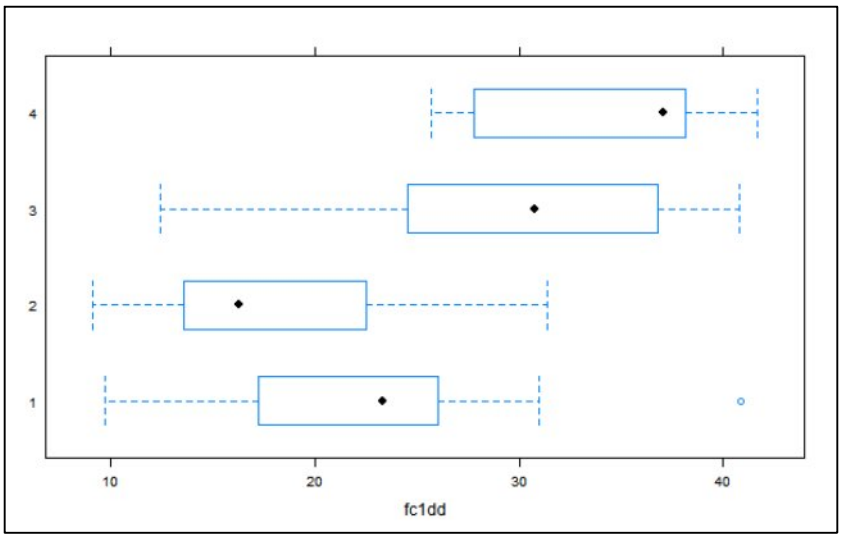
Appendix 37: Variability within and between classes for the proportion of the dairy product on the animal product of the farm



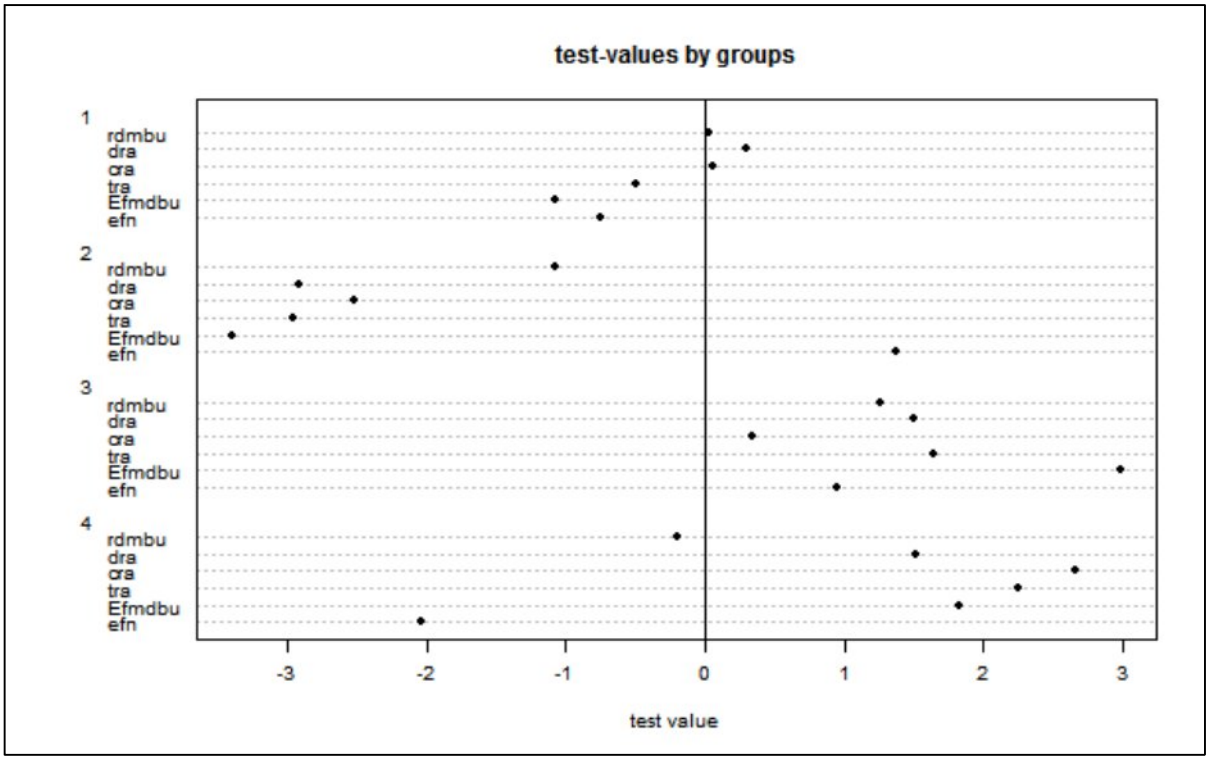
Appendix 38: Variability within and between classes for the fodder cost for one dairy animal par day.



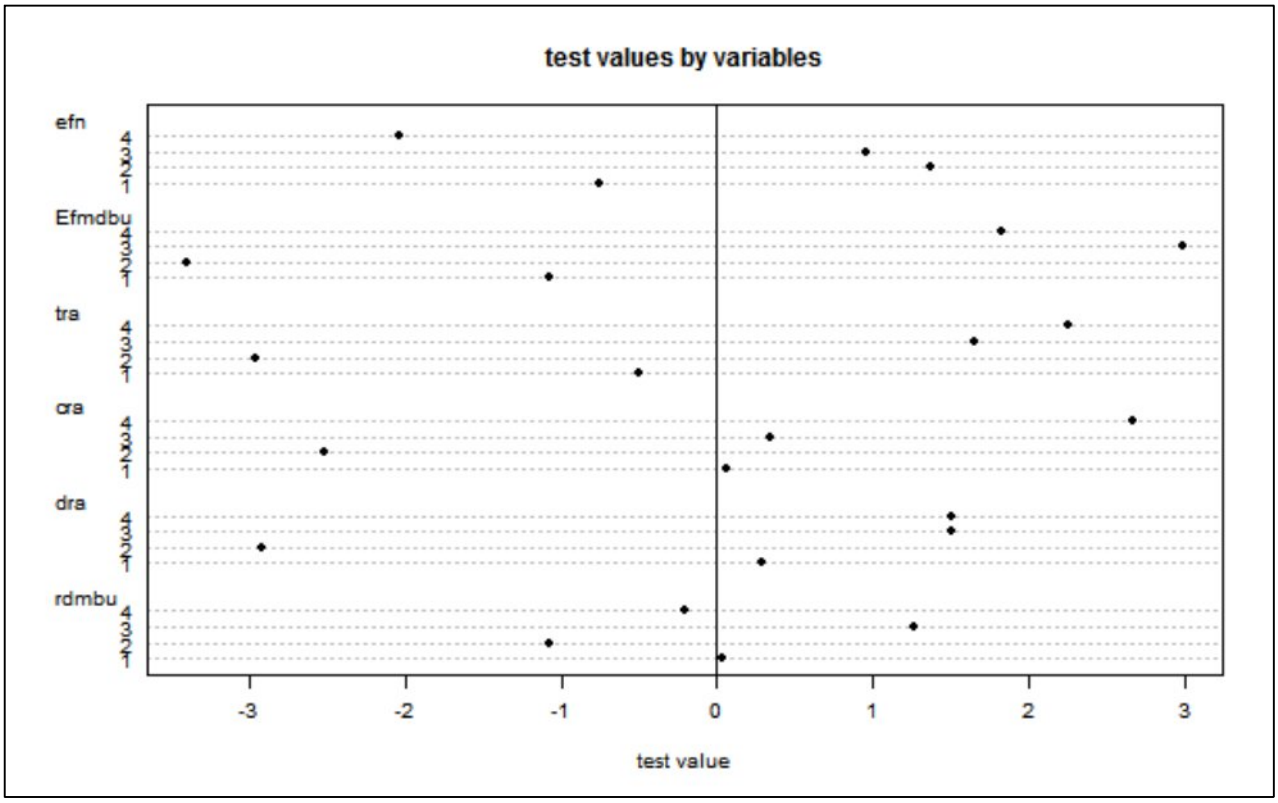
Appendix 39 : Variability within and between classes for the concentrate cost for one dairy animal par day.



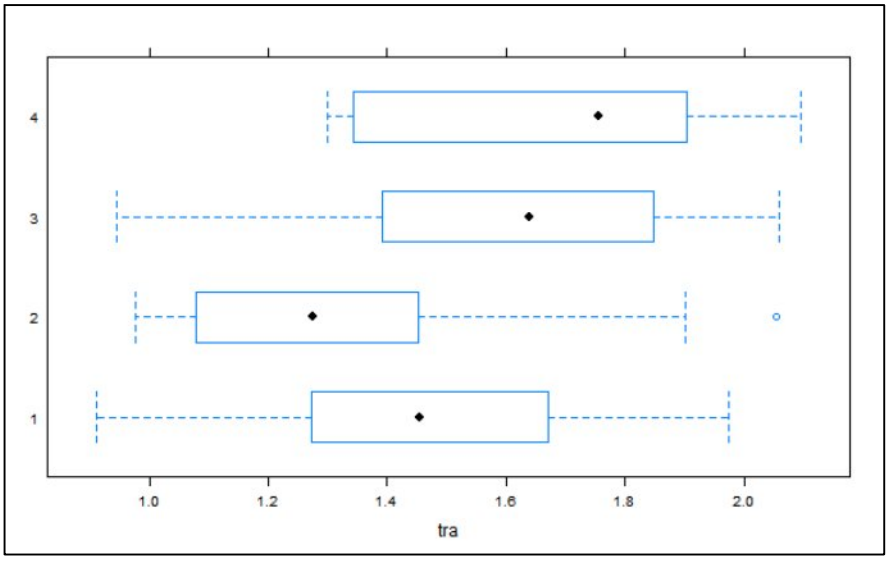
Appendix 40 : Variability within and between classes for the total feed cost for one dairy animal par day.



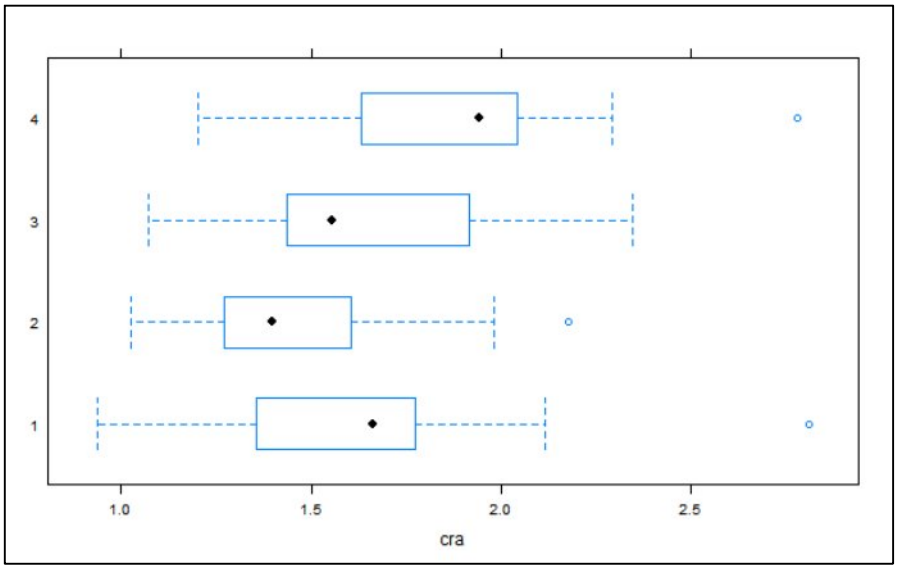
Appendix 41 : Test values on variables related to the efficiency by typoligical groups



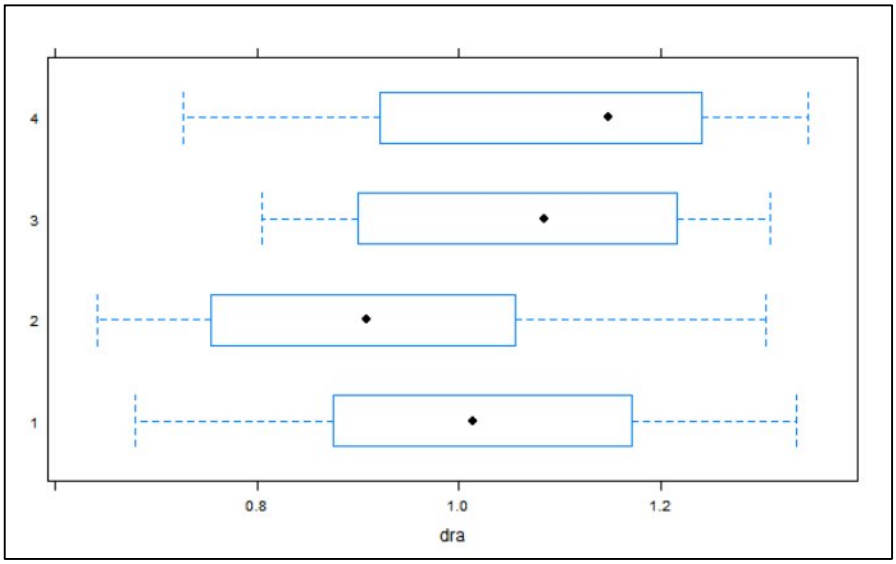
Appendix 42 : Test values on variables related to the efficiency between groups



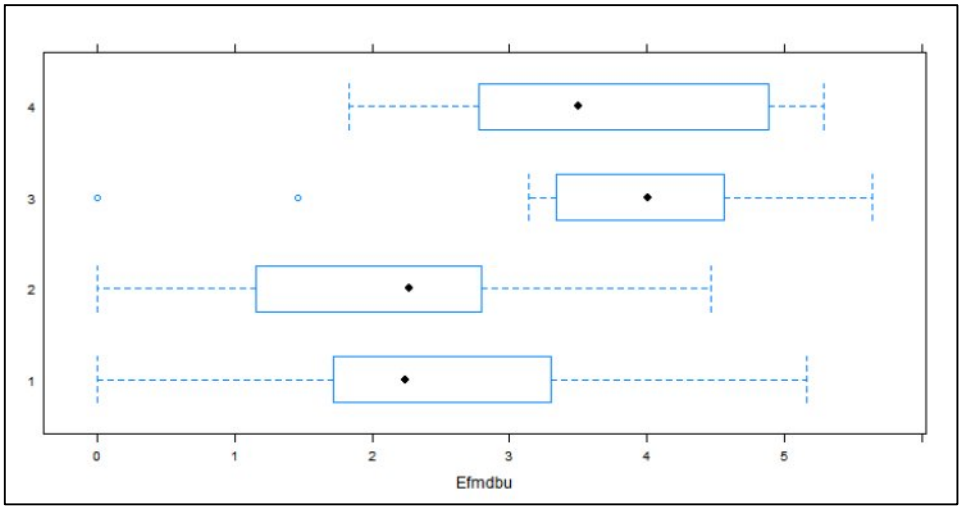
Appendix 43 : Variability within and between classes for the average TDN content in the daily ration of a dairy animal and a theoretical requirement (7.32kg/day)



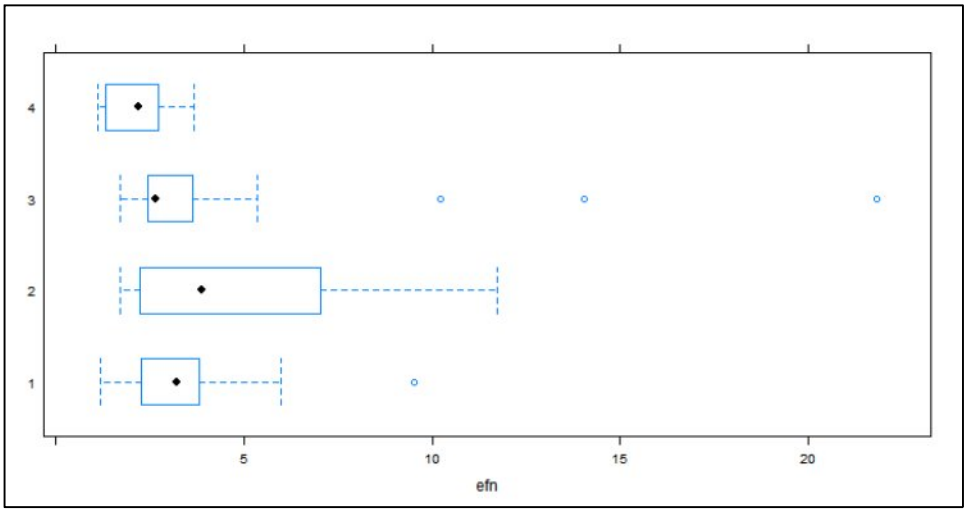
Appendix 44 : Variability within and between classes for the average CP content in the daily ration of a dairy animal and a theoretical requirement (1.32kg /day)



Appendix 45 : Variability within and between classes for the average DM content in the daily ration of a dairy animal and a theoretical requirement (16.5 /day)



Appendix 46 : Variability within and between classes for the ratio between the average daily feed costs for a dairy buffalo and the average milk production of a dairy buffalo



Appendix 47: Variability within and between classes for the ratio between N input and N output.

Theme	Variable name	Variable content
Dairy incomes	dcf	dairy cash flow
	dni	dairy net income
	dcff	dairy cash flow per family member
	dnif	dairy net income per family member
Technical parameters	mort_t	mortality rate
	er	exploitation rate
	pmt	average milk production per year
Farm activity	peraif	percentage of animal product in the global product of the family
	perdpap	percentage of the dairy product in the animal product
Land	bf	global income of the family (net income of the farm and offarm income)
	af	total area cultivated with fodder per year
	ac	total area cultivated with cereal per year
	at	total area cultivated with truck crop per year
	atot	total area owned by the family
	acult	total area use for crop by the family
Family income	fni	farm net income
	fnifm	farm net income per family per month
	fnimm	farm net income per male per month
	fniacm	farm net income per agro-worker (from the family) per month
Feed cost and quantity	fcTd	feed cost per TLU per day
	nccTd	fodder cost per TLU per day
	ccTd	concentrate cost per TLU per day
	perncfc	percentage of the fodder cost on the total feed cost
	percfc	percentage of the concentrate cost on the total feed cost
	fc1dd	total feed cost per dairy per day
	ncc1dd	fodder cost per dairy per day
	cc1dd	concentrate cost per dairy per day
	cncpt	fodder purchased cost on the fodder total price (produced and purchased)
	qncpt	quantity of fodder purchased on the total quantity of fodder per year per farm

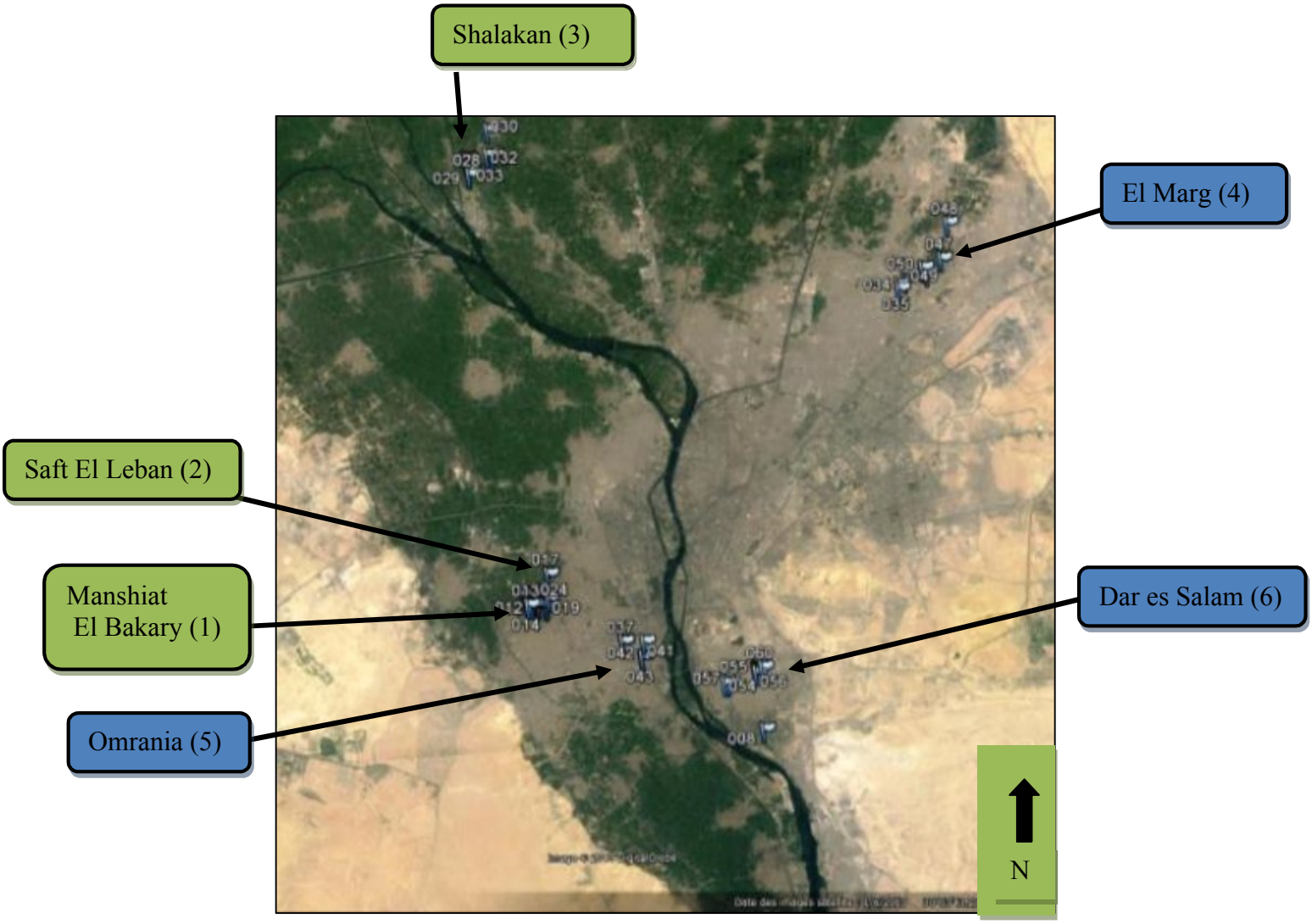
Appendix 48: Quantitative variables table, first part

Theme	Variable name	Variable content
Family variables	fsz	family size
	acml	number of potential male worker in the family
	acfm	number of potential female worker in the family
	chnm	number of childre in the family
	oy	total offarm incomes per farm per year
	acfarm	number of worker from the family working in the farm
	noag	number of worker from the family working outside the farm
Herd variables	bufe	number of dairy buffalo per farm
	bafe	number of dairy Baladi cow per farm
	crfe	number of dairy crossbred per farm
	She	number of sheep per farm
	lrhe	number of large ruminant per farm
	srhe	number of small ruminant per farm
	tlex	number of TLU per farm
	lfhe	number of fattening large ruminant in the farm
	clustersT	number of the typological group
Efficiency varibles	efn	N efficiency ratio
	Efmdbu	feed cost efficiency for the buffalo
	Efmdba	feed cost efficiency for the Baladi cow
	Efmdcr	feed cost efficiency for the crossbred cow
	tra	TDN ratio with a theoretical value
	cra	CP ratio with a theoretical value
	dra	DM ratio with a theoretical value
	rdmbu	DM efficiency of the buffalo
	rdmba	DM efficiency of the Baladi cow
	rdmcr	DM efficiency of the crossbred cow

Appendix 49: Quantitative variables table, second part

Qualitative variables	
Theme	**Variables name**
fc	management of the farm
fe	education of the head of the family
dh	distance between the land and the house
dp	perspective on the dairy activity
aspc	animal sale place
ads	animal direct sale (consumers or other)
sroc	operator who purchased the milk
srlc	milk sale place
ascc	criteria to sell an animal
vvc	veterinary visit

Appendix 50: Qualitative variables



Appendix 51: Cairo city pictures: urban and peri-urban areas investigated.

Feed type	Feed price (LE/kg)	TDN	CP	DM
barley	3.50	84%	13%	88%
beans	3.73	78%	23%	88%
berseem	0.36	63%	20%	12%
biscuits	1.07	95%	10%	90%
bran	2.04	71%	17%	89%
bread	1.50	89%	15%	68%
carottes	0.40	83%	10%	12%
coton seeds	2.58	98%	25%	90%
darawa	0.33	59%	12%	23%
dora (grain maize)	2.61	89%	9%	88%
Corn gluten feed	2.50	82%	22%	88%
pellets	2.32	71%	17%	89%
residus of hoven	2.37	89%	10%	91%
soya been	4.00	81%	40%	88%
straw (beans)	1.37	65%	15%	90%
straw (hegazi)	1.50	46%	15%	93%
straw (rice)	0.97	40%	40%	93%
straw (sugar cane)	0.49	25%	2%	91%
straw (wheat)	0.73	48%	5%	93%
sweet potatoes	1.00	80%	10%	21%
Bean peals	2.04	51%	15%	95%

Appendix 52: Feed table; average price in Cairo market during the study, percentage of: (i) Total Digestible Nutrient (TDN); (ii) Crude Protein (CP), (iii) Dry Matter.

Appendix 53: Questionnaire used with during interview

IDENT. :

Questionnaire

Urban and Peri-urban production systems

1. Governorate: /_____/
2. District: /_____/
3. Location: /_____/
4. Date of visit: / /
5. Interviewer name: /_____/

5a. Farmer telephone number

GPS Data: Way point: _____ (5b) N: _____ (5c) E: _____(5d)

Part 1: General data

6. Farmer's name: /_____/

7. Are you the head of the family? 1. Yes 2. No /_____/

8. If no who is the head of family: /____/

(1. Father, 2. Other brother, 3. Relatives, 4. Collective management with brothers)

9. If many brothers are responsible, How many brothers? /_____/

10. Story of the farm

Step (10a)	Date/period (10b)	Why? (10c)	Main activity (10d)	Comments (10e)
Since when do you arrive in Cairo, you or your family?				
When do you start an animal activity?				
When do you start a milk activity (buffalo or cattle)?				
First event that change the milk activity…				
Second events that change the milk activity…				

Part 2: Crop Production

11. More details about land use:

Holding type (11a)	area (kerat) (11b)	Where? (av. distance to the house: location, km) (11c)	Type of holding* **(11d)**	Since when do you use this land? (11e)	Cost for access to land (purchasing cost or annual cost of renting or in-kind) (11f)	Irrigation facilities* (precise the type) **(11g)**	Purchasing Cost (11h) of irrigation system (equipment) and year of purchase (11i)
own							
rent							

***(11d):** *1. Inheritance, 2. Purchase, 3. Rent, 4. Share cropping; 5. Common land, 6.Other holding define(11do) _____*

***(11g):** *1.Canal, 2. Private Well, 3. Collective well, 4. Other holding define (11go)_____*

12. How many kerat of land do you cultivate? /_____/

12a. Total water price for crop per year: _____

13. More details about costs of crop production (Winter 2011/12 and Summer 2012):

Type (13a)	Crop (13b)	Season 1 winter 2.summer (13c)	Area (13d)	Seed Quant. (tot) (13e)	Seeds price (13f)	Inputs (fertilizers, pesticides) Quant.(13g)	Inputs Price (13h)	Irrigation cost (13i)	Labors cost (13j)	Q. of main crops harvested 2010/11 (13k)	% of main crops sold (13l)	Unit price of main crops (13m)	Selling place (farm gate, market name) (13n)
1.													
2.													
3.													
4.													
5.													
6.													
7.													

Part3. Animal production

14. Herd composition (day of visit):

Type (14a)	Buffalo	Friesian	Crossbred	Baladi
Dairy (14b)				
Bulls (14c)				
Pregnant heifers (14d)				
calves (<2y)(14e)				
Fattening calves (<2 y)(14f)				
Main animal products (orientation: 14g)				

15. Herd composition fo SR and others

Type (15a)	Fattened(15b)	Adult(15c)
Sheep		
Goats		
Donkey		
Horse		
camel		
Poultry		

16. Fattening (animals) during the last fattening year 2012 (Period: during the last fattening operation)

Species (16a)	Breed (16b)	Source (1. Produced; 2. Purchased) (16c)	Start date (month/year) (16d)	Duration (month) (16e)	Initial weight (16f)	Weight at sale (16g)	Initial price if purchase (16h)	Sale price (16i)
Buffalo calve (veal)								
Cattle calve								
Lamb								
Goat								
Camel								

17.Animal Feeding

		Daily feed ration (type and quant.)in **winter**			Daily feed ration (type and quant.)in **summer**		
Animal (17a)	Stage (17b)	Type (17c)	Quant/day (17d)	Price	Type (17e)	Quant/day (17f)	Price
Lr	Milking	- - - -					
	Dry	- - - -					
	Fattening	- - - -					
	Growing	- - - -					
sr	Mature	- - -					
	Growing	- - -					
	Fattening	- - -					
poultry							
Other (precise) (17ao)							

18. Feed cost (for all animals)

Feed (18a)	Used period (18b)	Quantity. Purchased/month (18c)	Unit price (18d)	Transport and other cost (18e)	Problem of availability in the market? (explain) (18f)
Concentrates mixed					
Maize/ corn (grain)					
Wheat grain/bran					
Hay					
Silage					
Straw					
Additives					
Berseem (green)					
Maize (green)					
Crop residues					
Other (18ao)					
Water					

19. Milk production

Animal (species/ breed) (19a)	Average of daily milk production per animal(l/day)		If you have a drying period at which stage of lactation you stop milking? (19d)	Duration of drying period? (month) (19e)	Duration of lactation period? (month) (19f)	Calving interval (months)(19g)
	Min(19b)	Max(19c)				
Buffalo						
Cattle Friesian						
Cattle crossbred						
Cattle baladi						
Other (19ao)						

20: Dairy product selling strategy

Species (20v) :	Buffalo	Cow	Other(Came,goat)
Average total production of raw milk during the last week (kg/day)(20a)			
Self-consumption of raw milk (kg/day)(20b)			
Transformation for butter (kg/day or week)(20c)			
Transformation for cheese (kg/day or week)(20d)			
Transformation for *raïben* (kg/day or week)(20e)			
Do you sell **raw milk** (Yes / No)?(20f)			
If "yes", how many this week (**average kg /day)?(**20g)			
Where and to whom?(20h)			
Price (EGP / kg)(20i)			
Do you sell **butter** (Yes / No) ?(20j)			
If "yes", how many this week (kg /week)?(20k)			
Where and to whom?(20l)			
Price (EGP / kg)(20m)			
Do you sell **cheese** (Yes / No)?(20n)			
If "yes", how many this week (kg /week)?(20o)			
Where and to whom?(20p)			
Price (EGP / kg)(20q)			
Do you sell **raïben** (Yes / No)?(20r)			
If "yes", how many this week (kg /week)?(20s)			
Where and to whom?(20t)			
Price (EGP / kg)(20u)			

21. Numbers of sold animals (in 2012):

Species (21a)	Av. Age /animal (21b)	Number of animals sold at farm gate (21c)	Number of sold animals to market (21d)	Av. Price/ animal (21e)	'Av.' Weight Per animal (21f)	When? (months) (21g)
Buffalo	Mature female					
	Mature male					
	Young female					
	Young male					
Cattle	Mature female					
	Mature male					
	Young female					
	Young male					
Sheep	Mature female Young lamb					
Other (21ao)						

22. Numbers of purchased animals (in 2012):

Species (22a)	Av. Age /animal (22b)	Number of animals purchased at farm gate (22c)	Number of purchased animals to market (22d)	Av. Price/ animal (22e)	'Av.' Weight Per animal (22f)	When? (months) (22g)
Buffalo	Mature female					
	Mature male					
	Young female					
	Young male					
Cattle	Mature female					
	Mature male					
	Young female					
	Young male					
Sheep	Mature female					
	Mature male					
	Young female					
	Young male					
Other (22ao)						

23. How do you take the decision to sell (criteria)? (23a) /___/ (23b)/___/
(1. best price, 2. known persons, 3. need of cash, 4. Feast (Aïd); 5. Other. Detail_____(23o))

24. If you sell at the market, which (Name of the market)?
_____(24a)/ /_____(24b)/

25. At the market you sell to: (1. Trader, 2. Butcher, 3. Breeder, 4. Consumer): (25a) /____/ (25b) /____/

26. If you sell at farm gate, do you sell to the same persons? 1. Yes 2. No :/____/

27. Who are they: /____/ (1. trader, 2. butcher, 3. breeder, 4. Consumer)
28. Why do you prefer to sell at farm? _____

28a. Do you use all the manure you produce on your crop?
28b. For the manure that you sell: Quantity: (28ba)_____Price (28bb): _____EP/m3

Part 4. Sanitary aspects in the herd

29. Sanitary aspects in the herd (jan 2012 to now 2013)

Species (29a)	How many animals have you lost by disease during this period(29b)	Most common sanitary problems (not necessarily lethal) (29c)	Type of regular program of vaccination/treatment in the herd? (29d)	How many visit of the veterinary during this period?(29e)	Average veterinarian +medicine cost per animal/year (29f)
Buffalo					
Cattle					
Sheep					
Other (29ao)					

Part 5. Activities of the family

30. How do you consider the dairy activity? /_____(30a)/
1. Main economic activity,
2. A security for family income,
3. A security for family consumption,
4. A tradition,
5. A capital,
6. Other… detail : _____(30o)

31. How many total persons in your family? (Persons who depend economically on you): /_____/

32. How many persons are able to work (all potential workers)? /_____/

32a. Male able to work (adults) / _____/

32b. Female able to work (adults): /_____/

33. How many persons are underemployed (non employed)? /____/

34. For the persons of the family who work in or out the farm, please detail:

N° (34a)	Who is doing these activities*? **(34b)**	Main activities (34c)	Code Of activity* **(34d)**	Since when do you start (34e)	Level of occupation* **(34f)**	Revenue per month (34h)	Comments (34i)/ Number of people who are doing this activity (34ca)
1							
2							
3							
4							
5							
6							
7							

***(34b)** *1. Brother, 2. Son, 3. Daughter, 4. Relatives, 5.wife, 6. Other_____ _____ (34bo)*
***(34d)** *1. Dairy activities, 2. Other farm activity;2' daity and other farm activity 3. Occasional workers; 4. Governmental job, 5. Private salary, 6. Private business (shops, traders), 7. Other_____(34do)*
***(34f)** *1. Full time, 2. Part time, 3. Just few hours/week, 4. Occasional*

35. How many children < 16 years old? /_____/

36. How many go to school? /_____/

37. Number of hired labor in the farm (external workers): /_____/

38. Number of occasional labor /_____/

38a. For how many days of work per year do you use occasional workers:_____

39. Number of permanent labor /_____/

39a. Salary of external workers:_____

40. Education (Level of the head of the family) /----------/

1. No read, no write, *2. Primary school, 3. Secondary school, 4. High secondary school, 5. Technical diploma, 6. Other . If other details:……(40ao)*

Part 6. Perspectives:

41. What are the main difficulties (by order of importance) : /_____(41a)/ /_____(41b)//_____(41c)/ /_____(41d)//_____(41e)/

1. Find enough feeds 2. Disease on animal
3. The demand on milk 4. Milk price 5. Milk quality
6. Create conflict in the relation with neighborhood (pollution, dirty) 7. Pollution affects animal production
8. Feed price 9.Irrigation problem 10. Gasoil/oil supply 11. Other (41o): _____

42. In case of expansion in agricultural activities, how do you find funding (by order of importance)? /___(42a)/ /____(42b)

(1.Self- financing, 2. Regular bank, 3. Co-operative/association, 4. Family and friends, 5.Others_____(42o)

43. Comments (difficulty or facility to find funds): ----------

44. What do you want to change in your dairy activities?

45.Observations: