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Perspectives for dairy farming systems in Africa

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Chapter One

Introduction

1.1 Problem statement

Milk has been envisaged as a principal protein source, which could increase protein consumption in Africa (Meyer and Denis, 1999). It could be used as a supplement to breast milk and as an additional protein source to children, hence reducing child malnutrition, which is of high prevalence in Africa, especially in children less than 5 (World Bank, 2004). It is also an important source of employment with many traders, processors and retailers earning part or all of their income from the dairy chain. According to FAO statistics, milk demand is growing at a higher rate than milk production in Africa. Between the years 1990 and 2004, the demand for milk and dairy products in Africa was growing at an average rate of 4.0% per annum; meanwhile production only grew at a rate of 3.1%. Milk imports have also been increasing between 1990 and 2004 at a rate of 2.1% per annum, showing that the gap between domestic production and consumption is also widening up. With the available resources, one would expect Africa to be self sufficient in milk production and even export milk.

Dairy production in Africa has a potential for development which is seen in:

- the existence of a potential market for milk and dairy products due to high demand and import;
- the availability of local breeds which are adapted to natural conditions, as well as exotic cattle with a high-yielding milk potential;
- the availability of large fields of idle land which could serve as a potential source of forage production;
- the availability of cheap local feed materials and agro-industrial by-products which could be incorporated into animal diets;

- the presence of dairy processing units whose production capacities have not yet been fully utilised;
- the presence of research and teaching institutes as well as veterinary and extension staff capable of providing the dairy sector with knowledge;
- the presence of policy makers and donors with interest in the dairy sector.

Traditional systems still dominate milk production in Africa and account for more than 90% of the dairy ruminant population in Sub-Saharan Africa (Olaloku and Debre, 1992). Indigenous groups like the Maasai, Borani, Fulani and Tuareg have maintained a strong historic dairy tradition over several years. They share many customs and regard milk as a product of harmony that is offered free to relatives, friends and visitors (Bayé 2000, Sadou 2000, Suttie 2001). According to King, 2000 (cited by Odhiambo, 2006), 22% of Ugandans are closely associated with the pastoral farming system. Furthermore, up to 80% of the Ugandan population derive their livelihoods from subsistence agriculture and livestock production, producing 85% of the milk and 95% of the beef consumed in the country.

Growth in milk consumption in Africa is pushed both by a growth in population (of 2.8% per annum) and a small growth in per capita milk consumption of (0.8% per annum) between 1990 and 2004. Due to population growth, land shortage in urban areas and increasing interest in production and consumption, dairy production needs to increase greatly. The high milk demand in urban areas drive milk production systems in areas closer to big cities to focus on milk marketing, cost minimisation and profit maximisation (Fonteh et al, 2005). Unfortunately, these urban areas with the highest market potential for milk are usually heavily populated and have limited land which is preferentially allocated to other activities than dairying. Therefore dairying is forced to shift to the rural areas where there is a weaker market for milk. The lack of adequate transportation and cooling infrastructure in rural areas accounts for a loss of large volumes of milk in developing countries (Ndambi et al, 2007). Birachi (2006) showed that, on the one hand such farmers lack information on markets and prices and have a weak market influence and on the other hand, retail outlets incur high transaction costs since they deal with many small scale producers.

Several international bodies (Heifer Project International, Land O'Lakes, Send a Cow, etc) have developed strategies to promote milk production in African countries. These bodies usually have two main objectives: Improving on milk consumption especially by poor families (nutrition improvement) and increasing on farm returns from dairy farming (income generation and poverty alleviation). The total number of dairy farms across the African continent was estimated at 4.6 million for the year 2005 (Hemme et al. 2007). Hemme et al (2007) estimate that, on average, eight people live on every dairy farm, giving a total of 36.8 million Africans depending directly on dairy farming. It is therefore important for the government, NGOs, international bodies and other prospective investors in the dairy sector to understand the constraints at various stages of the dairy chain, in order to facilitate decision making on investment possibilities, technical support and policies which will best suit this large number of beneficiaries. It will also be important to see how dairying has evolved in Africa as a whole and in individual African countries as well. This will enable an understanding of the contribution of various countries to the African dairy sector and can allow a comparison of strengths and weaknesses of some nations in order to make recommendations for others.

It has been shown that agricultural policies are very influential in determining the patterns of production and that importance needs to be attached to the farm, which is the basic unit of production. This means that farming systems must be well understood in order to implement developmental policies. Secondly, with recent global trends, competitiveness of milk production is of great importance, where the question on who will produce the cheapest milk in future needs to be answered. In addition, individual African countries tend to promote local dairy production and discourage imports in order to reduce foreign exchange on dairy products and attain self sufficiency (von Massow, 1989; Ngwoko, 1986). This means that the costs of dairy production must be low enough to eliminate foreign competition and at the same time, the returns need to be satisfactory for the farmers so that they are motivated to stay in business and pass their farms on to the next generation. This becomes a great challenge for African countries especially as the WTO, in its struggle for liberalisation, is working towards a reduction or elimination of trade barriers on dairy products (Brunke et al, 2005).

Studies on the priorities for agricultural research in Eastern and Central Africa concluded that milk was the most important commodity for research and development in the region, based on its potential contribution to agricultural GDP (ASARECA/IFPRI 2005). According to Staal (2004), cattle ownership improves child nutrition either by increased milk consumption or by increased family income. He also highlighted that, for a better realisation of these potential benefits, more understanding is needed firstly, on allocations of milk and control of resources within households and, secondly, on policy directions that encourage milk availability and consumption (Staal, 2004). In Kenya, for example, the small-scale specialised dairy production system has witnessed enormous growth over the past years, due to the massive launch of policies favouring this system (Thorpe et al., 2000). Several policies have been suggested for development of the dairy sector of African countries, with each country placing emphasis on different parts of the milk supply chain. Most policies sprout from a concept that the dairy sector will be greatly developed if production and productivity of milk are increased at the national level, thereby reducing imports and improving on foreign exchange (Ngwoko, 1986). The decrease in funds from sponsors over the years and the desire to cover a broader scope has pushed policy makers to be more cautious in project expenses.

According to the International Livestock Research Institute, the right policies, marketing systems and technical support must be sought in order to foster dairy development in Africa (ILRI, 2003). This therefore implies a need for better understanding what the best policies and/or technical support services are that support organisations can apply in order to improve on dairy production. For selection of these policies and support services, adequate analytical tools must be developed and applied especially in traditional African agricultural systems where farms are very complex units.

Given the paucity of empirical studies on the farm-level economics of milk production in Africa, there remains a great lack of knowledge on African dairy production systems (Srairi and Kiade, 2005; Bebe et al., 2003; Ketema and Tsehay, 1995, Staal et al 2001, Staal 2004, Thorpe et al, 2000, Waithaka et al., 2002). The few studies that have been carried out apply different methodologies, leading to difficulties in understanding, comparing and applying the knowledge produced (Kathio et al. 2001).

Worse still, appropriate research tools which facilitate comparison of African farms are difficult to establish, bearing in mind the complexity of such systems.
This study reviews previous literature on dairy farming systems in Africa and gives an updated description of farming systems, not only in individual countries as in previous literature, but goes further to compare economic aspects of different systems in the different countries. This comparison shows how production systems differ in different African regions and helps in understanding if some elements of production systems in one country could be applied to develop systems of another country. Several studies have also suggested different policy interventions as well as business strategies that could improve on dairy farming in Africa. This study reviews their opinions and goes further to analyse the extent of this impact in real monetary terms as well as their potential contribution to the livelihood status of dairy producers.

The methodology applied was developed by the International Farm Comparison Network (IFCN) which is a unique system for comparing milk production systems worldwide, using the TIPI-CAL model (Technology Impact, Policy Impact Calculations model) on typical dairy farms. This method calculates for each typical farm, costs and returns per 100 Kg of milk produced, setting an unbiased base for regional, national and international comparison. It is also applied in assessing policy impacts on dairy farms and has a flexibility of ranking policy impacts based on several parameters.

1.2 Research objectives

Based on the shortcomings discussed in the preceding paragraphs, this research seeks to contribute to the understanding of the farm-level economics of African dairy systems and to provide useful data and information to inform policies aimed at protecting and promoting the economic sustainability of the African dairy sector. This research will respond to the research question: How do socio-economic aspects of various African dairy farming systems vary and how can different business strategies and policies influence farm economics.

The main objective of this research is to describe and analyse economic aspects of milk production systems in Africa and to show the impact of different policies on milk production and on the livelihoods of farmers.
The specific objectives of this thesis are to:

- review the relevant literature on dairy production systems and dairy development policies in Africa;
- understand the farm-level economics of typical dairy production systems in Africa;
- assess the potential impacts of policies and farm business strategies on African dairy systems;
- improve on existing methods for analysing the impact of policies and farm business strategies on dairy farms in an information-constrained environment.

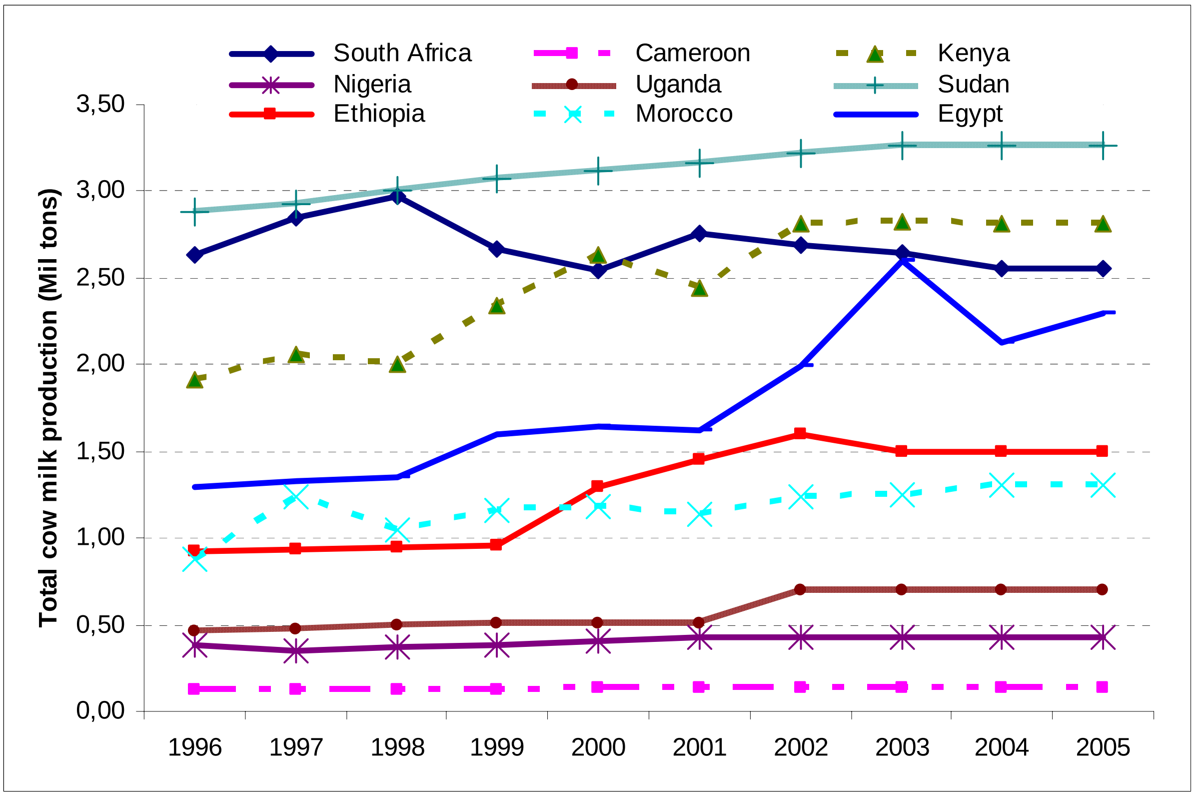
1.3 Description of study areas

The study regions include: Morocco in North Africa, South African Republic in South Africa, Uganda in East Africa and Cameroon in West/Central Africa. These countries have been selected based on their geographical location, access to literature and data sources and presence of home-based research partners in these countries with willingness to assist in the research procedure. The geographical coverage was considered with a goal of gaining an insight into the different geographical locations in Africa. The choice of farming systems in the different countries was guided by the desire to cover the major typical dairy farming systems found in literature. The selected countries are shown Figure 1.1.

Figure 1.1: Map of Africa showing the countries selected for the research

Figure 1.2 shows the trend in milk production in the selected countries and other African countries since 1996. Production has stayed relatively constant in Cameroon and Nigeria in West Africa, while there has been a small growth in production in Uganda and Morocco. Higher growth rates are observed in Sudan, Egypt and Ethiopia. In South Africa, production has decreased in recent years.

Figure 1.2: Trends of milk production in selected African countries



Source: FAO statistics

The following paragraphs describe the dairy sectors of the individual countries selected for this study.

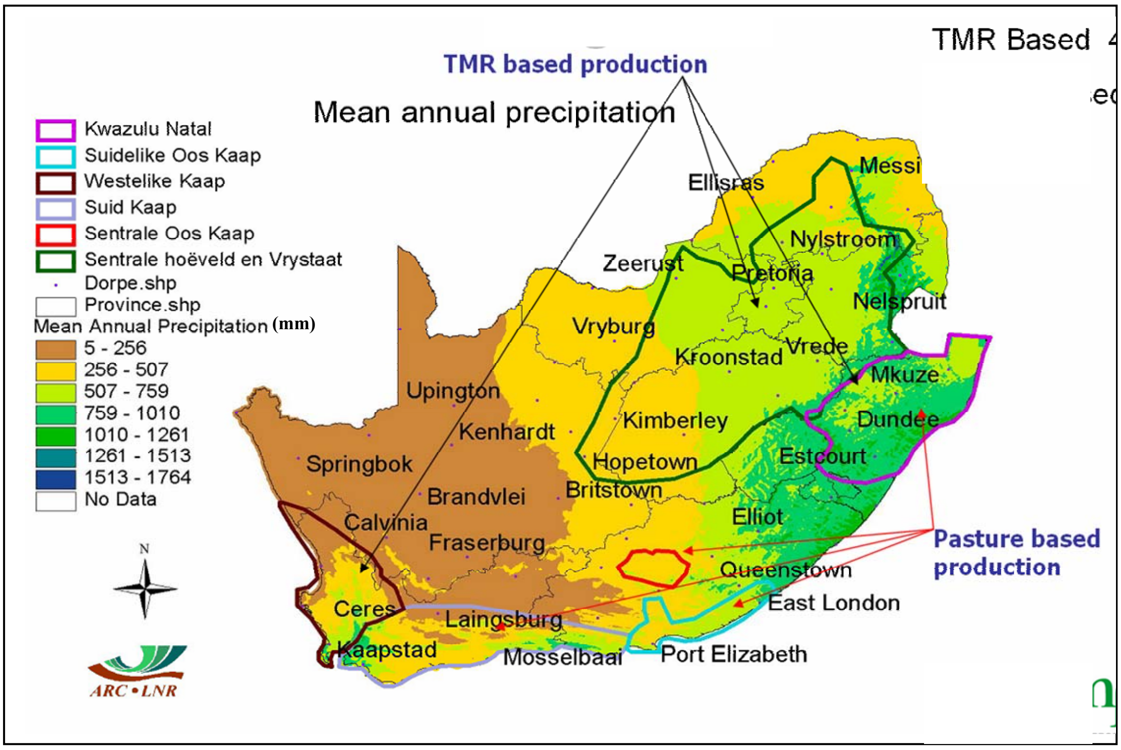
1.3.1 South Africa

South Africa has as geographical coordinates 29.00 S and 24.00 E. It has a total surface area of 1,219,912 square kilometres of which 12.5% is arable land with 0.79% of this land under permanent crops. The country has a total population of 43.8 million people and its growth rate is -0.5% per annum (CIA, 2008).

Milk production in South Africa stood at 2.56 million tons in 2005. Meanwhile, the country experienced an annual growth of 0.3% over the period 2000 – 2005. The number of dairy farms in South Africa is estimated at 4000 and was decreasing over time at an annual rate of 0.9% per year between 2000 and 2005. The average farm size in South Africa is 130 cows per farm with each cow producing an average of 4.9 tons of milk per year, while the average production per farm and year is 640 tons. Predominant dairy breeds include Holstein, Jersey, Ayrshire, Guernsey and their crossbreeds (see Annex 1). Per capita milk consumption in South Africa in 2004 was 57 kg Milk Equivalents per year. Two major dairy regions were selected for South Africa: Kwazulu Natal and Freestate regions. The Kwazulu Natal region is the second highest milk production region in South Africa in terms of milk volume while the Freestate region has the highest number of milk producers in total but produces only 10% of total milk production. The Kwazulu Natal region has the second largest production density per square kilometre in the nation and together with the neighbouring Free State region it produces one third of the total milk volume in South Africa (Coetzee & Maree 2007). The Kwazulu Natal region is located in the eastern part of the country where the average annual rainfall is higher (above 500 mm; Kunene & Fossey 2006) than in the western region where the annual average rainfall is below 500 mm. The higher rainfall favours better vegetation for forage production, hence a dominance of pasture-based milk production systems in Kwazulu Natal. Milk production in the Free State is predominately based on self-produced silage, hay and grain fed with concentrates in a TMR (Total Mixed Ration) system. The lower rainfall in this region prevents the dependence on pasture for animal feeding.

Two major production systems exist in South Africa: the TMR-based production and the pasture-based production system. Figure 1.3 shows the distribution of milk producing regions.

Figure 1.3: Climate and milk producing regions in South Africa



Source: Milk Producer Organisation – South Africa

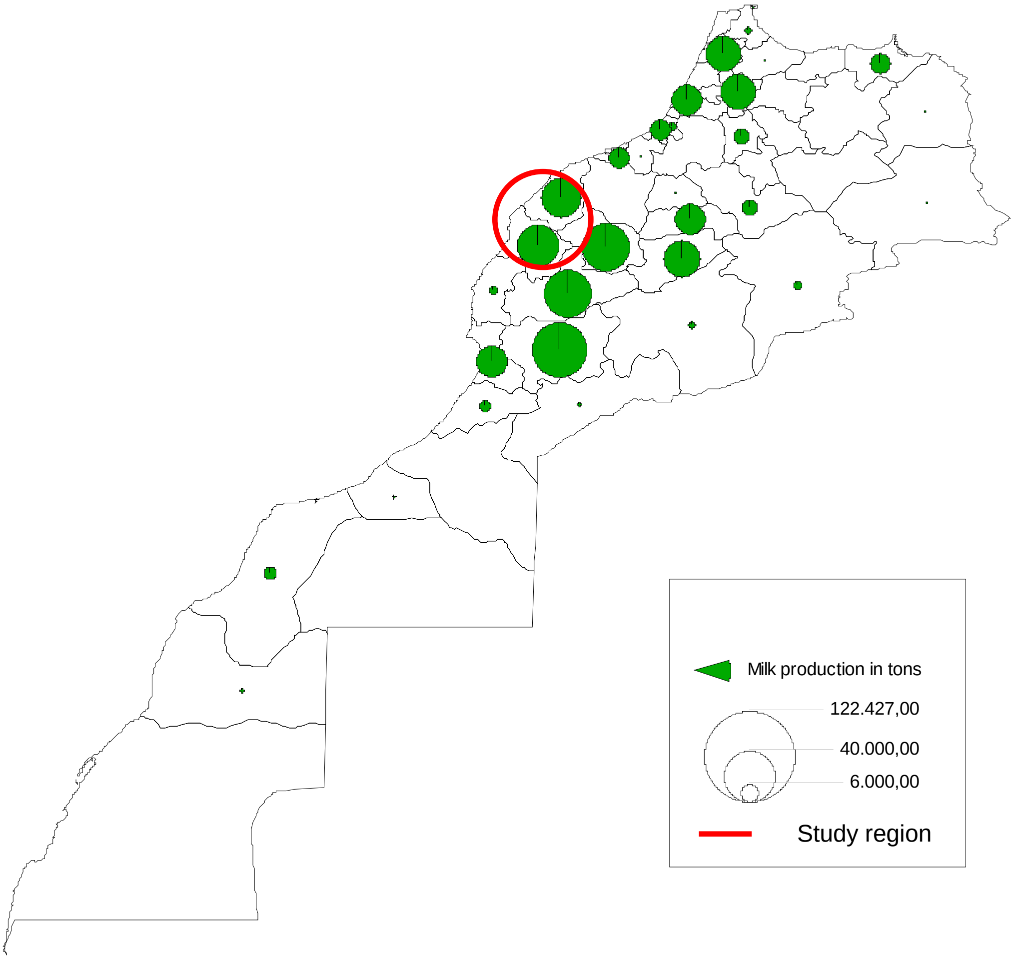
1.3.2 Morocco

Morocco lies on latitude 32.00 north of the Equator and longitude 5.00 west of the Greenwich meridian. It has a total surface area of 446,550 square kilometres of which 19% is arable land with 2% of this land under permanent crops. The total population of the country is 34.3 million people and its growth rate is 1.5% per year (CIA, 2008).

Milk production in Morocco stood at 1.4 million tons in 2005. Meanwhile, the country experienced an annual growth of 4.2% over the period 2000 – 2005. The number of dairy farms in Morocco was estimated at 769,000 in 1996. The average farm size is 2 cows per farm with each cow producing an average of 0.93 tons of milk per year, while the average annual production per farm is 1.1 tons. Predominant cow breeds are the local breed, Montbeliarde, Holstein Friesian and their crossbreeds (see photos in annex 2). Per capita milk consumption in Morocco in 2004 was 52 kg Milk Equivalents per year. Dairy systems for this study were selected from the Doukkala region. The Doukkala region comprises 107,000 hectares of irrigated land (Cadasse

2001). Doukkala is a region well known in Morocco for cattle production. It is also one of the first and major regions where dairying was introduced at large scale since 1975, and where irrigation water was not limited until recently as compared to other irrigated regions. Since the early 90's, Nestlé, as a new additional processor in the region, has been very active in Doukkala, where it installed a processing unit and several new collection centres for milk, thereby encouraging more dairy production. Figure1.4 shows the density of milk production in the country.

Figure 1.4: Milk production distribution in Morocco



Source: National Statistics Bureau - Morocco

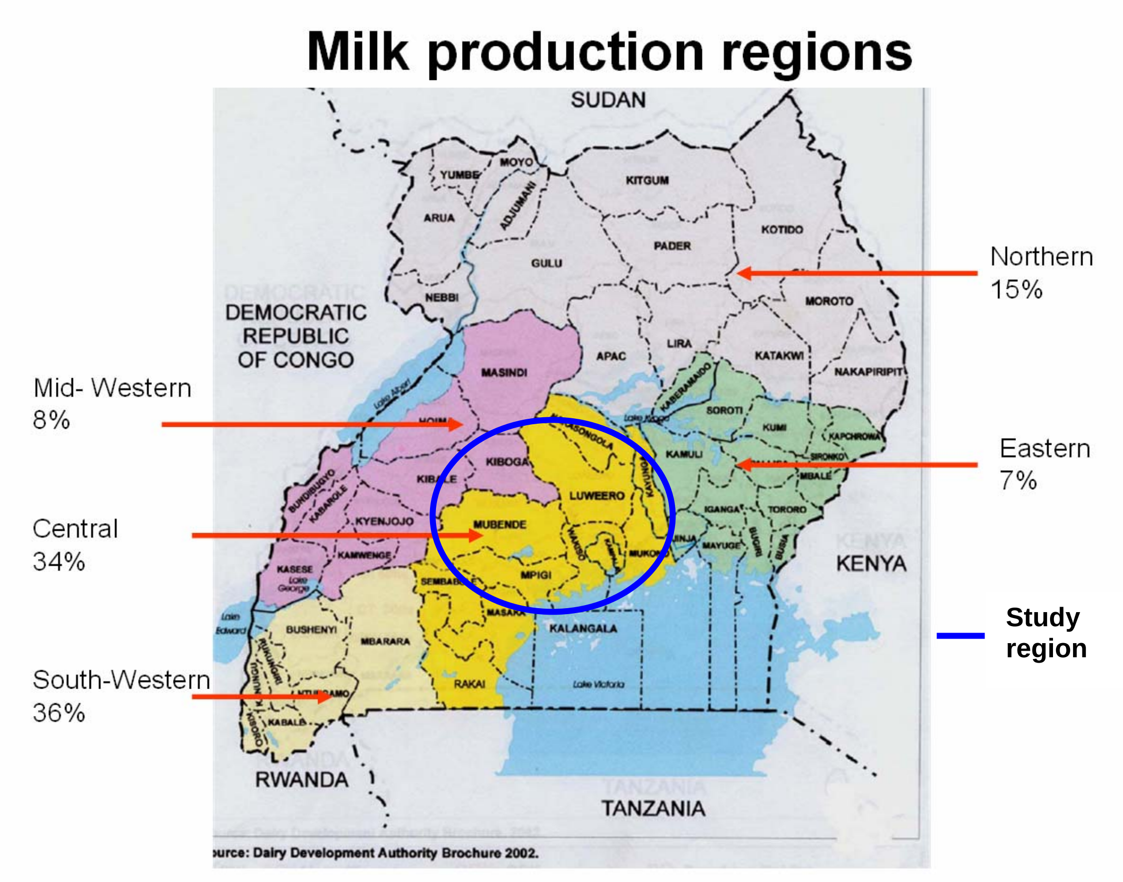
1.3.3 Uganda

Uganda lies on the geographical coordinates 1.00 N and 32.00 E. It has a total surface area of 236,040 square kilometres of which 21.57% is arable land with 8.92% of this land under permanent crops. The country has a total population of 31.4 million people and a population growth rate of 3.6% per annum (CIA, 2008).

Milk production in Uganda stood at 1.4 million tons in 2005. Meanwhile, the country experienced an annual growth of 13.1% over the period 2000 – 2005, one of the highest in Africa. The number of dairy farms in Uganda was estimated at 801,000 in 2002. The average farm size is 2 cows per farm with each cow producing an average of 0.8 tons of milk per year, while the average production per farm is 1.3 tons per year. Predominant dairy breeds are the local Ankole, Holstein Friesian and their crosses (Annex 3). Per capita milk consumption in Uganda in 2004 was 49 kg Milk Equivalents per year. The dairy systems analysed were selected from the central region. The central region is the second largest milk producing region, producing 34% of all milk in Uganda after the South Western region (producing 36% of total volume of milk). The central region includes Kampala, the nation’s capital which is the highest consumption area for milk in Uganda (Bunoti 1996). It is for this reason that the dairy production systems are rapidly evolving and adapting to the increasing milk demand. The presence of several intermediate milk dealers in this region gives a higher assurance to farmers that their milk will be bought. This is however not the case in the South Western region where farmers are sometimes discouraged by an unreliable milk market. As opposed to South Africa and Morocco where heavy investments are made in dairying, typical farming systems in Uganda are extensive systems with minimal input.

The country has been divided into five major milk production regions as shown in Figure 1.5.

Figure 1.5: Milk production regions in Uganda



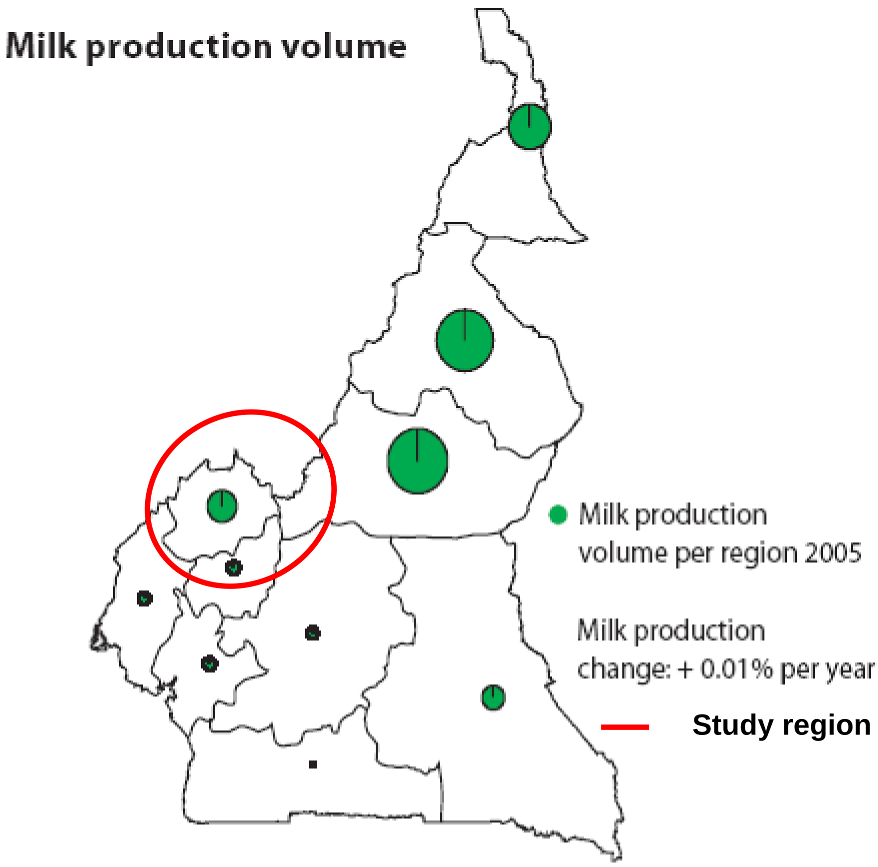
Source: Dairy Development Authority (DDA) - Uganda

1.3.4 Cameroon

Cameroon lies 6.00 degrees north of the Equator and 12.00 east of the Greenwich meridian. It has a total surface area of 474,440 square kilometres of which 12.54% is arable land with 2.52% of this land under permanent crops. The country has a total population of 18.5 million people and a population growth rate of 2.21% per annum (CIA, 2008).

Milk production in Cameroon stood at 0.13 million tons in 2005. Meanwhile, the country experienced a stable production over the period 2000 – 2005. The number of dairy farms in Cameroon was estimated at 235,000 in 2005. The average farm size is 60 cows per farm with each cow producing an average of 0.6 tons of milk per year. This large average farm size is due to the dominance of beef cattle which only have dairy as a side business. The common milk production breeds include the local Fulani and Gudali, Holstein Friesian, Jersey and their crosses. The per capita milk consumption in Cameroon in 2004 was 16 kg Milk Equivalents per year. Dairy systems in this study were selected from the Western Highland region. The Western Highland region is the third largest milk production region in Cameroon after the High Guinea-Savana and the Sudano-Sahelian zones. This region has advantages over other production regions because it is free from tsetse flies and the disease trypanosomiasis which is a major threat to cattle production in the other two dairy regions. This disease is particularly sensitive to graded cattle which bear great potential for dairy improvement (Belemsaga *et al*. 2005). The Western Highlands is also the region in the country with the highest number of specialised dairy farms and its proximity to the nation's economic capital Douala, a major milk consumption zone increases the market potential for its milk and dairy products. In addition, the Western Highlands have rich grassland fields for forage production and the lowest temperatures in the country, enabling a longer shelf life for fresh milk of more than 16 hrs under ambient temperatures (Ndambi *et al*. 2007) compared to only 4 hours in the Sudano-Sahelian zone (Kameni *et al*. 1999). This lower temperature is highly advantageous since most farmers do not have cooling facilities and, as a result, large volumes of milk are lost through post-harvest spoilage before the milk reaches the processor (Imele *et al*. 2000). As in Uganda, Cameroon's dairy production is dominated by extensive systems. As opposed to South Africa and Morocco, extensive dairy producers in Uganda and Cameroon have access to communal land where they can graze their cattle at very low cost, explaining the predominance of these systems. Figure 1.6 shows the milk production volumes in different regions of the country.

Figure 1.6: Milk production distribution in Cameroon



Source: Ministry of Livestock, Fisheries and Animal Industries, Cameroon

1.4 Preview of the thesis

This thesis is a cumulative study. It comprises six research papers, each focusing on a different aspect of the overarching research question. At the time of writing, three of the papers have been published in peer-reviewed academic journals, one has been accepted for publication and is yet to appear, another is under review, and one has been submitted for publication as a working paper.

The first paper, titled "Dairying in Africa – Status and Recent Developments", published in *Livestock Research for Rural Development*, Volume 19, August 2007, provides a wide-ranging review of the available literature on dairy production systems in Africa, trends in milk production, processing, consumption, imports and exports in Africa for the years 1990 to 2004.

The key findings from this review are that dairy farming systems differ greatly in the different African countries with regards to farm inputs, outputs and main objectives for farming. Pastoral systems dominate dairy production in Africa and account for 80% of milk produced, although they have the lowest milk yield per cow. The persistence of these systems in Africa, despite the existence of higher-yielding systems, draws attention to more in-depth studies of the constraints these farmers face towards improvement. Considering that the non-cash components could also be important in such systems, need arose for a detailed farm economic study, covering both cash and non-cash components of farm costs and returns, in comparison with other dairy production systems in Africa.

The views of previous authors on policy intervention in the African dairy sector have been explained in this paper. Studies covering areas like genetic improvement, marketing, veterinary services, extension services, import policies, and institutional support were critically analysed. However, there was very limited detail on economic impact of suggested policies on farming families. This led to a need for more detailed analysis of policy impacts, using appropriate analytical tools.

The second paper, titled "Milk production amongst Fulani grazers in the Western Highlands of Cameroon: constraints and development perspectives" published in *Livestock Research for Rural Development* Volume 20, January 2008 describes the specific problems faced by dairy farmers of the pastoral system in Cameroon. This paper does not only contribute to a better understanding of the socio-economic and cultural aspects of the pastoral system, but goes further to show what problems the farmers of this system face. The factors which prevent the dairy sector of a typical African country from exploiting the potentials as described in the previous article have been discussed in this paper. It shows how these problems originate and how they affect the dairy chain as a whole. Suggestions have also been given on how different stakeholders can respond to such problems in order to improve on the existing situation.

This paper reveals that farmers of this system fall among the least educated people in their community and this may pose a problem in the adoption of new technologies. Though land is cheap and available in rural areas, population pressure reduces its availability, leading to conflicts between crop farmers and cattle grazers. This means that, though land shortage is not yet a challenge in rural areas, the efficiency of land

use needs to be improved so as to cope with the larger demand for both animal and plant food sources from the reducing area of land available for agriculture.
The first two papers above have shown that, while there is a large potential for extending milk production in the study areas, a number of economic problems still hinder the development of the dairy sector. This means that, proper studies need to be carried out on possible stakeholder interventions at the farm level. This however requires a good understanding of the dairy sector. The dairy farm is the basic unit of milk production. If dairying is to be improved, the farmer should have enough motivation to keep producing. Farmers are grouped differently, based on their farming systems and it is most likely that farmers of the same farming system have similar perceptions. Therefore, it was necessary to describe the different farming systems in Africa in detailed economic terms.
The third paper of this study titled "Milk production systems in Central Uganda: a farm economic analysis" published in *Tropical Animal Health and Production* journal volume 40, May 2008 describes the economics of seven major dairy production systems in Uganda. This study covers all cash and non-cash components of costs and returns of each production system.

This study revealed that all seven farming systems had specificities and differences in their inputs and returns, leading to a further splitting of the systems into three intensive and four extensive systems. Farmers closer to the urban areas practice more intensive production with higher inputs due to higher land and labour costs, while those further away in the rural areas practice more extensive dairying since land and labour resources are less expensive. The higher milk price and better developed market in the urban areas could motivate intensive production, despite the higher cost of production. This study only analyses farming systems in Uganda and therefore partly meets with the objective of understanding the economics of dairy production systems in Africa. For a better coverage of this objective, need arose to study the farming systems of other African countries.

The fourth paper titled "An economic comparison of typical dairy farming systems in South Africa, Morocco, Uganda and Cameroon" (under review at *Tropical Animal Health and Production* journal) compares typical dairy production systems in four African countries. This comparison included a complete regional coverage of Africa, with Morocco representing North Africa, South African Republic representing South Africa, Uganda representing East Africa and Cameroon representing West and Central Africa.

As in the previous paper, this paper separates all farming systems into intensive and extensive systems. It was found that, when the farms get bigger in size, the need for acquisition of hired land and labour increases. Although extensive farming systems have the lowest costs of production per 100 kg of milk, milk yields and input productivities are lowest, leading to very low net income from the dairy enterprise. Large-scale intensive systems like those in South Africa have relatively low costs of production and higher productivities of inputs, generating a higher net income from dairying. The question that immediately came up was: what policies or farm business strategies can help extensive dairy farmers to improve on income generation from the dairy enterprise?

The fifth paper titled "Application of the TIPI-CAL model in analysing policy impacts on African dairy farms" (accepted for publication in the *Quarterly Journal of International Agriculture*) tries to answer the question posed at the end of the previous paragraph. After an understanding of the dairy systems in Africa, considering the fact that extensive systems dominate production and account for over 80% of milk in Africa, considering the fact that these systems have low productivities and generate little income, considering the fact that an improvement of this system will greatly impact on dairying in Africa, this study focuses on the impact of different policies and farm business strategies on the extensive dairy farming system in Uganda. The TIPI-CAL model was used for this analysis. Seven policy areas were analysed, including genetic improvement, veterinary service provision, extension service provision, marketing improvement, consumption improvement, input provision and credit provision. This analysis aimed at selecting the best farm strategies and policies that could improve on dairy production and to what extent.

This paper shows that, in general, policies and/or strategies which improve on marketing channels for these rural farmers have a positive impact on their income generation. The impacts of all policies could be multiplied up to a factor of three if the farmers could replace their local cows with graded ones. However, financial constraints as well as accessibility to inputs could hinder this replacement. This study covers the objective of assessing the potential impacts of policies and farm strategies on African dairy systems. It only uses one method of policy impact analysis despite the existence of several other methods. The advantage of this model is its ability to generate results from areas with very limited available data. Due to this limitation in data availability, it was also necessary to see if other methods could bring additional contributions to the previous findings; if so, then how can the methodology be improved?

The sixth paper titled "Comparing the EXTRAPALATE and TIPI-CAL models in analysing policy impacts on Ugandan dairy farms" (submitted as a working paper for FAO and a modified version as an article in the *Journal of Economics and Applied Informatics*) compares the results obtained in the previous article with results from an analysis using the EXTRAPOLATE model. This comparison was done in the light of the last objective of this study, which was to improve on existing methods for analysing the impacts of policies and farm strategies on dairy farming in an information-constrained environment.

The two models can be briefly described as follows: the EXTRAPOLATE (EX-ante Tool for RAnking POLicy Alternatives) is a communication tool for policy impact assessment. It assesses the impact of different policy measures on a pre-defined (status quo) situation of various stakeholders. The tool facilitates discussion of the relevant issues and enables users to visualize the predicted impacts of policy interventions and rank them, based on logical judgment. The TIPI-CAL (Technology Impact, Policy Impact CALculations model) is an on-farm policy impact assessment tool. It assesses policy impacts to a detailed extent on farm variables (cost, revenue and farm structure changes) of typical farms, using real values. Impacts could be measured on a static (one year) or an inter-temporal scale (up to ten years).

A comparison of results from both models show a broad variation in ranking for two policy areas (genetic improvement and veterinary services provision) while the other five policy areas were ranked similarly in both models. These differences in ranking were due to two reasons: firstly, the TIPI-CAL model only analyses the typical case, thereby excluding the best or worse cases while EXTRAPOLATE analyses a general situation averaging all possible cases. Secondly, analysis using the TIPI-CAL model also incorporates technology adoption possibilities to some extent, while the

EXTRAPOLATE model does not. From comparison of results, the strengths and weaknesses of each of the models were discussed and it was suggested that both could be applied successively in future policy impact analysis studies in Africa.

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Chapter Two

Dairying in Africa – Status and recent developments

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Summary

The quest for more knowledge on the African dairy sector has been increasing over recent years. Dairying has been envisaged as a means to improve on the nutritional status and income generation from poor African families. This has led to the implementation of lots of developmental projects in favour of dairying. Different trends have been noticed in dairy sectors of different countries over the past years. This review describes the present dairy situation in Africa and looks at trends in the sector from 1990 to 2004. It gives a general overview of dairying in Africa, its trends and policies which have impacts on its development. Many open points have also arisen, which could serve as a starting point for further studies on dairying and its drivers.

Key words: Africa, dairy development, milk, policies, production systems, trends

2.1 Introduction

Traditional systems have dominated milk production in Africa for several years and still supply considerable amounts of milk today and also account for above 90% of dairy ruminant population in Sub-saharan Africa (Olaloku and Debre 1992). Indigenous groups like the Maasai, Borani, Fulani and Tuareg have a strong historic dairy tradition. They share many customs and regard milk as a product of harmony that is offered free to relatives, friends and visitors (Bayé 2000, Sadou 2000, Suttie 2001). Due to population growth, land shortage and increasing interest in production and consumption, market-oriented dairy systems are now evolving, with the use of high performing graded animals and/or higher inputs. Several international bodies (Heifer Project International, Land O'Lakes, Send a Cow, etc) have developed strategies to promote milk production in African countries. These bodies usually have two main objectives: Improving on milk consumption especially by poor families (nutrition improvement) and increasing on farm returns from dairy farming (income generation and poverty alleviation). Therefore it is important to see how dairying has evolved in Africa as a whole and in individual African countries as well.

2.2 Dairy production systems in Africa

For a long time, dairy systems in Africa have been classified into different groups, based mainly on farm inputs and outputs. A summary of these systems is shown on Table 2.1:

Table 2.1: Dairy production systems in Africa

System / Description	Traditional systems (Pastoral systems)			Semi-intensive systems		Intensive systems	
	Maasai pastoralists	Borana local herders	Fulani, Tuareg and Peuhl pastoralists	Large state-owned farms	Cooperative farms	Cross breeding	Small family farms with exotic cows
Countries	Kenya, Tanzania	Ethiopia, Kenya	West Africa	Widespread	Widespread	Widespread	Widespread
Breeds used	Zebu	Boran, Zebu	Fulani, Gudali Zebu, Peuhl	Local + Exotic	Local + Exotic	Crosses	Exotic
Milk collected (Kg/cow/ lactation)	< 200	200 - 300	< 200	> 2500	> 2500	1500 - 2500	1500 – 3500
Herd size	10 - 120	10 - 120	10 - 300	> 300	> 100	10 - 30	1 - 5
Main breeding objective	Beef*	Beef*	Beef*	Milk	Milk	Milk	Milk
Proportion of milk sold	< 10%	< 10%	0 – 30%	> 60%	> 80%	> 60%	> 50%
* In these systems, milk production is also important, mostly for subsistence. Exotic breeds = Mainly Holstein Friesian, Ayrshire and Jersey							
Herd size = Milking cows, dry cows, heifers, calves and bulls							

Source: Own estimates from field experience and literature collection

2.2.1 Pastoral systems

Pastoral systems have transhumance as a common feature, where pat or all of the family move along with the animals in search of pasture. One of the oldest pastoral systems is practiced by the **Maasai** in the sparsely populated semi-arid range-lands of Kenya and Tanzania. The Maasai live in extended families of 10-15 people with herds averaging 100-170 cattle and as many sheep and goats also. They produce and consume about 0.85 kg of milk per person per day; meanwhile, a greater share of the income comes from sales of livestock. Only a few of them grow crops while the majority purchases most of their foodstuff. In this system, milk surplus is shared with neighbours or exchanged in barter, but is rarely sold except by households living close (<5 km) to main roads and urban centres where there is demand for fresh and fermented milk, and butter. The **Borana** pastoral system is similar that of the Maasai. Here, the frequency and amounts of dairy products traded depend on herd size and distance to the market. Milk sales in this system is however of higher interest than is the case with the Maasai (de Leeuw et al 1988).

According to Tonah (2002), dairy production by the **Fulani** in Ghana is characterised by migratory pattern, which is changing over time. Similar to the Maasai, Fulani have a uniqueness which stems from the fact that they are culturally the least known to the indigenous population and share very few practices with the host population. Fulani settlements are typically located at the outskirts of the settlement and consist of several concentric huts arranged to form a single housing unit. In a study on Fulani Agro-pastoralists in central Nigeria, Waters-Bayer (1988) found that dairy production units had modal household sizes of 7 – 13 persons with almost equal males and females and 45% of members above 18 years.

Contrary to the situation of the Fulani in Ghana, milking by Nigerian Fulani is only done once daily by boys and men and exceptionally by women. The modal herd size is usually between 40 – 60 cattle with majority of families keeping sheep and all keeping poultry. Grazing is done within 5 – 6 Km from their homesteads most of the year and animals return each evening after grazing. In the dry season, arrangements are made with local farmers for stubble grazing and manuring. During such periods, a woman or one of her children have to spend up to an hour on the way to such farms, taking along cooked food for the herders and returning with milk for the household (de Leeuw et al 1988).

Another pastoral system is that where herders are pastoralists who act as managers of communal herds with cattle, which are entrusted to them by local farmers who each own a few heads (de Leeuw et al 1988).

An improved system, the agro-pastoral system arises from the pastoral system, whereby cattle owners also cultivate crops in order to diversify production and reduce risks. The farmers here are sedentary, unlike the pastoralists who are mobile. They also graze their animals on communal grazing land and feed crop residues to cattle, unlike pastoralists who rarely use feed complements (Kategile and Mubi 1992).

2.2.2 Intensive systems

Market infrastructure increases the importance of the dairy component in smallholder dairying. Increasing population growth and urbanisation have led to the intensification of dairy systems around urban areas in Africa which is also favoured by a higher demand in such areas. The farms here are small (about 1-2 ha with 1-2 cows generally Holstein Friesian or Ayrshire). Feeding is mainly cut-and-carry with planted Napier grass *(Pennisetum purpureum)* and crop residues, especially from maize and bananas. Most work on the majority of such dairy farms is done by the family. Contrary to pastoral systems where large proportions and sometimes all the daily milk is consumed at home, only a small portion of milk produced in this system is left for home consumption and the rest sold (de Leeuw et al 1988).

Larger intensive farms are usually owned by rich individuals, cooperatives or the government. There is a higher market orientation in this systems and more emphasis is laid on feeding and breeding management to assure optimal production. More investments are also made on buildings and machinery while the use of hired labour is unavoidable. These systems concentrate on the supply of milk in large towns and in most cases have one or more guaranteed delivery sources (Diop et al 1995).

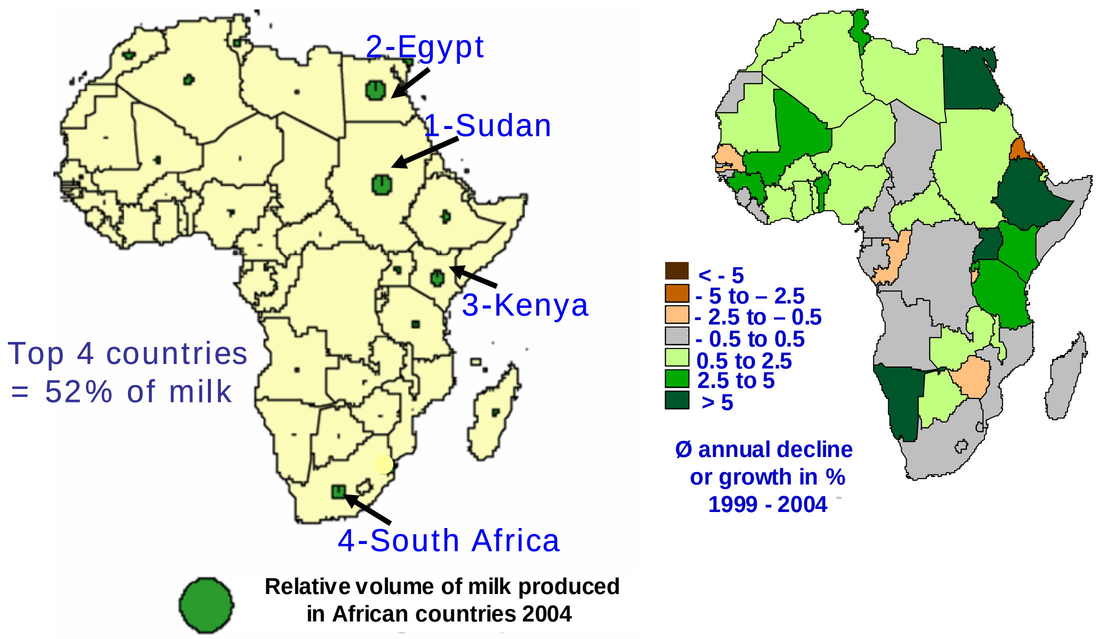
2.2.3 Semi- intensive systems

This system is common in peri-urban zones, having farms which are owned by business men, civil servants and private individuals who employ labour in the catering of their animals, with milk production as their major objective (Diop et al 1995). Dairying is done with some degree of intensification by a combination of grazing and concentrate-feeding. Here, there is use of graded cows or crossbreeding, usually between exotic bulls and local cows. The aim of crossbreeding is to upgrade for better milk production and at the same time retaining the adaptability of the animals in changing environmental conditions (Bayemi et al 2005). In such farms where management is moderate, it is important for the animals to have a natural resistance to environmental stress. Milk production here is much higher than in pastoral systems, though still less than in graded cows.

2.3 Milk production status and trends

In the year 2004, total cow milk production in Africa was 21,244,474 tons produced from a total of 46 million dairy cows giving an average milk yield of 461 Kg milk per cow over the year, which is only one fifth of world average yield (FAOSTAT 2006).

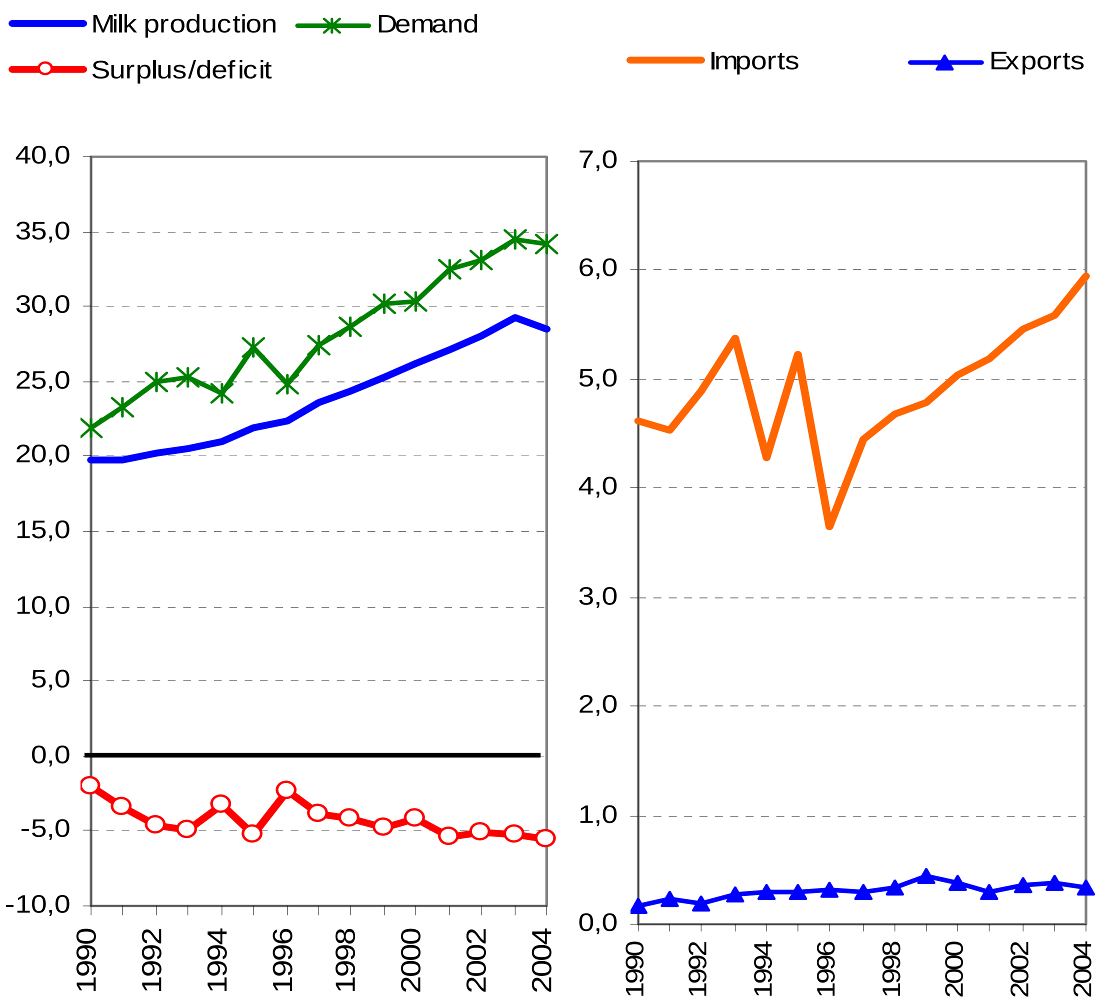
Figure 2.1: Volume of milk produced and annual growth percentages



Source: FAOSTAT 2006, IFCN Sector model 2006

The top five African milk producing countries in terms of milk volume are Sudan, Egypt, Kenya, South Africa and Algeria. Meanwhile, the first four countries alone produce 52% of total African milk (Figure 2.1). Geographically, the production volume is higher in countries at the Eastern side of Africa and by those in the North. Though there is a slow overall growth in milk production in Africa, individual countries have witnessed different growth and reduction rates. Between the years 1999 and 2004, remarkable increase trends (>5%/year) were noticed in countries like Egypt, Ethiopia, Uganda and Namibia. A considerably decreasing trend in milk production (between -5 to - 2.5%/year) was found in Eritrea, meanwhile Burundi, Congo, Senegal and Zimbabwe noticed smaller decreases (of -2.5 to -0.5%/year). The other countries either had a small increase or an almost constant production.

Figure 2.2: Milk production, consumption, imports to and exports from Africa from 1990 – 2004 (million tonnes ME)



Source: FAOSTAT, 2006; IFCN Sector Model, 2006

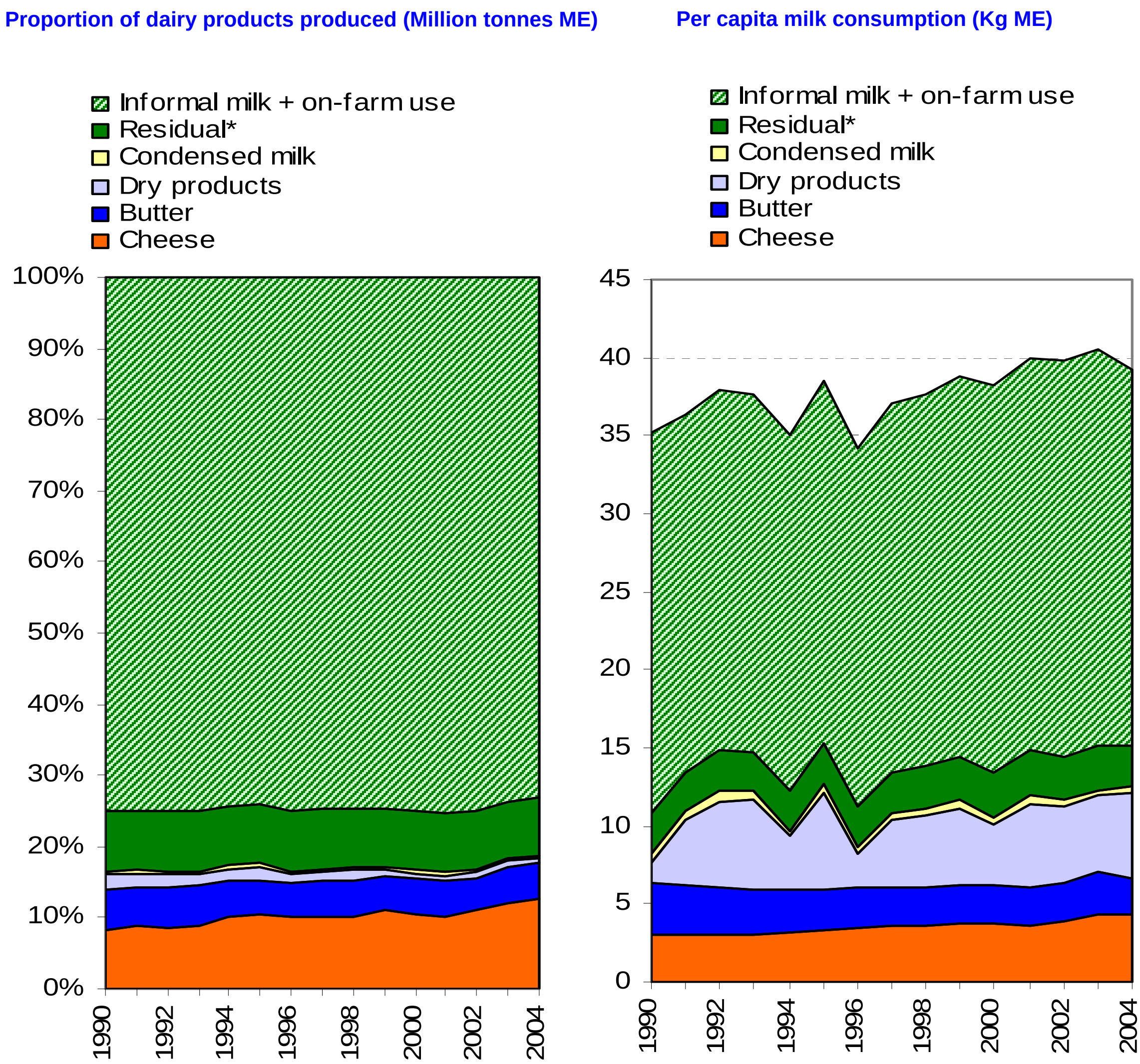
♠ME = Milk Equivalent: Milk equivalents are used to aggregate supply and demand for milk and milk products in one single figure, instead of balancing supply and demand for each product like milk fat or milk protein (IDF 2003). In this study, the combined butterfat and non-fat solids method was used, which takes into consideration all the solids in milk (IDF 2003).

Generally, there has been an increasing trend in milk production in Africa over the years (Figure 2.2). Between the years 1990 and 2004, the demand for milk and dairy products in Africa was growing at an average rate of 4.0% per annum; meanwhile production only grew at a rate of 3.1%. Growth in consumption was pushed both by a growth in population (of 2.8% per annum) and a small growth in per capita milk consumption (of 0.8% per annum) between 1990 and 2004.

Milk imports have also been increasing within the period of 1990 – 2004 (Figure 2.2) at a rate of 2.1% per annum, showing that the gab between production and consumption is also widening up. Meanwhile, milk export, though very little (consisting of only 1.2% of total production), was increasing rapidly at the rate of 7.8% per annum during the period of 1990 – 2004 (FAOSTAT 2006; IFCN Sector model 2006). Increase in imports has also been favoured by a reduction of import duties. In Kenya, for example, local dairies couldn't sometimes buy all milk from local producers because the demand for their end products was lower, as consumers could get cheaper imports (ILRI 2003). It is important to note here that, exports and imports here also include inter continental sales, where Nigeria comes on top of the milk import list.

Processing and consumption patterns for dairy products in Africa

Figure 2.3: Proportion of different dairy products Per capita consumption (Kg ME) of dairy products in Africa from 1990 – 2004



*Residual = Mainly fresh milk products + others not specified in chart

Source: FAOSTAT 2006; IFCN Sector Model 2006

As seen in Figure 2.3, only about 15% of the total milk produced is processed to standard products (cheese, yogurt, butter, etc). More than 70% of total production goes through informal markets or is consumed on the farm.

The per capita consumption of milk increased from 35 Kg ME in 1990 to about 40 in 2004 (Figure 2.3). While the consumption of cheese and dry products slightly increased, that for butter and condensed milk slightly reduced over the years. While the production of milk powder is very little, its consumption is quite high, since this is the most common form of imported milk. Consumption of milk and milk products in Africa is greatly influenced by traditions and cultures. The countries with the highest per-capita consumption in Sub- Saharan Africa are Sudan, Mauritania, Botswana and Kenya (ILRI 2003).

2.4 Dairy development policies in Africa

Dairy trends and production systems can be greatly influenced by policies. In Kenya, for example, the small-scale specialized dairy production system has witnessed enormous growth within the past years, due to the vast adoption of policies favouring this system (Thorpe et al 2000). Several policies have been suggested for development of the dairy sector of African countries, with each country laying emphasis on different parts of the dairy chain. Most policies sprout from a concept that, the dairy sector will realise a great impact if the production and productivity of milk is increased at national level to at least maintain self sufficiency, thereby reducing imports.
The major policy areas of intervention on the African dairy sector include have been discussed below:

2.4.1 Genetic improvement of dairy animals

On a comparative basis, traits like age at first calving, calving interval, milk yield per lactation, lactation length and fat percentage have been used to evaluate production in dairy cows. Many studies have shown that local African breeds are less productive than exotic breeds (Tambi 1991; Mwenya 1993; Bebe et al 2003). Some authors believe that, though local breeds are less productive, proper breeding schemes and management could greatly increase milk yields on a more sustainable basis (FAO 1990; FAO 2001; ILRI 2006). Others show that, the crossing of breeds within African countries could secure better production and adaptation to local hazards (Jordt et al 1986). A number of attempts to use exotic breeds in Africa have been successful, leading to a strong development of interest in policies which favour the introduction of such breeds. Exotic cow breeds are less adapted to African conditions are hence, more susceptible to diseases and environmental stress (Ahunu et al 1993; Bebe et al 2003; Bayer and

Wanyama 2005). Additional labour and capital input requirements for exotic breeds are a major constraint to farmers, who in most cases do not usually have access to credit facilities (Tambi 1991; Per and Marc 2002). The introduction of exotic breeds to Africa is usually governed by policies and most countries set control limits for semen or livestock imports with an aim of preserving local genetic resources (Mwenya 1993). The situation was worsened from1986, by the outbreak of the mad cow disease, which led to several laws banning the import of semen, livestock and other cattle products (Marsh et al 2005), which in some countries have not been completely uplifted till date. A compromising situation could be reached at by the practice of cross breeding, whereby, the crosses are believed to be more adaptable to local conditions than exotic breeds and more productive than local breeds (Ogle 1990). It would be important also, to study the percentage level of introduction of exotic genes at which production is most profitable on an economic basis. From these examples, three policy areas for genetic improvement are highlighted; those that improve on local breeds by selection and management, those which promote crossbreeding and those which promote the replacement of local breeds with exotic ones.

2.4.2 Promotion of the marketing and consumption of milk and dairy products

Marketing is a very important aspect of the dairy chain. Presence of close by markets for milk and dairy products is a key motivating factor for milk producers. The promotion of marketing will require gathering of milk from several producers, transforming it to an acceptable marketable product and delivering it to consumers at the desirable time and at an affordable price. Due to high costs incurred in collection and cooling of milk, it is solicited that larger volumes are handled to reduce unit costs of transactions. A common means of doing this is the installation of cooling centres for milk in production areas and the organisation of farmers into dairy cooperatives (D'Haese et al 2005). It is also important to note that a minimal milk supply level is required for profitable operation of such units. Encouragement of formal and informal markets for milk is a common policy area looked upon (D'Haese et al 2005; Leksmono et al 2006). Marketing policies are most convenient when they go along with policies that encourage milk consumption, especially in Western and Central African countries, where the per capita consumption is still very low. In Uganda, for example the DDA

(Dairy Development Authority) promotes milk consumption using adverts on printed posters, in newspapers and over the radio. Slogans like "so, have you had milk today?", "got milk"? "How often do you take a cup of milk …" are common. Promotion of milk consumption through an adoption of the School Milk Programme in Southern and Eastern Africa has also led to great changes in the dairy sector, as it is seen to improve on the livelihoods of the milk producers and also on the nutritional status of benefiting school children (Saamanya 2005; Mutagwaba 2005).

2.4.3 Provision of appropriate veterinary and extension services

In order to produce milk, farmers first of all need knowledge which they can apply to intelligently combine all available resources to produce milk of acceptable quality, while optimising profit. Due to modernisation, technology is changing and more efficient methods of combining resources are evolving. African dairy farmers are in most cases of low educational background and need to acquire this knowledge through a simple and understandable approach. Provision of veterinary and extension services to farmers is such an important policy area in Africa (Tambi 1991; Kyomo 1993; Okwenye 1995; Urassa and Raphael, 2004). The provision of government incentives on veterinary and extension services is very important; though the promotion of private services may also be good, since public services are hardly regular (Swai et al 1993). The impact of provision of such services could be measured in several ways. In Kenya, for example, training of farmers led to a reduction of calf mortality from 20% to less than 10%, within 4 years. The same approach also reduced mortality rates in Tanzanian cows (FAO 2001).

2.4.4 Provision of credit and farm inputs

The provision of credit to livestock farmers could promote the adoption of improved livestock technologies especially in rural areas where most farmers lack tools. However, credit provision to dairy farmers is usually a very complex issue having difficulties in the decisions on the amount and form of credit, the interest charged, targeting of specific farmers' groups and specific activities, and repayment schemes (Ahmed and Ehui 2000; Per and Marc 2002). Most formal credit institutions are reluctant to give money to dairy farmers because they often don't have good sureties and are susceptible to epidemics which could lead to inability to pay debts. For easy management and reduction of transaction costs, credit institutions prefer to loan larger sums of money to fewer clients than to loan small sums to many dairy farmers. Therefore specific credit facilities are required for these farmers. The formation of farmer groups and dairy cooperatives could be helpful in three ways: firstly a group has better access to formal credits than individual farmers and secondly, external support or trainings from the public and private sectors is easier in groups, finally credit schemes could be easily organised within the group. In some cases, it is possible to give credits in the form of farm inputs (feed, vet medicine, insemination, farm equipment, etc) and deduct credit refund directly from milk returns at cooperative level.

2.4.5 Milk import policies

In order to promote the local dairy industry, African policy makers tend to discourage the importation of milk and dairy products. The import situation could be worsened in subsequent years as the WTO globalisation policies are aiming at a reduction in tariff barriers hence, imported milk and dairy products will become cheaper. According to von Massow (1989), African governments have the following goals in selecting policies:
Provision of urban consumers with dairy products at affordable prices; generation of revenues from dairy imports; reduction of the amount of foreign exchange spent on dairy imports; and stimulation of dairy development, thereby generating income for producers and moving towards self-sufficiency in dairy products. At present, Nigeria is the highest importer of milk and dairy products in Africa (FAOSTAT 2006). This position has been maintained despite import reduction arising from two ways: first of all, by government regulations on milk imports through restricted import licensing, prohibition of fresh milk imports and imposing of specific import duties on dairy products (Ngwoko 1986), and secondly, after the devaluation of the Nigerian naira (₦) in 2001, leading to a reduction in the purchasing power and subsequently a drop in importation of milk powder and butter oil (Yahuza 2001). The domestic industry also faces difficulties like lack of feed, low milk yields, competition from imports, inefficient extension services, lack of inputs and low milk prices which discourage local production. From this experience we could conclude that, restricting imports can only successfully control importation if favourable policies and suitable resources are allocated to the promotion of domestic production.

2.4.6 Institutional support to the dairy sector

If policies must be implemented to promote dairy systems then institutions must be present to determine the most helpful policies and develop the best strategies for their implementation. In Eastern and Southern Africa, dairy development is supported by a number of institutes:

- The International Livestock Research Institute (ILRI) which has its head quarters in Nairobi, Kenya and a principal unit in Addis Ababa, Ethiopia. ILRI principally carries out livestock research as a tool for poverty alleviation.
- National and international dairy boards which intervene actively in different parts of the dairy chain. For example, the ESADA (East and South African Dairy Association) is a quite new body which was formed in 2004 for Eastern and Southern African countries. The main aim of ESADA is to increase the trade in African dairy products and specifically, to actively lobby for an improved policy environment conducive to regional and international trade. In addition, she serves as a source of market information and assists her members in the promotion and marketing of their products within the region and across the globe (ESADA 2006). Individual countries also have dairy promotion bodies such as the Kenyan Dairy Board, Dairy Development Authority (DDA, Uganda), Tanzania Dairy Board and Dairy Development Agency (DDA, Ethiopia). All these bodies usually work hand in hand with the government and function in promoting production, marketing and consumption of milk and dairy products and also guide in the implementation of related policies.
- The operation of many NGO's, the active participation of the private sector in offering services to farmers and the promotion of the formation of farmer organisations. For example, in Uganda NGO's like Heifer project International, Land O' Lakes, Send a Cow and Worldwide Sires all intervene in the dairy sector. The simultaneous involvement of private and public veterinary and extension services to farmers is worth mentioning.

At this juncture, it is clear that dairy development needs to be accomplished through policies that can attract various stakeholders to invest in this sector. The initial step will be seeking the right policies. Nevertheless, seeking the right policies is not enough for dairy development, but also having supportive institutions and services for stakeholders.

Since African farmers fall within the class with a relatively lower educational background, these institutions face a challenge of simplifying knowledge to an acceptable form to these farmers which would also prevent conflicts with indigenous knowledge and traditional practices.

2.5 Conclusions

Though milk production has been increasing in Africa over the years, demand has also increased and the gap between these two is widening up. Due to population growth and increase in per capita consumption, demand for milk is expected to increase, even more, in the future years. Increasing milk production to satisfy demand is therefore a challenge to African dairy systems. The relief of trade barriers through reduction of import duties is a current strategy under implementation by the WTO which may affect the African dairy sector. This implies that for local dairy industries to survive, not only production but productivity also, have to increase, in order to stand competition from foreign markets. Some countries have been able to make enormous increases in production over recent years, showing that there is a potential for the dairy industry. However, sector policies, organisational structures and support services for dairy farmers need to be properly oriented to stimulate dairy development especially by strengthening the dominant informal sector and encouraging specialised small and large scale dairy production.

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Chapter Three

Milk production amongst Fulani grazers in the Western Highlands of Cameroon: Constraints and development perspectives

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Abstract

Dairy development is becoming more popular in African countries and there is increased need for a better understanding of dairy systems. Dairying has been envisaged as a means of improving on the nutritional status and income generation of poor rural families. The expected outcomes of many dairy developmental projects are not met, partly because proper understanding of possible constraints to development is usually lacking prior to project implementation. This study covers the points of view of dairy farmers as well as representatives of all identified stakeholder groups of the dairy chain. The major constraints to milk production arose from the poor access of farmers to resources and information. The availability of a closer milk market to these farmers could be a major motivating factor for milk production.

Key words: Cameroon, Dairy, Disputes, Marketing, Potentials

3.1 Introduction

Cameroon falls within countries with the lowest production and consumption of milk. The per capita milk consumption is less than 20 Kg ME (milk equivalents) per year, of which more than 15% is imported (Tambi, 1991; FAOSTAT, 2006; Ndambi and Bayemi, 2006). Local demand for milk and dairy products in Cameroon is likely to increase over the years. By the year 2020, the population of Cameroon will be above 27 million against about 16.5 million (2005 stand). Urban population will also increase from 8.7 million at present to more than 18 million in 2020 (UNDP, 2000; FAOSTAT, 2006). It is estimated that milk production per head of cattle must double by the year 2020 in order to meet up with demand in third world countries (UNDP, 2000), Cameroon inclusive.

In addition to the increasing demand, more awareness is being attached to the importance of dairying in developing countries. Milk has been envisaged as a principal protein source, which could increase protein consumption in Africa (Meyer and Denis, 1999). It could be supplemented to reduce child malnutrition, whose prevalence in children less than 5 years in Cameroon was reported at 22% in 2003 (World Bank, 2004). Dairy development is therefore important, first of all as a means of improving on the nutritional status of poor farmers and secondly as a means of employment and income generation to these poor families. In such African countries where traditional systems dominate milk production (Ndambi et al 2007) and where the formal sector only receives about 2% of total milk production (Ndambi, 2006), strengthening of the informal sector as well as promotion of the formal sector are very important for dairy development.

It is therefore important for the government, NGO's, international bodies and other prospective investors in the dairy sector, to understand the constraints at various stages of the dairy chain, in order to facilitate their intervention. This study aims at determining constraints of milk production, directly from dairy farmers as well as representatives from all identified stakeholder groups of the dairy sector.

Dairy production in the Western Highlands of Cameroon has a potential for development which is seen in the:

- Existence of a potential market for milk and dairy products due to high demand and import. However, this market is concentrated in urban areas which are sometimes far away from production sites
- Availability of local cattle breeds, which are adapted to local conditions, as well as exotic cattle with a high yielding milk potential
- Relatively lower ambient temperatures in the region convenient for milk storage
- Availability of favourable conditions for forage production, relative to other parts of the country (lower temperatures, natural grassland vegetation, nine months of rainfall per year).
- Presence of dairy processing units whose production capacities that have not yet been met.
- Presence of a research and academic institutes in the region with personnel competent in carrying out dairy research
- Presence of veterinary and extension staff capable of intervening in the dairy sector

Despite the above-mentioned potentials, dairy production in this region has not experienced substantial development over the years. For this reason a big necessity arose to find out the points of view on dairy developmental issues from various stakeholders of the dairy sector.

3.2 Methods

3.2.1 Area of studies

Cameroon is located in Central West Africa. It is bound by Equatorial Guinea to the southwest, Gabon to the south, Congo to the southeast, the Central African Republic to the east, Chad to the northeast, Nigeria to the northwest and the Gulf of Guinea to the west. Its geographic coordinates are: 6. 00 N and 12. 00 E. Cameroon has a total surface area of 475,440 sq km of which 469,440 sq km covers land and 6,000 sq km is made up of water. The lowest point is the Atlantic Ocean 0 m while the highest is Fako (on Mount Cameroon) 4,095 m. Land use in Cameroon is distributed as follows: arable land: 12.81%, permanent crops: 2.58% others: 84.61% (2001 status). Cameroon is separated into five agro-ecological zones, one of them, the Western Highlands on which this study was conducted. The Western highlands lie between latitudes $5^{o}20'$ - 7^{o} North and longitudes $9^{o}40'$ - $11^{o}10'$ East of the Equator. Average annual precipitation ranges from 1500 – 2500 mm while minimum and maximum temperatures are 10^{o}C and 34^{o}C respectively (Bayemi et al, 2005a).

3.2.2 Collection of data

Data was collected from dairy farmers and other stakeholders such as processing plants, NGO's, veterinary workers, extension workers, researchers, feed vendors and micro-credit institutions. Focus was laid on qualitative data; as such farmers and other stakeholders were interviewed using a semi-structured questionnaire with open-ended questions. This consisted of eight sections covering personal information, farm resource allocation, utilisation and marketing of milk, income utilisation, organisation of farmers, problems faced and future perspectives, and dairy production parameters. A total of 72 farm families and 23 other stakeholders from 30 villages in the Western Highlands were interviewed. Selection of villages for the study was based on their known history of milk production. The results described are a qualitative interpretation from the interviews.

3.3 Production parameters and constraints to dairying

3.3.1 Educational level and Customs of dairy producers

Eighty-six percent of the Fulani milk producers never had formal education, showing that the literacy level among them was very low. Only 4.2% of them had acquired primary school education, while 9.7% attended secondary/high school and none had university education. Since most of them were not educated, they also preferred not to send their children to school. Some Fulani herders explained that cattle production was a school on its own for their kids and therefore there was no need for formal education. Furthermore they claimed that, though many people were attending school, only very few offices could employ them hence a high unemployment rate was expected for school leavers. Instead, animal rearing would bring forth direct income for their children, if they already start from childhood. Their experiences with children who attended formal education were that, the children learnt to be thieves, were delinquent and wanted to neither take care of cattle nor stay with their parents. In addition, they kept requesting for money from their parents and never gave a convincing account on their expenses. Their worst experiences were from administrators, whom they knew to be well educated but whom they found very dishonest in handling conflicts.

3.3.1 Household structure and labour absorption by the dairy farm

Household labour is the most common form of labour used in dairy farms and depends on the size and ages of household members.

Cattle herding was principally done by men and sometimes by male children (Table 3.1). With local cattle breeds, either the cattle owner (and/or his son) was a herdsman or employed one or more herdsmen on fulltime basis, depending on his herd size, family labour availability or both. Payment of fulltime herdsmen ranged from US-$ 30 US-$ 60 per month. In cases where the cattle owner was not a herdsman, agreements were made on how to share the milk. A fixed or variable amount of milk was supplied to the cattle owner on a daily basis. This was sometimes not possible when the production area and house of cattle owner were far apart. Sometimes cattle owners discouraged milking because they preferred that calves should consume all the milk and grow healthier.

Table 3.1: Role distribution (% of those involved) in different dairy activities

Persons in charge	**Activity**			
	Herding	Milking	Processing	Control of income from milk sales
Men	73.6	12.5	2.8	18.1
Women	-	72.2	81.9	81.9
Children	13.9	5.6	6.9	-
Everybody	-	2.8	5.6	-
Hired herdsman	12.5	6.9	2.8	-

Women were principally concerned with milking, processing, milk sales and control of the money arising from milk sales. It was noticed that, not only the far off markets discouraged them, but also suppression from their husbands. These Fulani men who were in full control of the money got from cattle sales preferred that the milk remains for calf consumption so that they could earn more from beef sales, rather than letting their wives earn from milk sales. The men also expressed dissatisfaction in female handling of money, saying that, women spent all their money on beauty (make-up, cosmetics) and never contributed in paying for other essential family expenses.

3.3.3 Milk yield

The average quantity of milk collected per local cow was only 1.8 litres per day. The milk collected per cow was less than 300 Kg per lactation, not only because of the low production potential of the cows, but also because all cows were not milked daily, during their lactation period. Weaker cows were not milked in the late dry season and milking was stopped completely, during the last weeks before the rains. Milk spoilage was also a common problem to farmers. Higher ambient temperatures hastened spoilage in milk. It was difficult for herders to transport fresh milk to markets because the closest markets were usually very far from their production areas and transportation was also difficult due to poor roads. The situation was aggravated by the absence of electricity and cooling facilities and the poor hygienic conditions of milk production. Therefore a lot of milk got spoilt at the level of the producer.

3.3.4 Milking Practices

The Fulani usually milked their cows only once a day. Herders explained that their cows had a low milk yield, spent most of the day on the fields and were sometimes located very far from their houses, restricting the possibility for a second milking. During the transhumance period, only a few selected cows were left behind to provide milk for the family and to cater for the young calves which were not strong enough to cover long distances. Milking often started when the calf was about two months old, and/or was judged to be strong enough to receive reduced quantities of milk and complete its feeding on pastures. Milking was done in the open (without a separate milking area); early in the mornings before animals went out to graze. At this time, the calves, which were restricted from meeting the dam through out the night, were released. The calf was allowed to suckle for a very short time, to induce milk let down, after which it was driven away and only allowed to continue suckling after milking. During milking, cows were restricted from hurting the milking person by attaching their two rear legs together, using a rope. Sometimes cows were not milked because they were “stubborn at milking” and could harm the milking person.

Hygienic practices such as care of udder, care of milking utensils, and the milking procedure were observed for different farmers. Only 11.1% of farmers washed the udder of their cows before milking. As concerns washing of milking utensils, 58.3% of farmers used cold water, while the others (41.7%) used hot water. Those who used hot water had experienced that milk spoilage was accelerated when cold water was used in washing. The nature of the milking container also had an influence on spoilage. Some farmers experienced that; milk stored in wooden calabashes got spoiled faster than milk stored in plastic containers. The use of calabashes for milk storage was still very common in Fulani communities. This tradition was linked to culture and typical Fulani herders kept a special calabash (*yardudé*) at one corner of their houses where milk was stored for special guests.

3.3.5 Milk marketing

After milking, the milk was either set for sales as raw milk, boiled or processed for consumption and/or sales. Since milking is only done once a day, milk is only sold in the mornings. Depending on the herd size, production per cow and market availability, the milking frequency (number of days to milk in a week) as well as the number of cows to be milked is determined.

Formal markets are hardly accessible to Fulani herders. Only part of the milk which went through the dairy cooperative reached formal markets. Though 27.8 percent of farmers could sell milk at their homes, this was less frequent and unreliable. A majority (69.4%) of them needed to cover long distances to reach local markets and therefore needed a compensatory milk price. In order to earn more income from milk production, they either adulterated their milk by adding water or processed the milk by fermenting locally, thereby benefiting from higher incomes due to value addition. In this way, milk spoilage was also minimised. None of the farmers sold milk directly to the dairy plant. However, 11% of these farmers sold their milk to dairy cooperatives, from where milk was processed and/or sold to the public and to the dairy plant. This intermediary handler was necessary for the dairy plant in order to control milk quality and minimise transaction costs, especially as the total production per farm was very low. In many cases, Fulani grazers intentionally produced less milk, exclusively for home consumption, thereby under-exploiting the production potential of their animals. They selected and milked a few cows from the herd and did not milk the same cows everyday.

3.3.6 Milk preservation and processing

In order to reduce spoilage, some farmers consumed all the evening milk either in the evening, or stored it in a water bath at room temperature for the next day's consumption. Fulani farmers have indigenous plants which are used for milk preservation for example "*Inono*" is a tuber, which is either used full or cut and put into a container of fresh milk. It could be used to preserve milk for the next day's use. "*Daninili*" is a root, which is also used for the same purpose. It is simply washed and put into the container containing milk. The use of such plants is only an indigenous practice, since no research has been done to prove the applicability and efficiency of such milk preservatives as well as toxicity that may arise from their use.

Extensive milk production zones are typically far off from urban areas; meanwhile, a larger part of consumers dwell in these urban areas. Local villagers in these production sites were unable to offer an acceptable price for the milk, thus discouraging the herders from milking more than the quantities required in their homesteads. Farmers realised that it was not economically sustainable when they hired public transportation in order to sell their milk in urban areas. This grew worse when the quantity of milk sold was very small. In other areas, women carried their milk in metal pans on their heads to such markets (usually further than 5 Km). Despite the fact that they sold their milk at relatively higher prices, marketing was very laborious and time consuming.

3.3.7 Animal health

Animal diseases were very rampant amongst Fulani herds. Foot and Mouth Disease (FMD), the most dangerous disease noticed was also very common. Farmers claimed that this disease which has not got any treatment till date has killed several heads of cattle from the same herd within a few days. Other common diseases were brucellosis, haemorrhagic septicaemia, and tick and worm infestation. A few cases of trypanosomiasis infection were observed, though this disease was not endemic in the study region. Infection was more common on animals returning from transhumance from bushy or forest areas. Besides trypanosomiasis, lots of other diseases and parasites were spread during the transhumance period, when animals from several herds graze together along fertile valleys or forest areas. Most herders treated their animals themselves using drugs from veterinary pharmacies or informal vendors. Except in cases of severe attack, veterinary services were hardly sought. Even when required, these services could sometimes hardly be reached because most grazing areas are usually far-off from veterinary stations and communication is poor.

Most herders boycotted compulsory national prophylaxis programme which consisted of vaccination of animals against diseases declared as endemic. In the 1970's, all cattle were vaccinated for free by the Cameroonian Government. The government later decided that farmers should show an interest by contributing to the vaccination costs. This led to the introduction of a subsidised vaccination charge of 390 FCFA (about 0.78

USD) per animal per year, for three major vaccines. For this reason, cattle owners expressed dissatisfaction and reluctance to attend vaccination campaigns. Some of them refused to vaccinate while others only vaccinated few selected animals for two reasons:

- To secure at least the best animals in the herd from endemic diseases in case an outbreak occurred.
- To acquire a permit to move along with animals or sell them. Only vaccinated animals could be transited or sold in formal markets. Since animals do not have identification numbers, farmers simply vaccinated few animals and used the vaccination certificate for others.

Also, vaccination staff had to conduct these campaigns in regions, which were very far from their homes. They had to spend some days in these areas which sometimes had poor facilities and communication network. They therefore needed enough support and motivation, which was sometimes lacking. According to statistics from the Ministry of Livestock, Fishery and Animal Industries (MINEPIA), in the year 2003, the estimated cattle population for the North West Province was 457,838 heads. From these, only 72,070 heads (31.48%) were effectively vaccinated (MINEPIA, 2003). After discussions with stakeholders, the following reasons were suggested for not meeting vaccination targets:

- Graziers not presenting all cows
- Inaccessibility to some areas due to farmer grazier disputes
- Insufficient logistic for vaccination
- Bad roads, lack of transport means
- Insufficient cooling facilities for vaccines
- Poor motivation of field staff

These show that there is interlink of problems within the sector and a need for combined efforts to solve them.

3.3.8 Cattle reproduction

Breeding was usually natural. One selected big bull of well developed muscular structure was usually left throughout with the cows. Sometimes one or two smaller bulls were also left in the herd, though they could only perform reproductive activities when the main bull was old and weak, absent or sick. The bull(s) could easily detect heat and mate cows immediately. Fulani herders prefer not to cull their cows even when they do not give birth frequently. They believe that these cows should not be slaughtered, they will someday give birth and that it is Allah (God) who gives calves. This practise could be advantageous when younger cows are concerned, which later reproduce. However, most cases involve older cows which did not finally reproduce after a long time. The retention of animals in the herd had an advantage of having a bigger herd size which reflected wealth and offered prestige to the owner. The use of exotic breeds as well as crossbreeds was undesirable to most Fulani herders. They explained that this was not only because the animals require more investment and feeding costs, but also that they needed so much care and are often more destructive to crops than local animals.

3.3.9 Theft

Some farmers reported cases of cattle theft. Cattle were stolen away from the herd during the night and sometimes in the day, when cattle were left to graze on their own. Some Fulani herders used charms which they believe could keep all animals of the herd together in the absence of the herder. Such charms were also believed to entice the cattle such that they maintain a close relationship with their herders and could not accept to go with a strange herder. Theft was not only reported for cattle, but also at times, armed robbers brutalised and openly requested for money from families owning cattle. The situation was worsened by the fact that most of these cattle owners lived in isolated areas which were far from public security agents and were in most cases, also cut off from communication.

3.3.10 Family asserts

Table 3.2: Percentage of farmers possessing or having access to various facilities

	Facilities	**% of farmers in possession**
General	Own house	94.4
	Own stable	8.3
	Own cooling facilities	5.6
Transport facilities	On foot	100.0
	Motor bike	2.8
	Push cart	6.9
	Bicycle	16.7
	Vehicle	0.0
Water sources	Tap water	16.7
	Well water	5.6
	Spring water	20.8
	River	86.1
Energy sources	Fuel wood	100.0
	Electricity	11.1
	Cooking gas	2.8
	kerosene	86.1

Only 8.3% of the interviewed cattle herders owned cattle stables (Table 2). Usually, the Fulani cattle owners allow their animals to sleep under tree shades in fenced areas close to their homes. Very few farmers had refrigerators and hence the possibility of owning cooling facilities. Therefore milk had to be transported to consumers or processors within a short period to limit spoilage. As concerns transport facilities, the more expensive the facility, the fewer the number of farmers in possession of it. None of the herders had their own vehicles. The lack of appropriate transport facilities was also a serious problem, as milk needs to reach processors and consumers within a short time.

Most herders used water from streams to feed animals and for their households as well. This is because their homes were often located in distant areas where portable water was hardly affordable. Milk producing households require energy for processing and storage of milk, besides other uses. Energy availability was influential production and processing. For example, only farmers with electricity could own refrigerators and hence store fresh or processed milk for longer hours. Only 11.1 % of herders had electricity supplies at their homes. Energy was provided by kerosene, which was used for lighting and sometimes for cooking, while most of the cooking energy was got from wood.

3.3.11 Land availability and use – Farmer-grazer disputes

Most of the land in rural (potential farming and grazing) areas of the Western Highlands do not have official land titles and is thus legally owned by the state. Conflicts between crop farmers and herders on landownership were identified by Fulani herders as the biggest problem. Such conflicts have reoccurred in the same villages several times over the years because definite solutions have hardly been adopted. Worse still, no action is being taken to prevent the up rise of such conflicts in potentially disputable areas. Conflicts usually have crucial consequences such as; killing or injury of humans, killing or injury of cattle and destruction of crops and granaries. In most conflicts, farmers accuse cattle grazers of letting their animals graze on cultivated land, destroying crops and bribing to gain favour from administrators. The Fulani also seriously blamed the increasing encroachment of crop farmers into grazing land over the years and the placement of crop farms along access ways to water points, which were inevitable routes for their cattle.

In former times, the Fulani cattle herders moved with their cattle as nomads and only temporarily settled where they found abundant pasture. Nowadays, there is a great tendency towards sedentary farming due to population pressure; which has reduced the available land for grazing. The settlement of these grazers raises a number of conflicts, first of all within themselves, since they find it difficult to give up their extensive grazing habits and secondly with local communities, who claim to be first settlers thus imposing a superiority complex and indigenous rights over land. Most farmers and grazers tend to resolve their problems by themselves, despite the setting up of a legislative procedure by the Cameroonian government to solve such disputes. Whenever farmers and grazers were not able to reconcile by themselves, their disputes were resolved by a team of members forming a farmer-grazier commission. For problems to be solved by this commission, an inspection fee of US-$ 40 each is paid by both the accuser and the accused. In some cases, the farmer's compensation after field evaluation was less than US-$ 40 which he paid as inspection fee. The situation is aggravated by a very long formal procedure involving several parties. Herders accused administrators for always requesting money from them, whenever such disputes arose. Therefore the government officials who are already on large salaries exploit herders, taking advantage of their defensive position and the lack of knowledge on their civic rights.

3.4 Perspectives for dairy development

Any intervention for improvement on the dairy sector must consider the root causes of each problem before attempting a solution. Poor educational background as well as beliefs and customs could act as barriers to a change in behaviour of farmers. The organisation of training courses and other extension activities would enlighten farmers and help to reduce some of such barriers.

From the situation described in the previous paragraphs, three major perspective areas have been envisaged for the improvement of dairying in Cameroon:

- Increasing milk production, both quantitatively and qualitatively
- Improving on milk storage and/or processing
- Improving on collection and marketing channels for milk and dairy products

3.4.1 Increasing milk production, both quantitatively and qualitatively

- **Selecting and breeding of best animals**

Fulani herders already practice selection by the fact that they select one bull to head a herd. Physical characteristics like muscle formation and size of the bull are often considered. However less attention is paid to milk production in breed selection. With improved market access, farmers develop more interest in dairy production and might apply indigenous knowledge to improve on dairy breeds. However, this would be slow as they usually have a poor educational background. Other bodies (the state, NGOs, research institutes) could hasten the process by guiding farmers through.

- **Crossbreeding local cattle with high yielding exotic breeds**

Research attempts on the use of crossbreeds have been carried in Cameroon (Bayemi et al., 2005a). However, adoption has been very slow. It is only of recent that mixed farms are sprouting up, with a growth in the use of AI on local cows (Bayemi et al. 2005b). Despite the slow adoption, the few farms practicing crossbreeding are very successful in increasing on farm income and in adapting the crossbreeds to local conditions. The costs of an exotic bull as well as feeding costs of exotic cattle are usually very high for local farmers, who rely on low input production systems. They will rather keep more local animals to maintain prestige, than fewer crossbreeds or exotic breeds, even if production is higher in the latter. At the moment, due to intervention from a local NGO MBOSCUDA (Mbororo Social and Cultural Development Association), these farmers are developing more interest in income generation. The NGO organises adult literacy classes for rural Mbororo-dominated communities and also trains them on small scale income generating activities, especially for women. With such lessons, acceptance of any forms of innovation may be easier.

- **Improving on animal health**

Veterinary services could be improved by the creation of vet posts in rural areas. It is however difficult to increase these posts in areas where farms are far from each other, secondly, because these farmers hardly seek veterinary services, except in critical circumstances. The farmers themselves need to be sensitised to develop consciousness on the importance of investing in animal health because, veterinary practitioners will only be attracted to where they make an acceptable profit margin. The government could also intervene by employing public veterinary agents and motivating them to cover such poorly accessible areas.

- **Improving on animal feeding**

Pasture improvement is a major means of improving on feeding under such systems, since farmers depend on forage for animal feeding. Formerly, with an abundance of pasture, grazers preferred to wander about with their animals until they found good pasture. However, because of demographic pressure, grazing land is gradually reducing and cattle owners are now seeing the need to improve on pastures. Lack of land ownership also creates fears for pasture improvement. In recent years, the increased sedentary nature of these farmers has prompted them to be engaged more and more into practicing pasture improvement. This includes planting of better yielding forage species, at least at the peripheries of the homesteads and destruction of weeds on pasture land. If this initiative is encouraged, then a better outcome would be expected. Also, promotion of research on use of cheap local materials for animal feeding is necessary to encourage such farmers to invest (more) on animal feeding.

- **Increasing milking frequency**

Milking is not done regularly by Fulani herders. Waters-Bayer (1988) found a similar situation in Nigeria, where some cows were only milked several days after calving or not milked at all, in cases of poor production. Increasing milking frequency could increase milk production. However, the animals need to be well fed in order to assure improved production and there also needs to be an assurance of nearby market to absorb the produced milk.

- **Improved hygienic practices during milking and milk handling**

Washing of milking containers using hot water was a cheap means of sterilisation. The appropriate milking material would also influence hygiene. This could be acceptable as the farmers are interested in keeping their milk for longer.

- **Keeping the milking area and animal clean**

Construction of a separate milking compartment would be an initial step for improving on the hygienic conditions of the milking area. The feasibility of such a step is very doubtful as it is found expensive for farmers; it would however be cheaper if local materials like wood are used. In addition, training courses could be very helpful in such cases.

3.4.2 Improving on milk storage and/or processing facilities

Storage and processing quality of milk could be improved for all farmers by:

- Improving on hygienic conditions of production
- The availability of cooling facilities
- The availability of processing equipment
- An affordable cost of cooling and processing

The availability of facilities alone may not solve the problem, but may also depend on the cost of these facilities. Farmers could be assisted if they get some form of credit. For example credits paid through a direct deduction of income from milk sales to a permanent delivery centre. This would be also feasible in cooperative groups.

3.4.3 Improving on collection and marketing channels for milk and dairy products

- **Organisation of farmers into farmer groups, each serving as a milk collection site**

Collection could be cheaper if all milk produced in the same area is brought together by the farmers themselves. In this case transportation is easier, since a collector doesn't need to travel from door to door. This could only be possible if there is an accessible road linkage and if the distance between the producers and processors or consumers is not too far so as to minimise transportation costs.

- **Improving on communication between different farmers and with processors and consumers**

Knowledge on better production techniques and market availability as well as marketing strategies are important for farmers. Information on consumer preferences, seasonal variations in demand, temporary dairy markets and potential markets is also vital. Due to poor communication network information dissemination could not be difficult. Formation of farmer groups or use of local information transfer systems could be helpful in this case.

- **Improvement of road infrastructure**

Roads are sometimes very poor, especially in the rainy season. Government intervention in road maintenance is usually desired by local communities. Due to financial constraints, the government cannot cover all roads. An alternative to government intervention is a community approach, which has been going on in some areas. In this case, a community sets aside a day for communal labour, whereby members construct and/or repair their roads themselves. This approach has been very successful in some villages. However, association amongst such community members needs to be high. Also, this is laborious, time consuming and is of low efficiency.

- **Affordable collection and marketing cost**

Proper networking and a good transportation infrastructure could assure an affordable transportation cost. Emphasis should be laid on the importance of local markets for dairy development. If farmers find a regular outlet for their milk, they will be motivated to shift their production goals from subsistence farming to a more market-oriented dairy production. This is the case as was noticed in Sabga village (North West province), where a project on small scale processing was recently implemented. Farmers in this area had barely local breeds and could run the plant at a cooperative level. Milk hygiene and pasture improvement techniques were taught to farmers and adoption was very high, leading to improvement in both quality and quantity of milk produced from the area.

3.5 Conclusion

Despite several opportunities, milk production amongst the Fulani herders of the Western Highlands might only develop through a simplification of its complexity, which requires intervention from committed stakeholders. Farms are the basic unit of milk production and farmers' interest in milk production is therefore a pre-requisite for dairy development. Fulani cattle owners still need to develop more interest in dairying, not only for subsistence but also as a means of income generation. As concerns farmer-grazier conflicts, the establishment of land tittles, enforcement of punitive sanctions to defaulters and loyalty in the execution of administrative duties for the authorities concerned would be prerequisites for a definite solution to be reached. Finally, an attractive market opportunity for farmers, especially in rural areas will strongly motivate them to orient production goals, with more focus on milk marketing.

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Chapter Four

Milk production systems in Central Uganda: a farm economic analysis

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Abstract

The Ugandan dairy sector has been developing rapidly over recent years and is dominated by small-scale farmers owning more than 90 percent of the national cattle population. Due to market forces and higher competition for production factors, milk production systems in Uganda are intensifying. It became important to understand production systems, especially those around the capital city Kampala, where consumption is highest. Three intensive and four extensive milk production systems were identified and analysed, using TIPI-CAL (Technology Impact Policy Impact Calculations model). The results show that the production systems are very different in many respects but share similar development trends. Whereas the intensive systems use graded animals and invest heavily into feeding, buildings and machinery, extensive systems use local breeds and invest minimally. The total costs of milk production falls with increasing herd size. Dairy returns vary among the farms from 18 to 35 USD per 100 Kg of Energy Corrected Milk produced. All systems make an economic profit, except the intensive one-cow farm, which would only make profits if no better alternatives are available for the family resources employed in dairying.

Keywords: Farm analysis, Milk, Production systems, typical farms, Uganda

4.1 Introduction

Dairy production plays a vital role in Uganda in improving on people's nutritional status, generating income to farmers and improving soil fertility through manure application (Nakiganda et al, 2006). It is also an important source of employment with many traders, processors and retailers intervening in the dairy chain. Traditional smallholder dairy production systems still dominate dairying in Africa (Olaloku and Debre 1992, Ndambi, 2006) and according to King in 2000 (Cited by Odhiambo, 2006), 22% of Ugandans are closely associated to the pastoral farming system. Furthermore, up to 80% of the Ugandan population derive their livelihoods from subsistence agriculture and livestock production, producing 85% of the milk and 95% of the beef consumed in the country.

Milk production is growing very fast in Uganda, which falls among the group of African countries having the highest growth rates, between 1990 and 2004 (Ndambi et al., 2007). According to FAO statistics (FAOSTAT, 2006), over the years 1996-2005, the annual growth in milk production in Uganda was 5.7%, which is double the growth rate for Africa as a whole (2.8%). An enormous growth in dairy production was noticed between the years 1991 and 2004, where production increased threefold (Dobson, 2005). This has been attributed to favourable climate with two rainy seasons, presence of foreign support institutions and a potential export market favoured by the lowering of export tariffs to Kenya and Tanzania in 2005 (Dobson, 2005).

Home consumption is also increasing in Uganda, and as in most other developing countries, milk consumption is higher in the cities than in rural areas where production is cheaper. Kampala, the capital city of Uganda with a population of more than 900,000 inhabitants (Kimeze, 2003), is the major consumption centre (Bunoti, 1996). Most of the milk produced in nearby areas is transported mostly as raw milk through either formal or informal channels.

Milk production systems in rural Uganda normally involve the use of local breeds and are primarily targeted on self subsistence. However, due to the high demand, milk production systems in areas closer to Kampala have a focus on milk marketing, cost minimisation and profit maximisation (Fonteh et al, 2005). Thorpe et al (2000) postulate that market-oriented smallholder dairy systems have a tendency of operating in the vicinity of large cities because the presence of a market overrides other production factors. Unfortunately, land scarcity is a major constraint to expansion of such systems and has been for a long time responsible for several ownership conflicts, even among brothers (Sekitoleko, 1993).

It is presumed that farming systems around Kampala have been adopting various management patterns of farm resources in order to adapt to the increasing market demand. In this way, economic production parameters are becoming more and more important, not only to farmers, but also to the government and other stakeholders of the dairy sector. At present, there is lack of knowledge on detailed economic parameters of milk production systems, especially at the farm level. It is for this reason that this study sets out to provide an in-depth economic characterisation and comparison of the major milk production systems in central Uganda. The analysis is based on a typical-farm approach. Each of the most common milk production systems is represented by a typical farm constructed and validated by a panel of dairy experts.

This paper is organised into five further sections covering: a review on the importance of dairying in Uganda, description of the methodology applied, presentation of results, discussion of key findings, and a conclusion.

4.2 Methodology

The methodology applied for data collection, economic analysis and results validation was developed by the International Farm Comparison Network (IFCN) and utilises the TIPI-CAL (Technology Impact Policy Impact CALculations) model. This model was developed by Hemme (1999) and has since been refined to suit its applicability on a global scale. The TIPI-CAL model is a production and accounting model which can simulate farm (dairy, beef and crop) data for up to 10 years. This model is a think tool for better understanding farming systems and is based on the concept of typical farms. In this study, a typical farm represents the most common farm type within a production system which has an average management and performance and that produces the largest proportion of milk. Typical farms were built and validated by a panel of dairy experts consisting of two dairy farmers, one local veterinary officer, one representative of the Ugandan Dairy Development Authority, one representative of the Ugandan Agriculture Ministry and two external dairy experts. The data collection procedure can be summarised into five steps:

Step one: Identification of typical farms by panel of experts, data input into the TIPI-CAL model. The panel approach is a modified Delphi Technique (Custer et al., 1999) having a good capacity of obtaining inputs from widely dispersed experts. It uses an open-ended questionnaire which is discussed by a selected panel of experts. Their opinions are discussed in successive sittings (usually three) until a consensus is arrived at. This approach has also been proven efficient in studying dairy farms in several countries (Hemme, 2000; Kirner, 2003; Garcia et al, 2005; Garcia et al, 2006).

Step two: Farm visits and completion of data collection

Step three: Analyses and interpretation of the results from the previous two steps

Step four: Validation of data entries by the panel of experts, assessment of feasibility of first results and re-entry of data.

Step five: Final analysis and interpretation of results

For this study, the districts of Mukono (peri-urban, with intensive farming systems) and Kayunga (rural, with extensive farm types) were selected. Dairy farming systems which had previously been identified using the EXTRAPOLATE model (Thorne et al. 2005) were studied comparatively. One typical farm was chosen for each identified dairy farming system and studied in greater detail. This approach of typical farms and panel approach has proven to be very practical and to produce in-depth results on an international scale (Isermeyer et al. 2003). The selected systems include three peri-urban (smallholder intensive, medium holder intensive large-scale intensive systems) and four rural (smallholder extensive, medium holder extensive, pastoralist and agro-pastoralist farming systems. The calculations are based on the computer simulation model TIPI-CAL (Technology Impact and Policy Impact Calculations) version 4.0. This version was further developed in the years 2005-2006 to better represent the complexity of small-scale dairy farming using a whole household approach including off-farm employment for each family member their non-cash benefits and non-dairy farm incomes. The farm economic analysis using the TIPI-CAL model runs through a number of indicators as illustrated stepwise in Figure 4.1.

The net cash farm income is obtained by deducting total expenses from total receipts. From this, non-cash adjustments are made. In addition, the opportunity costs of farm owned factors are deducted to give the entrepreneur's profit (Figure 1).

The cost calculations are based on the dairy enterprise, which consists of the following elements: milk production, raising replacement heifers and forage production and/or feed purchased for dairy cows and replacements.

The analysis results in a comparison of returns and total costs per kilogram of milk. Total costs comprise expenses from the profit and loss account (cash costs, depreciation, etc.), and opportunity costs for farm-owned factors of production (family labour, own land, own capital, etc). The estimation of these opportunity costs was carefully considered, though the potential income of farm owned factors of production in alternative uses is difficult to determine. For the estimations and calculations the following assumptions were made:

Labour costs: For hired labour, cash labour costs currently incurred was used. For unpaid family labour, the average wage rate per hour which a hired worker would get to perform the task in the same respective region was used.

Land costs: For rented land, rents currently paid by the farmers were used. Regional rent prices provided by the panel were used for owned land.

Capital costs: Own capital is defined as assets, without land, plus circulating capital. For borrowed funds, a real interest rate of 6 per cent was used; for owner's capital, the real interest rate was assumed to be 3 per cent.

Depreciation: Machinery and buildings were depreciated using a straight-line schedule on purchase prices with a residual value of zero.

Adjustment of VAT: All cost components and returns are stated without value added tax (VAT).

Adjustment of milk ECM 4 percent*:* The milk output per farm is adjusted to 4% fat and 3.5% protein ECM. Formula: ECM milk = Milk production / ((0.383* fat in % +0.242 * protein in % + 0.7832)/3.1138) Energy Corrected Milk.

+ Total receipts =

+ Crop (wheat, barley, etc.)
+ Dairy (milk, cull cows, calves, etc.)
+ Government payments

- Total expenses =

+ Variable costs crop
+ Variable costs dairy
+ Fixed cash cost
+ Paid wages
+ Paid land rent
+ Paid interest on liabilities

= Net cash farm income

+ Non cash adjustments =

- Depreciation

+/- Change in inventory

+/- Capital gains / losses

= Farm income (Family farm income in Dairy Report 2001)

- Opportunity costs =

+ calc. interest on own capital
+ calc. rent on land
+ calc. cost for own labour

= Entrepreneurs profit

Figure 4.1: Farm Economic Indicators (IFCN Method)

4.3 Results

4.3.1 General classification of milk production systems in Uganda

Seven farming systems were studied, consisting of three intensive systems in Mukono district (MK) and four extensive systems in Kayunga district (KY). The systems are briefly described in this section, before the results of the farm economic analysis are presented:

System one: Smallholder Intensive system

This farming system is common in semi-urban areas. Farms usually have 1 to 3 graded dairy cows in a herd of about 2 to 6 animals. Zero-grazing is commonly practised in this system and the household usually owns a small piece of land on which it grows forage (mainly *Pennisetum purpureum*) for the animals and some cash crops (mainly for home consumption). Milk yield per cow reaches 2,500 kg milk per lactation, which is obtained with relatively high use of concentrates. Manure is easily collected and utilized as fertilizer. The household income from off-farm sources is significant. In this farming system, a one-cow farm (MK-1) was selected for detailed analysis.

System two: Medium-holder Intensive system

This farming system comprises of farms with 10 – 20 graded dairy cows grazing on fenced paddocks. The amount of concentrates provided per animal and the lactation yield per animal are lower than those of the zero grazing system. Although this system incurs extra costs in fencing and maintenance, significant reductions are made in labour and feed costs. A 15-cow farm (MK-15) was selected for detailed analysis of this system.

System three: Large-scale Intensive system

This system comprises large farms with more than 30 graded dairy animals. Such farms are usually owned by business men or civil servants working and living in the city. The farms more capital intensive and usually have a means of delivering their milk in bulk immediately after milking, enabling them capture higher milk prices than other farming systems. This farm type is seen both as a lucrative economic activity and as an attractive investment option for the savings from off-farm sources. For detailed analysis of this system, a 45-cow farm (MK-45) was chosen.

System four: Small-holder Extensive system

This system consists of small farms with less than 10 local dairy cows. The farms usually own little land (about 2 ha), but have access to larger public grazing land. Due to the small scale production and distance from the city (potential market), their milk is usually sold to local vendors, who collect milk once a day from several farms. These farms do not use concentrates, but supplement animal feeding with salt as a mineral. A three-cow farm (KY-3) was used for further analysis of this system.

System five: Medium-holder Extensive

This system includes farms with 10 – 20 local dairy cattle grazing on natural pastures as in the previous system. A hired herdsman guides the animals along as they graze on public or rented land. Since it produces more milk, sales are usually done directly to the local milk collection centres. For further analysis, a 13-cow farm (KY-13) was chosen to represent this system.

System six: Pastoralist/semi-nomadic system

This semi-nomadic system comprises large farms with more than 30 local cows grazing on public land. Due to the shortage of public grazing land, nomadic systems are increasingly renting private land and staying on the same area for months and even years. As in the previous system, they also feed only salt and have a hired herdsman. Although such farms hire a herdsman, family labour, especially from children is also of great importance. A 35-cow farm (KY-35) was analysed more detailed in this system.

System seven: Agro-pastoralist system

In this system, more than 30 low-graded animals are grazed on owned land. The main economic activity is usually cash crop production, while dairying is a side activity. The management and technology levels used on these farms are basically the same as in the other extensive systems. In addition, this system has crop residues for animal feeding during the dry season and the animal manure is used to fertilise crops. A 40-cow farm (KY-40) was used in the analysis of this system. A summary on the production systems analysed is on Table 4.1.

We now proceed to the presentation of farm economic indicators for the seven systems. We first consider indicators relating to farm inputs and then proceed to output indicators in the next sub-section.

Table 4.1: Summary of milk production systems

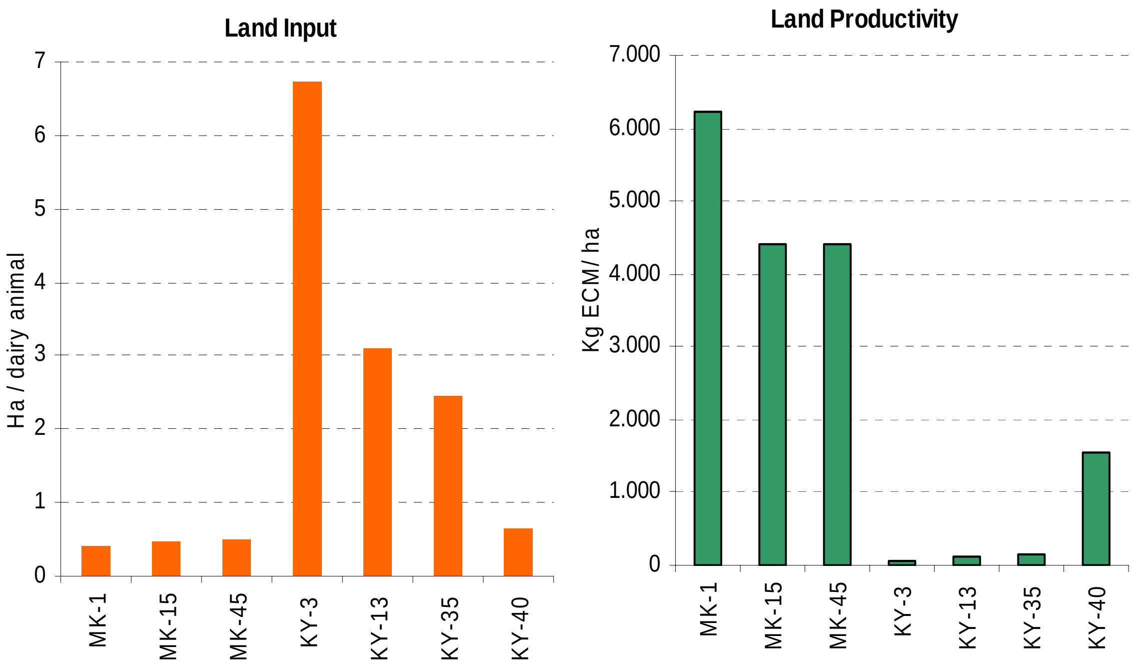
Production system	Cattle breed	No. of cows on farm	Lactation yield per cow
Smallholder intensive system	Holstein	1	2700 Kg
Smallholder extensive system	Local	3	564 Kg
Medium-holder intensive system	Holstein	15	2400 Kg
Medium-holder extensive system	Local	13	480 Kg
Large scale intensive system	Holstein	45	2500 Kg
Pastoralist/semi-nomadic system	Local	35	435 Kg
Agro-pastoralist system	Crossbreeds	40	1141 Kg

4.3.2 Economic indicators related to farm inputs

Land input and productivity

Land input per dairy animal (which includes owned and rented land used both for grazing and to produce by-products fed to dairy animals) varies from 0.4 up to almost 7 hectares (Figure 4.1). In Mukono, the land needed per animal is constant at about 0.5 ha per head unlike in Kayunga where it decreases as herd size increases. On average, the farms in Mukono use significantly less land per cow than those in Kayunga, where up to about seven hectares could be allocated to one cow.

There is a clear difference in the intensity of land use for fodder cultivation in the three systems in Mukono, while the systems in Kayunga depend on natural pastures which are usually low yielding and hence have a lower productivity. In Mukono, cultivated crops such as sorghum, Napier grass and silage maize allow for a constant supply of green fodder throughout the year, which results in higher land productivity and hence a higher stocking rate.



ECM = Energy Corrected Milk: Milk output is adjusted to 4% fat and 3.3 % protein.

Figure 4.2: Land input and productivity of seven farming systems

Labour input and productivity

Labour input varies from about 100 up to 1,500 man-hours per dairy cow per year (Figure 4.3). The MK-1 farm has the highest labour input and almost all the family members carry out different tasks on just one cow. The higher labour productivity the two larger farms in Mukono (MK-15 and MK-45) is due to the fact that such farms employ more experienced workers for their exotic animals. This leads to a lower wage cost per 100 kg ECM hence higher profits are expected. In both the intensive and extensive systems, the labour input per cow decreases as herd size increases. Exceptionally in KY-40, labour wages are so low that the farmer can hire extra labour for the crops and animals and still obtain profits.

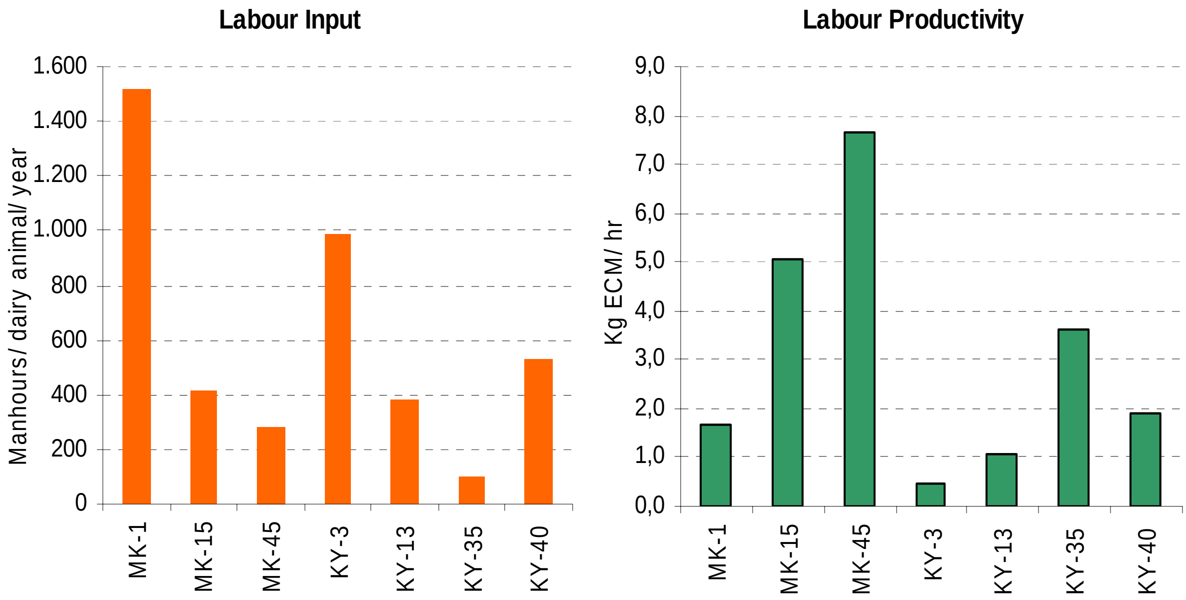


Figure 4.3: Labour input and productivity of seven farming systems

Capital input and productivity

Among the seven milk production systems, capital input per dairy animal is highest for MK-45 (Figure 4.4). Such farms are characterised by heavy investments in machinery (tractor, pick-up van etc.) and also have graded animals of very high value. All the systems have a comparable capital productivity of between 1,500 to 2,000 Kg of ECM for every 1000 US-$ invested on the farm, except for the agro-pastoral farm (KY-40), where dairying is a side business to crop production. In this system, unlike the others, there is less capital invested due to cheap land, almost no machinery and buildings, and cheap, low-graded animals. These animals, however, have relatively good milk yields, resulting in a comparatively low capital investment per 100 Kg of milk.

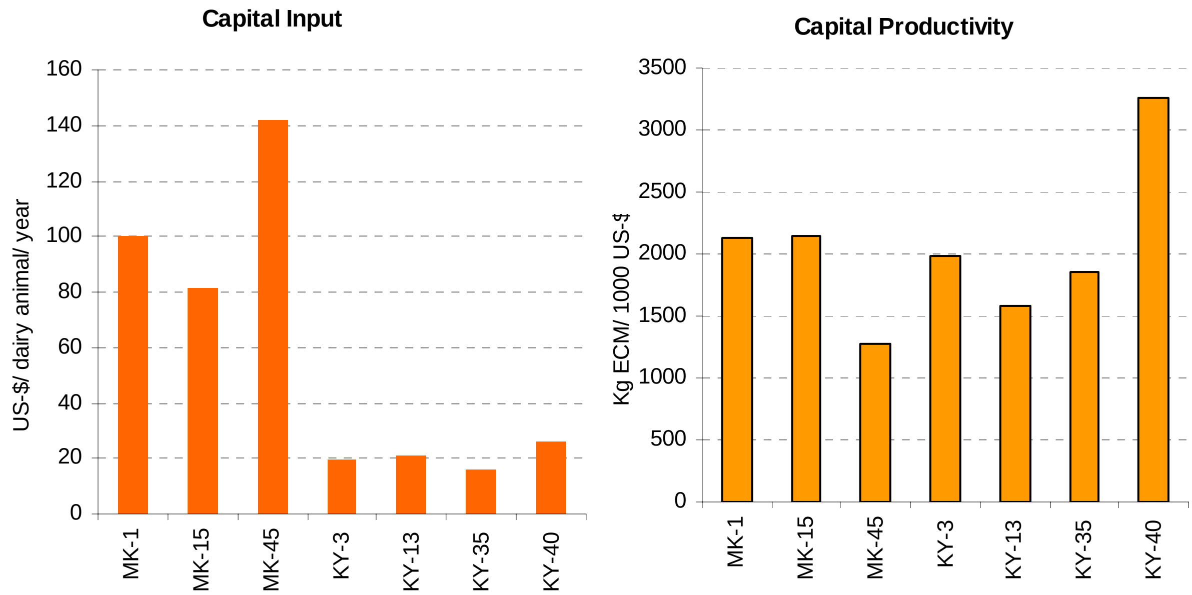
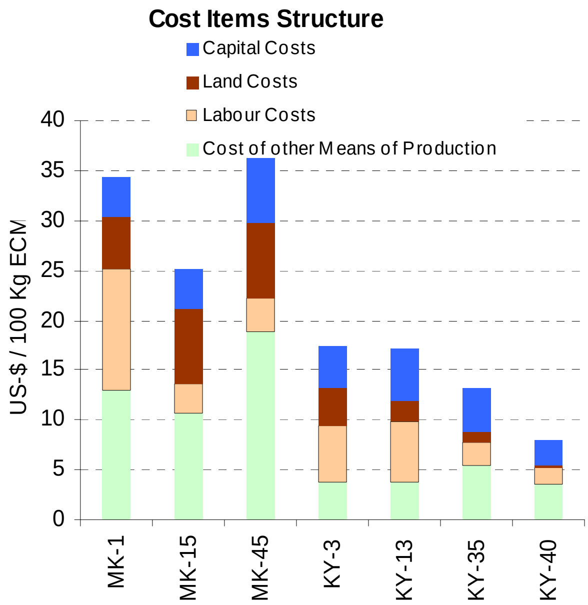


Figure 4.4: Capital input and productivity of seven farming systems

Costs of the dairy enterprise

Total farm costs are much higher for the intensive farms than for the extensive farms (Figure 4.5). Land costs and the costs of other means of production (including feeding, vet care, fuel, etc) are equally higher in the intensive systems than in the extensive ones. Capital costs and labour costs are much higher in smaller farms than in larger farms within the intensive and extensive systems. As concerns proportions of farm costs, the one-cow intensive farm (MK-1) has the highest proportion of opportunity costs on the farm, while the agro-pastoralist farm (KY-40) has the lowest. The proportion of cash costs on the total farm costs increases with herd size within intensive farms, while it is varies less (between 40 – 52%) within the extensive farms. Within the intensive and extensive systems, the depreciation costs increase with herd size, except for the pastoralists (KY-35) who have very minimal farm investments.



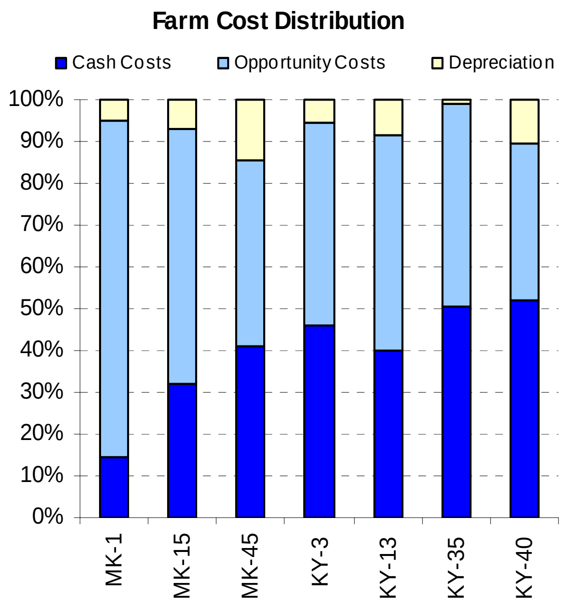


Figure 4.5: Costs of the dairy enterprise

Economic indicators relating to farm returns

Structure of farm returns and income

Farm returns range from 350 to 62,000 US-$ per year (Figure 4.5). All farms are able to cover the total farm expenses and generate a net positive farm income ranging from 200 to over 55,000 US-$ per year for (KY-3 and KY-40 respectively). Both highest and lowest farm incomes are found in the Kayunga farms. While the three smaller farm types in Kayunga show relatively small differences in returns, expenses and net incomes, the larger Kayunga farm generates very high returns. These can be attributed to its large and very profitable cash crop enterprise and, secondly, to factors of the dairy enterprise such as bigger herd size, better genetics and better feeding management during the dry seasons. The larger Mukono farm shows the widest difference between farm returns and net farm income, an indication of high costs of production.

In all production systems but one, the shares of dairy returns exceed 75% of the total farm returns, the exception being the KY-40 system, whose crop enterprise clearly dominates.

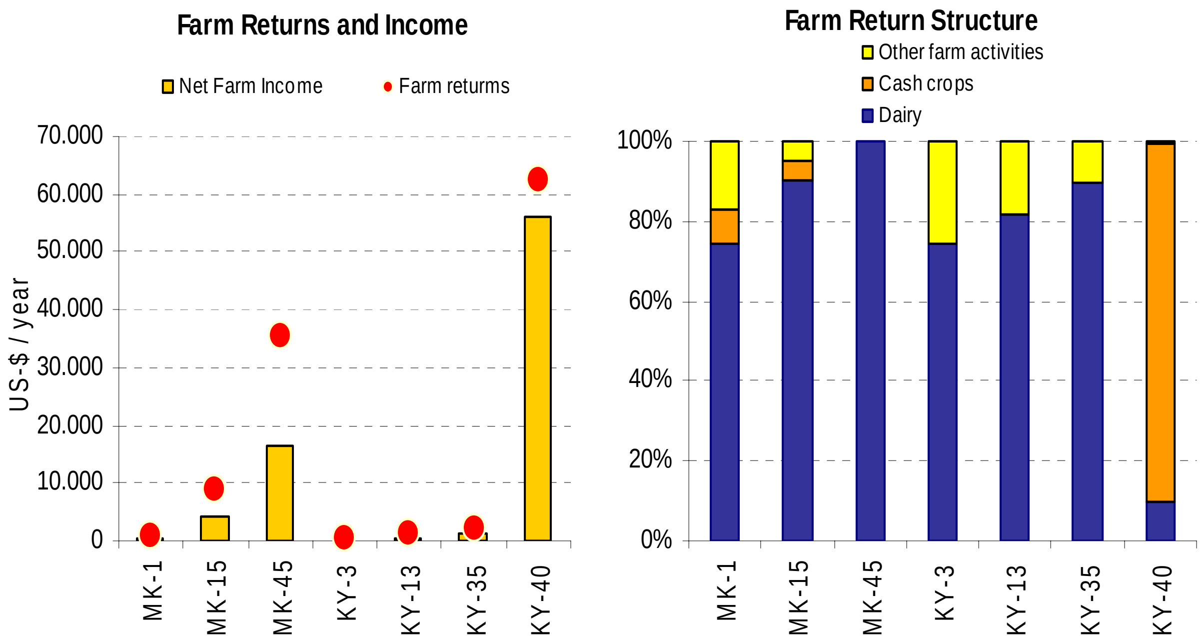


Figure 5.6: Farm returns and return structure of seven farming systems

Returns of the dairy enterprise

The total cash returns per 100 kg ECM range from 18 to 37 US-$ for KY-35 and MK-45 respectively (Figure 4.7). These returns include the sales of milk, livestock and manure. In addition, households consume milk, which is a non-cash return from the dairy enterprise. Non-cash returns range from as little as 0.15 up to almost 5 US-$/ 100 kg ECM produced. The milk used for calves and manure left on the field as fertilizer have not been deducted since they are part of the input set for the production of milk, livestock, etc., which are already considered. Only the milk kept for the consumption by the household has been considered. Except for the one-cow farm where a large proportion of produced milk was consumed by the household, intensive production systems consumed a lower proportion of milk than extensive systems.

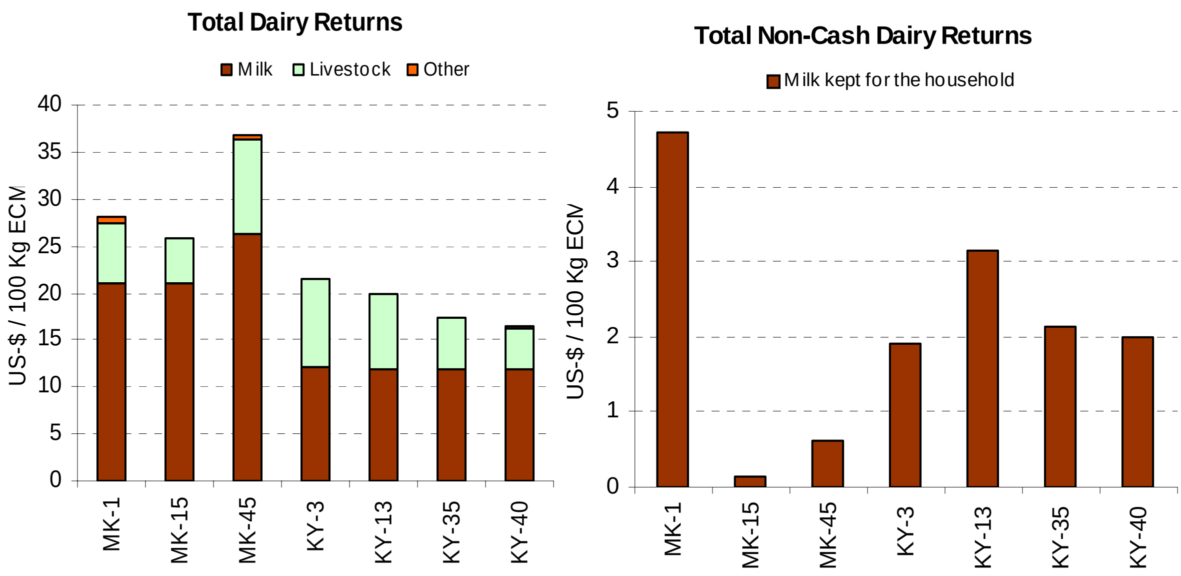


Figure 4.7: Dairy returns of seven farming systems compared

Profits and returns to labour

When only cash transactions are calculated, all farm types make a positive net farm income, which varies between 10 and 15 US-$ per 100 kg ECM (Figure 4.7). However, when the household's own resources (opportunity costs for land, labour and capital) are included in the cost calculations, six dairy enterprises generate a positive entrepreneur's profit; this ranges from about 0.6 to 7.5 US-$ per 100 kg ECM. Only the MK-1 (zero grazing) farm makes a negative entrepreneurs profit (loss) of 6 US-$ per 100 kg ECM. The negative value is mainly the result of the high family labour input employed to a single cow, leading to very high opportunity cost figures. The economic sustainability of this system will depend upon the existence, or otherwise, of better alternatives for the employed family labour, and whether the farm generates a positive cash net income.

The larger farms (with 15 cows and above) make a return to dairy labour in excess of local wage rates. This means that such farmers yield a higher income from working on their farms than from most of the jobs around their location. This also shows that dairying at a scale of 15 cows and above is a competitive form of employment when compared to local alternatives. On the other hand, smaller farms (MK-1, KY-3 and KY-13) generate returns to labour below equivalent local wage rates, implying that the labour invested in these operations could earn higher returns if they were employed in other sectors of the economy.

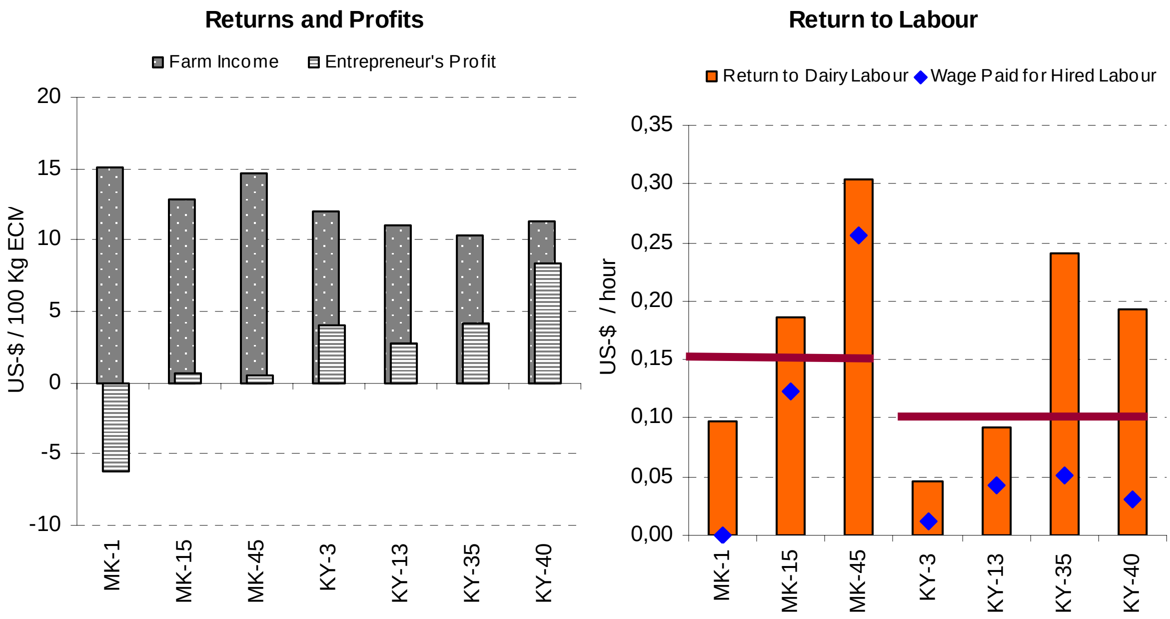


Figure 8: Farm profits and returns to labour of farming systems compared

4.4 Discussions

Land availability and dairy systems are closely related by the fact that the farms in Mukono (closer to Kampala) are more intense in land use. Since land is more expensive in this area, the farms here used relatively less land per animal as compared to the farms in rural Kayunga, where animals are grazed on large natural pastures which are either rented (cheaply) or publicly owned with free access. In Mukono, cultivated forage and maize silage are used to increase the productivity of the expensive land. A similar situation was noticed in Ethiopia (Ketema and Tsehay, 1995), where farmers in peri-urban systems intensify land utilisation compared to pastoral systems.

Generally, the labour input per animal decreases with herd size both in the peri-urban farms and in the rural farms. In rural farms, for example, the number of hours a herdsman needs to graze 15 animals is the same as he would need to graze 30 animals. This means that he spends half the amount of time per animal on the larger farm compared to the smaller one. This also applies to farms with graded animals, except for the fact that they have more activities. In smallholder intensive farms, several hours of labour (usually by almost all family members) are employed to one or very few cows. Common tasks include fetching of fodder, chopping the fodder, milking, cleaning the pen, etc. In larger families, the tendency of employing more hours to the dairy is even higher, since more than one person might be engaged in carrying on any of the above-mentioned tasks at a lower efficiency.

As usual, graded animals require more capital than local ones. Larger farms would also need more capital than smaller ones, at the same level of intensification. The very low investments in farms with local breeds was earlier noticed by Dobson (2005) where only a minimal investment could be done on fencing of the grazing area, meanwhile, other investments were found to be unaffordable for most farmers. An exceptionally high level of investment is found in the large farms with graded animals. Such farms serve as a recreational place for the owner's family, who live in bigger cities. Typically, wealthy businessmen living and working in Kampala city find dairy farming to be both an attractive investment opportunity and ideal place to make their social activities away from their hectic urban lives.

A majority of cattle holders in Kayunga make an extremely low per capita income, on one side, while on the other, they are extremely cost competitive milk producers receiving an (inter)nationally low milk price. Such farmers, who form the vast majority in the country, are positioned to capitalize on dairy development interventions that both (a) connect them to the growing urban dairy markets of Kampala, Jinja, etc. and (b) promote access to affordable farm inputs and services that support business development.

While the intensive systems in Mukono show no particular relationship between dairy returns and farm size, the extensive farms in Kayuga show a decreasing trend in dairy returns, with increasing herd size. This shows that it is more profitable for farmers to keep larger herds of animals than smaller herds. This conforms to the findings of Mwebaze (2004), who noticed a decreasing productivity of cows with decreasing herd size, cause by poorer management in smaller farms.

As concerns the one cow zero-grazing farm type, Olupot and Sseruwo (2004) also report extremely high labour input for this dairy system in Uganda. The performance of such farms could be regarded either as good or poor, depending on the existing situation. In a broad sense, this farming system makes economic sense, as long as farmers do not have a (more) lucrative alternative for their labour, which is the current situation in Uganda. Once better-paid alternatives appear, milk production would be less attractive under such conditions and could either shift towards more distant areas like Kayunga or be practiced at a larger scale.

4.5 Conclusion

Several milk production systems exist in central Uganda, each system being specific in its input and outputs. There is more intensification of production and higher land productivity in farms closer to Kampala than in those further away. Extensive production systems consume larger proportions of milk at the household level than intensive production systems, except for the one cow zero-grazing farms, where family consumption is promoted. The running of farms with smaller herd sizes (less than 15 cows in this case) is less economical in terms of labour returns since the farmer would earn more income if he worked outside the farm. Since farmers show interest in adapting their production parameters to increasing milk demand, the putting in place of favourable conditions for their development will be solicited. The authors plan to carry further studies on how different farm strategies would affect productivity and profitability, so as to obtain a broader view of the sustainability of these production systems.

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Chapter Five

An economic comparison of typical dairy farming systems in South Africa, Morocco, Uganda and Cameroon

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Abstract

Population growth, urbanisation and increased *per capita* milk consumption are main reasons for recent increasing milk demand in Africa. Due to globalisation, it is important to know how competitive various production systems are, especially as most governments promote local production and disfavour dairy imports. The TIPI-CAL (Technology Impact, Policy Impact Calculations model) was used to analyse and compare costs and returns of predominant dairy farming systems in South Africa, Morocco, Uganda and Cameroon. Results show that, as farms grew larger in size, family resources (especially land and labour) became insufficient and there was need for their acquisition from external sources. Though extensive dairy farming systems had the lowest cost of milk production (<20 US-$ per 100 kg milk), their input productivities and milk yields were lower, leading to very low net cash returns from dairying. Large intensive farms in South Africa had relatively low costs (<30 US-$ per 100 kg milk) and a high Return on Investment (ROI) due to a higher efficiency of input utilisation. It was concluded that intensification of dairy farming and simultaneously increasing the scale of production will greatly increase productivity of farm inputs, thus recommended for development of the dairy sector in African countries.

Keywords

Africa; Competitiveness; Costs; Farming systems; Milk; Returns

5.1 Introduction

Dairy production is becoming more and more important in Africa as opposed to the past when milk was mainly a product of subsistence. Nowadays, specialised market-oriented production systems have sprouted with the use of improved breeds and more sophisticated technology. Nonetheless, traditional production systems still persist, especially in rural areas where market influence is low. Ndambi *et al.* (2007a) showed that milk demand is growing at a higher rate than milk production in Africa, due to increasing population and per capita consumption and that production needs to increase significantly in order to cope with demand. The same authors showed that agricultural policies are very influential in determining the patterns of production and that importance needs to be attached to the farm, which is the basic unit of production. This means that farming systems must be well understood in order to implement developmental policies. Secondly, with recent global trends, competitiveness of milk production is of great importance, where the question on who will produce the cheapest milk in the future needs to be answered. In addition, individual African countries tend to promote local dairy production and discourage imports in order to reduce foreign exchange on dairy products and attain self sufficiency (von Massow, 1989; Ngwoko, 1986). This means that the costs of dairy production must be low enough to eliminate foreign competition and at the same time, returns from dairying need to be satisfactory for the farmers so that they are motivated to stay in business. This becomes a great challenge for African countries especially as the WTO (World Trade Organisation), in its struggle for liberalisation, is working towards a reduction or elimination of trade barriers on dairy products (Brunke *et al*, 2005). This means that the cheapest producers will gain a global dairy market in future.

Studies on milk production systems have been conducted on individual African countries in isolation (Ketema & Tsehay 1995; Urassa & Raphael 2002; Waitaka *et al*. 2002; Sraïri & Kiade 2005). Very little work has been done in comparing production systems in different African countries. Worse still, appropriate research tools which enable the comparison of African farms are difficult to establish, bearing in mind the complexity of such systems. The International Farm Comparison Network (IFCN) has developed a unique system for comparing milk production systems worldwide, using the TIPI-CAL (Technology Impact, Policy Impact Calculations model) on typical dairy farms. This method calculates costs and returns per 100 Kg of milk produced on each typical farm, setting an unbiased base for regional, national and international comparison. This paper aim at describing and comparing milk production in the major production systems of four different countries in Africa: South African Republic, Morocco, Cameroon and Uganda. Emphasis has been laid on the farm costs and returns as well as on the productivity of farm inputs.

5.2 Methodology

5.2.1 Analytical model

The methodology applied for data collection, economic analysis and results validation was developed by the International Farm Comparison Network (IFCN) and uses the

TIPI-CAL (Technology Impact Policy Impact CALculations model). This model was developed by Hemme (2000) and has since been refined to suit its applicability on a global scale. This model is an analytical tool for better understanding farming systems and is based on the concept of typical farms. Unlike most other economic analytical methods, the IFCN methodology uses a few typical farms to represent production systems. This means that the selection of such farms is a very crucial issue. The typical farm approach has been proven to be scientifically correct, have access to data on all existing costs, create transparency and international comparability in the arena of costs of agricultural production and produce results which are closer to reality than statistical averages (Hemme, 2000; Holzner 2004). This study applies version 4.0 of the TIPI-CAL model. This software has been further developed in recent years to better represent the complexity of small-scale dairy farming using a whole household approach including off-farm employment, non-cash benefits and non-dairy farm incomes. The farm economic analysis using the TIPI-CAL model runs through a number of indicators as illustrated stepwise in Figure 5.1. The net cash farm income is obtained by deducting total expenses from total receipts. From this, non-cash adjustments are made. In addition, the opportunity costs of farm-owned factors are deducted to give the entrepreneur's profit. The cost calculations of the dairy enterprise consist of the following elements: milk production, raising replacement heifers and forage production and/or feed purchased for dairy cows and replacements. The analysis results in a comparison of returns and total costs per 100 Kg of milk produced on the farm. The opportunity costs for farm-owned factors of production (family labour, own land, own capital, etc) were carefully considered, since the potential income of farm-owned factors of production in alternative uses is difficult to determine. For the estimations and calculations the following assumptions were made:

Labour costs: For hired labour, cash labour costs currently incurred was used. For unpaid family labour, the average wage rate per hour which a hired worker would get to perform the task in the same respective region was used.

Land costs: For rented land, rents currently paid by the farmers were used. Regional rent prices were used for owned land.

Capital costs: Own capital is defined as assets, without land, plus circulating capital. For borrowed funds, a real interest rate of 6 per cent was used; for owner's capital, the real interest rate was assumed to be 3 per cent. These reflect the method of "capital using costs" developed by Isermeyer (1989).

Depreciation: Machinery and buildings were depreciated using a straight-line schedule on purchase prices with a residual value of zero.

Adjustment of VAT: All cost components and returns are stated without value added tax (VAT).

Adjustment of milk ECM 4 percent: The milk output per farm was adjusted to 4% fat and 3.5% protein ECM (Energy Corrected Milk; Hemme 2006). This formula was used:

ECM = Milk production / ((0.383* fat in % +0.242 * protein in % + 0.7832)/3.1138).

Figure 5.1: Farm economic indicators of IFCN method

+ Total receipts =	
+	Crop (wheat, barley, etc.)
+	Dairy (milk, cull cows, calves, etc.)
+	Government payments
- Total expenses =	
+	Variable costs crop
+	Variable costs dairy
+	Fixed cash cost
+	Paid wages
+	Paid land rent
+	Paid interest on liabilities
= Net cash farm income	
+ Non cash adjustments =	
-	Depreciation
+/-	Change in inventory
+/-	Capital gains / losses
= Farm income (Family farm income in Dairy Report 2001)	
- Opportunity costs =	
+	calc. interest on own capital
+	calc. rent on land
+	calc. cost for own labour
= Entrepreneurs profit	

5.2.2 Selection of countries and dairy regions

Four countries: South African Republic, Morocco, Uganda, and Cameroon were selected to represent the South, North, East and West of Africa, respectively. This selection aimed at having a general impression of dairying in the different regions of Africa and hence the continent as a whole. Therefore, the geographical location, access to literature and data sources and presence of home-based research partners willing to participate in the research process were used as criteria for selecting countries.

One major dairy production region with a high potential for dairy development was selected per country except for South Africa, where two regions were selected. A brief description of the selected dairy production region for each country is provided in the following paragraphs.

South Africa: The **Kwazulu Natal region** is the second highest milk production region in South Africa while the **Freestate region** has the highest number of milk producers but produces only 10% of total milk production. The Kwazulu Natal region has the second largest production density per square kilometre in the nation and together with the neighbouring Free State region it produces one third of the total milk volume in South Africa (Coetzee & Maree 2007). The Kwazulu Natal region is located in the eastern part of the country where the average annual rainfall is higher (above 500 mm; Kunene & Fossey 2006) than in the western region where the annual average rainfall is below 500 mm. The higher rainfall favours better vegetation for forage production, hence a dominance of pasture-based milk production systems in Kwazulu Natal. Milk production in the Free State is predominately based on self-produced silage, hay and grain fed with concentrates in a TMR (Total Mixed Ration) system.

Morocco- The **Doukkala region** comprises of 107,000 hectares of irrigated land (Cadasse 2001). Doukkala is a region well known in Morocco for cattle production. It is also one of the first and major regions where dairying was largely introduced since 1975, and where irrigation water was not limited until recently as compared to other irrigated regions. Since the early 90's, Nestlé as a new additional processor coming into the region, has been very active in Doukkala, where it installed a processing unit and several new collection centres for milk, thereby encouraging more dairy production.

Uganda – The **Central region** is the second largest producing region, producing 34% of the total milk in Uganda after the South Western region (producing 36% of total milk). The central region includes Kampala, the nation's capital which is the highest consumption area for milk in Uganda (Bunoti 1996). Also, the central region is the area where the offices of the DDA (Dairy Development Authority) are located. This is an administrative body that aims at improving dairy production, processing and consumption in Uganda. It is for these reasons that the dairy production systems are rapidly evolving and adapting to the increasing milk demand. The presence of several intermediate milk dealers in this region gives a higher assurance to farmers that their milk will be bought. This is however not the case in the South Western region where farmers are sometimes discouraged by an unreliable milk market.

Cameroon – The **Western Highland region** is the third largest milk production region in Cameroon after the High Guinea-Savana and the Sudano-Sahelian zones. This region has advantages over other production regions because it is free from tsetse flies and the disease trypanosomiasis which is a major threat to cattle production in the other two dairy regions. This disease is particularly sensitive to graded cattle which bear great potential for dairy improvement (Belemsaga *et al*. 2005). In addition the Western Highlands have rich grassland fields for forage production and the lowest temperatures in the country, enabling a longer shelf life for fresh milk of more than 16 hrs under ambient temperatures (Ndambi *et al*. 2007b) compared to only 4 hours in the Sudano-Sahelian zone (Kameni *et al*. 1999). This lower temperature is highly advantageous since most farmers do not have cooling facilities and, as a result, large volumes of milk are lost through post-harvest spoilage before the milk reaches the processor (Imele *et al*. 2000).

5.2.3 Selection of typical farms

From these production regions, the most predominant dairy production system was selected and one most typical farm was chosen per production system. The most typical farm represents an average-sized farm in the region, having a moderate management and moderate performance and producing a relatively large proportion of milk within the selected system. A second typical farm with a larger herd size was chosen from the same production system in order to enable an assessment of potential impacts of scale economies on the most typical farm. Since the most typical farms in Uganda and Cameroon were from extensive production systems and those from South Africa and Morocco from intensive systems, need arose for the selection of farms from intensive systems from Uganda and Cameroon in order to expand the base for comparison. For this reason, this study has also included two intensive farms from each of these countries. The first additional farm for both countries is a one-cow farm, which represents an initial phase of introduction of graded cows and has been promoted by many Non-Governmental Organisations (NGOs) in both countries as a form of income generation and nutrition improvement in poor families. The second additional farm for both countries comprises farms using crossbred cows. The inclusion of these farms enabled a comparison of intensive systems across all four nations as well as a comparison between intensive and extensive dairy farming.

The typical farms were selected by panels of four to six dairy stakeholders consisting of farmers, veterinarians, extension workers, and NGO officials. The panel approach applied a modified Delphi Technique (Custer *et al*. 1999) having a good capacity of obtaining inputs from widely dispersed experts. Their opinions were discussed in successive sittings (usually three) until a consensus was arrived at. This approach has also been proven efficient in studying dairy farms in several countries (Kirner 2003; Garcia *et al*. 2005; Garcia *et al*. 2006, Ndambi *et al*. 2008a).

The data collection procedure is summarised into three steps as shown below:

i) Panel sessions

Selected experts sat together in panel sessions where discussions were held during which relevant farm data was recorded into the TIPI-CAL model by one or two experienced researchers who mastered the model. During this initial stage, experts first described the most typical dairy farm type in the region and then the larger farm type. In Uganda and Cameroon, two panels were assembled; one for intensive systems and another for extensive systems.

ii) Farm visits

Panel sessions were interspersed by farm visits where practical information was gathered to complete theoretical assumptions from the panels.

iii) Validation of data

After all data had been entered, an initial analysis was done and the results discussed by the panel of experts. At this stage, the feasibility of provisional results was assessed, aiming at adjusting incorrect data inputs. After this step, the data including new entries were analysed and final results obtained.

A general description of all 12 farms analysed is shown on Table 5.1.

The farm sizes range from one cow in Uganda and Cameroon to 366 cows in South Africa. The sizes of agricultural land differ greatly between the farms and range from one hectare in Uganda to 480 hectares in South Africa. In the next paragraphs, farm economic indicators for all selected typical farms will be described. Indicators relating to farm returns will be discussed first, followed by farm costs and finally by farm profits.

Table 5.1: Description of typical farms analysed

Country	**South Africa**		**Morocco**		**Uganda**				**Cameroon**			
Farm	ZA-89	ZA-366	MA-4	MA-12	UG-3	UG-13	UG-1	UG-15	CM-20	CM-35	CM-1	CM-10
Number of cows	89	366	4	12	3	13	1	15	20	35	1	10
Dairy region	Free state	Kwazulu Natal	Doukkala region		Central region				Western Highlands			
Farming system	Int	Int	Int	Int	Ext	Ext	Int	Int	Ext	Ext	Int	Int
Total agric land per farm (ha)	480	222	2	13	22	41	1	8	21	43	5	30
Breeding method	AI	AI	AI	AI	Natural	Natural	AI	Natural	Natural	Natural	AI	Natural

Int = Intensive system, Ext = Extensive system, AI = Artificial insemination

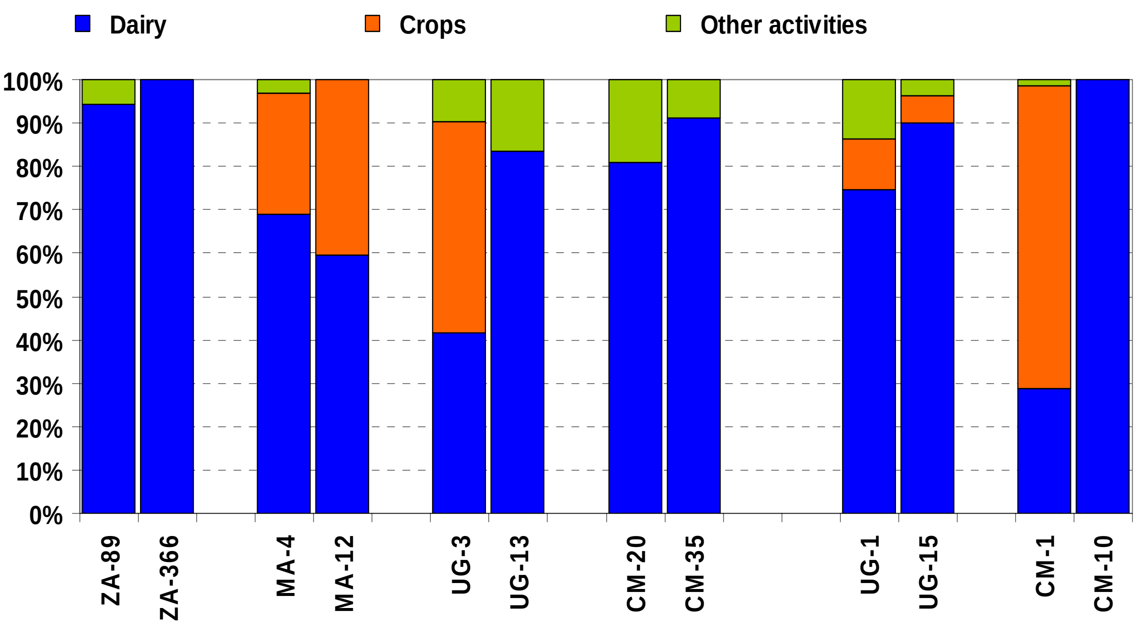
5.3 Results

5.3.1 Farm returns

Return structure of the whole farm

All farm returns for the larger intensive farms in South Africa and Cameroon come from dairying (Figure 5.2). The Moroccan farms, though intensive in dairy production still have significant shares of their farm returns from crops. Indeed, very few farms in Morocco could be labelled as specialized dairy farms. All farms have above 60% of their farm returns from dairying except the three-cow farm in Uganda and the one-cow farm in Cameroon which obtain large proportions of their returns from crops.

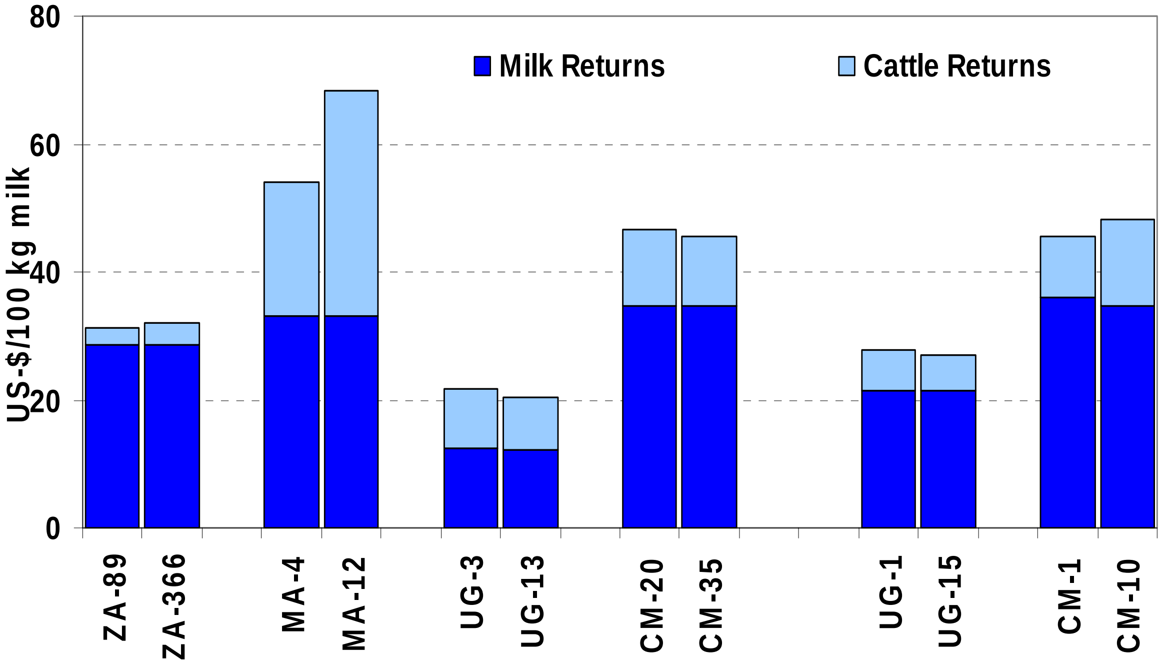
Figure 2: Structure of farm returns for the whole farm



Dairy returns

A large proportion of dairy returns from all farms consist of returns from milk sales (Figure 5.3). All intensive systems have much higher returns from every 100 Kg of milk produced on the farm than extensive systems. Cattle returns contribute to a very small proportion of dairy returns on the large South African farms while they contribute to a greater extent on the dairy returns of the Moroccan farms.

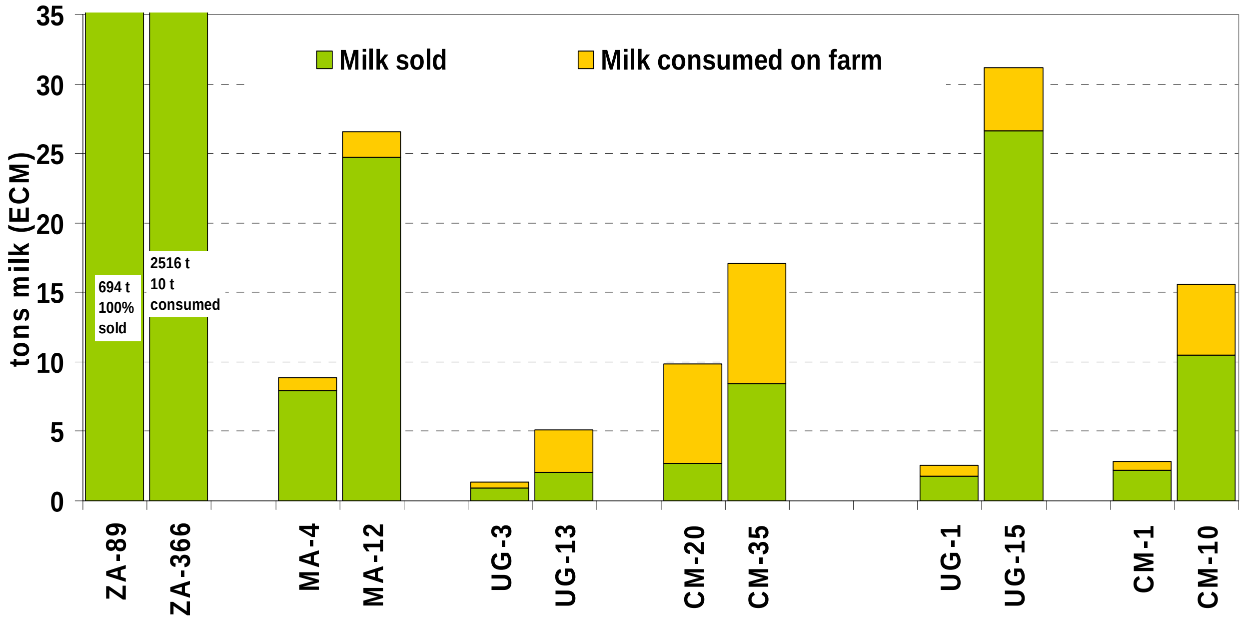
Figure 5.3: Dairy returns of the farms



Total milk production

The South African farms produce the largest volumes of milk (694 t and 2516 t per year, respectively) of which all is sold by the larger farm and only 10 t (accounting for less than 2% of total production) are consumed on the smaller farm (Figure 5.4). All intensive systems sell a very large proportion of their milk while the extensive systems consume larger proportions of their milk.

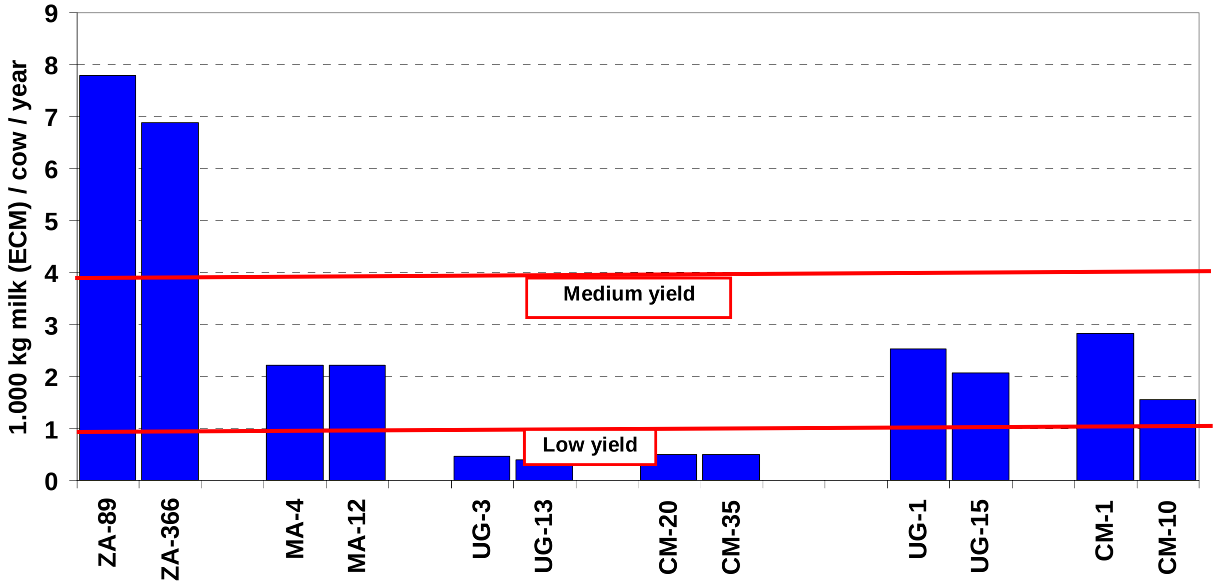
Figure 5.4: Total milk produced per farm and year



Milk yield per cow

There is a clear difference between milk yields of cows in intensive farms and those of extensive farms (Figure 5.5), with the latter producing less than 500 Kg milk per cow per year. We distinguish three categories of typical farms with respect to milk yield. **Low-yield** farms are the extensive farms in Uganda and Cameroon, producing less than 1000 Kg milk per cow and year. **Medium-yield** farms are the intensive farms in Morocco, Uganda and Cameroon with yields between 1000 – 4000 Kg and, finally, **high-yield** farms are those in South Africa with more than 4000 Kg milk per annum. The difference in milk yields between pure breeds (UG-1, CM-1) and crossbred cows (UG-15, CM-10) is seen in the intensive farms of Uganda and Cameroon.

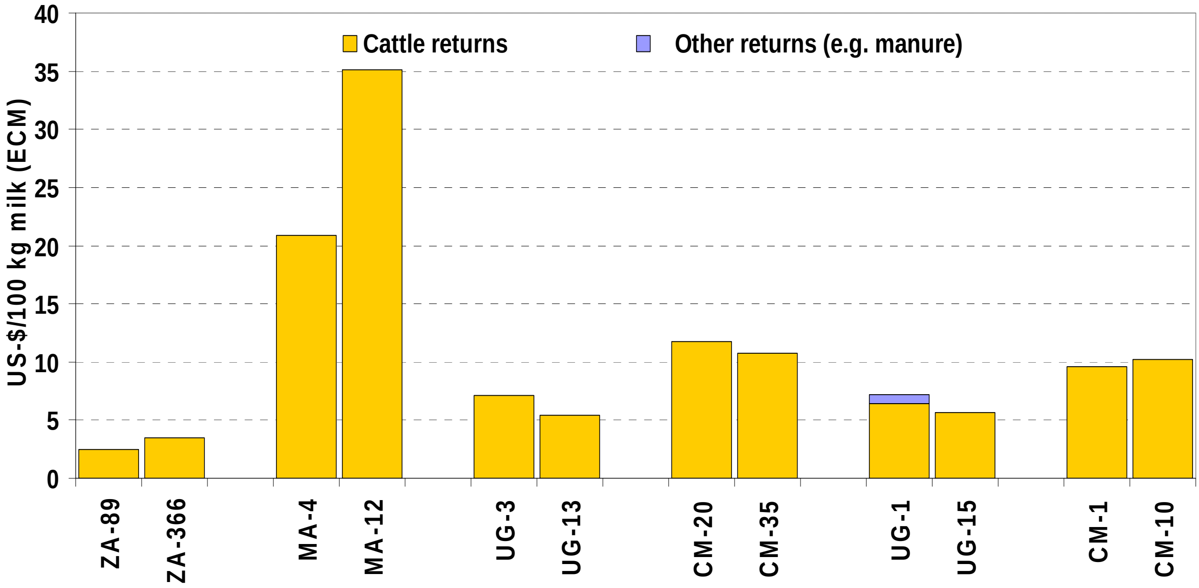
Figure 5.5: Milk yield per cow



Non-milk returns

From Figure 5.6, we see that only the one-cow Ugandan farm has returns from manure sales, while the other farms do not sell manure. Moroccan farms have the highest returns from cattle, indicating that beef production is lucrative on such farms. Meanwhile, the South African farms which are highly specialised dairy farms have the lowest non-milk returns per 100 Kg milk. The non-milk returns of the small and larger typical extensive farms in Cameroon and Uganda are almost similar to those of intensive farms in the respective countries.

Figure 5.6: Non-milk returns of the dairy farm

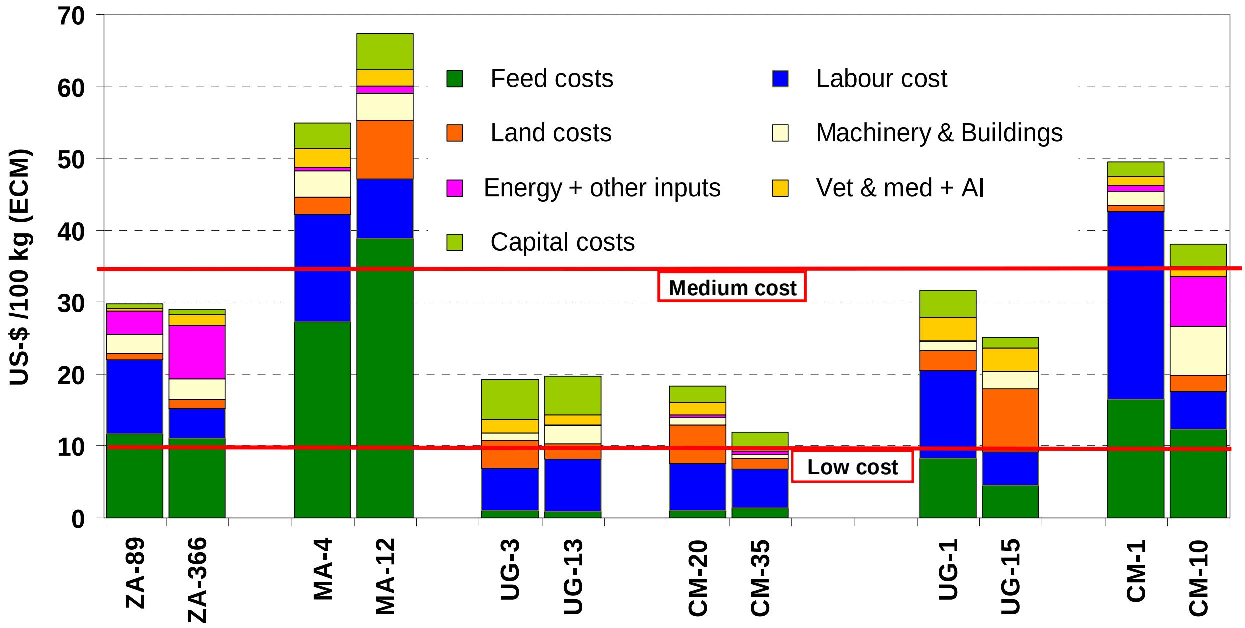


5.3.2 Costs of farm inputs

Cost components

All intensive farms have higher costs per 100 Kg of milk produced than extensive farms, with the Moroccan farms incurring the highest costs (Figure 5.7). Three cost levels are distinguished for the typical farms in this analysis: **low-cost** systems with less than 20 US-$ costs (the extensive farms in Uganda and Cameroon), **medium-cost** systems with costs between 20 and 35 US-$ costs (the intensive systems in South Africa and Uganda), and **high-cost** systems with costs of more than 35 US-$ per 100 Kg of milk produced. The highest cost components in the intensive system are those for feed, followed by labour. In the extensive system, labour costs are the highest components.

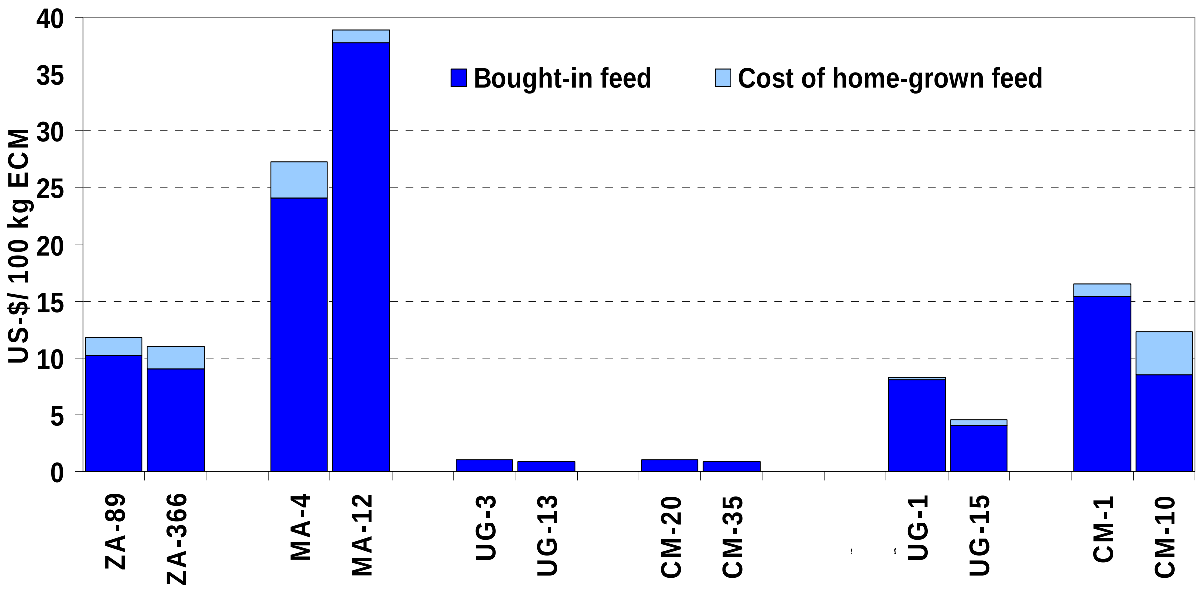
Figure 7: Cost components of the dairy farms



Feed costs

A greater proportion of feed cost on all farms is from bought-in feed (Figure 5.8). All four typical extensive farms in Uganda and Cameroon do not grow forage for their animals and hence do not have costs for feed grown on-farm. These same farms have the lowest feed costs which only come from mineral purchases. The feeding costs per 100 kg milk produced on the one-cow farm in Cameroon are almost twice those of the one-cow farm in Uganda, though both systems are similar.

Figure 5.8: Feed costs of the dairy farms



Labour costs

Table 5.2 shows the total number of labour hours per farm and year, the average wages for labour and labour productivity, expressed as milk output in kg ECM per hour of labour on the farm. The South African farms have the highest annual labour input and the highest wages for labour on the farms as well. There is a great difference in labour costs between the 89-cow farm and the 366-cow farm in South Africa, with the former almost three times the latter. It should be noted that, in addition to the average wages received on the extensive farms in Uganda (UG-3 and UG-13), herdsmen also obtained some food and housing accommodation from their employers, which have not been accounted for on Table 2. The farms UG-3, UG-13 and CM-1 have relatively high labour inputs, compared to the number of cows on the farms, leading to a very low labour productivity in the farms. The farms UG-3 and CM-20 which have low milk sales also have low labour productivities.

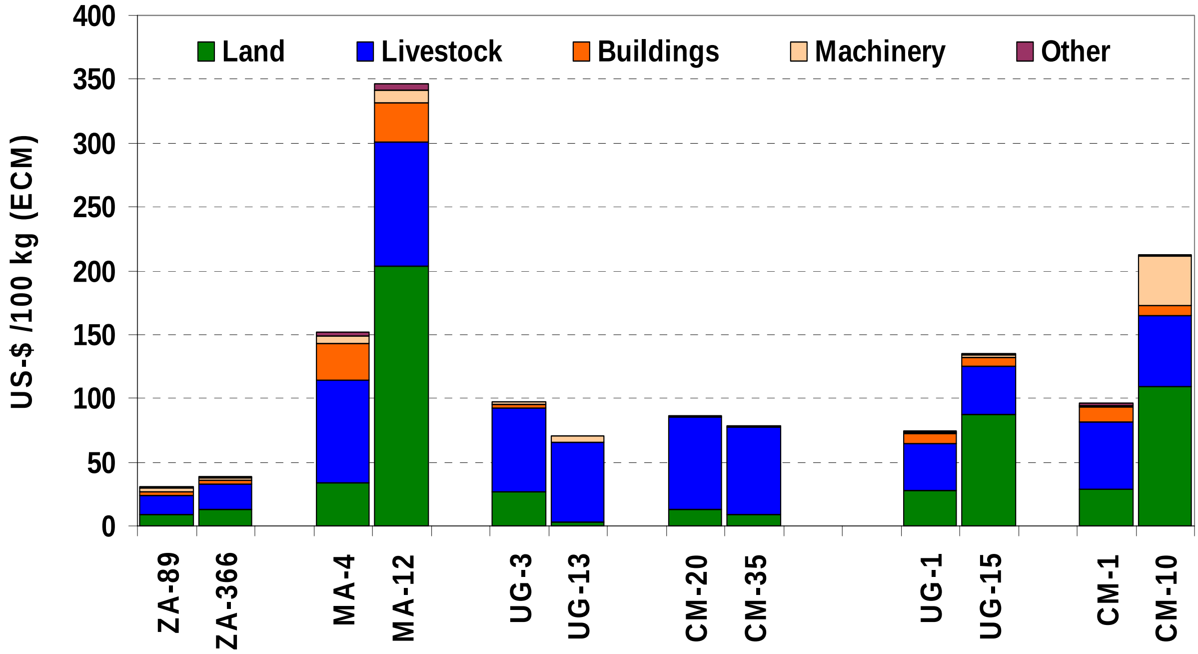
Table 5.2: Labour costs of farms

	Farms											
	ZA-89	ZA-366	MA-4	MA-12	UG-3	UG-13	UG-1	UG-15	CM-20	CM-35	CM-1	CM-10
Total hours of labour per year	10,250	39,870	1,898	3,468	2,956	4,006	1,515	4,140	2,728	3,410	2,850	3,468
Average wages on farm (US-$/h)	6.98	2.59	0.70	0.56	0.03	0.08	0.20	0.35	0.24	0.27	0.26	0.28
Labour productivity (kg ECM/h)	67.70	63.10	4.67	6.81	0.47	1.03	1.67	7.52	3.61	5.01	1.09	3.34

Asset structure of dairy enterprise

The intensive farms in Morocco have the largest assets per 100 Kg of milk produced, followed by the intensive farms in Cameroon (Figure 5.6). South African farms have the lowest asset costs which are below 50 US-$. The highest proportions of assets on all farms come from land and livestock. Livestock accounts for more than 70% of asset values in farms of the extensive systems in Uganda and Cameroon, meanwhile, buildings and machinery account for a minute share of assets in these systems.

Figure 5.9: Asset structure of dairy enterprises of farms



Land costs

The South African farms (ZA-89 and ZA-336), which are the largest in the sample of farms, incur the lowest land costs per 100 Kg of milk produced (Figure 5.2). Meanwhile, the intensive farms in Morocco (MA-12) and Uganda (UG-15) have the highest land costs per 100 Kg of milk. Farms of the extensive systems in Uganda and Cameroon incur a large proportion or all of their land costs on rented land, whereas all farms of the intensive systems operate exclusively on owned land, except for the smaller farm in Morocco where half of the farmland is rented.

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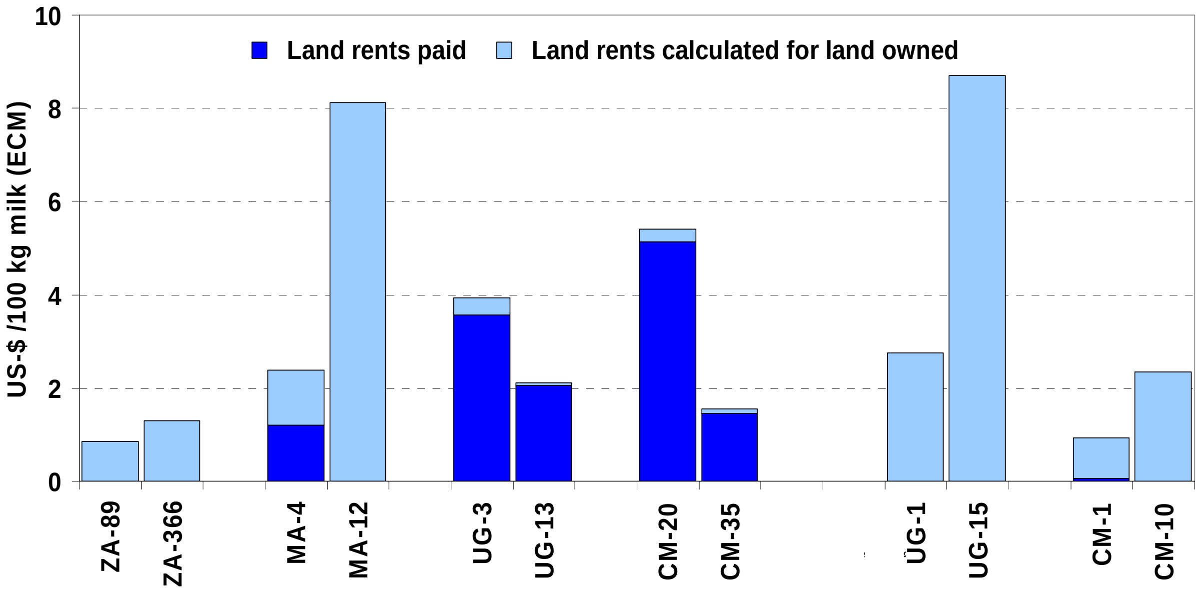
Figure 5.10: Land costs of farms

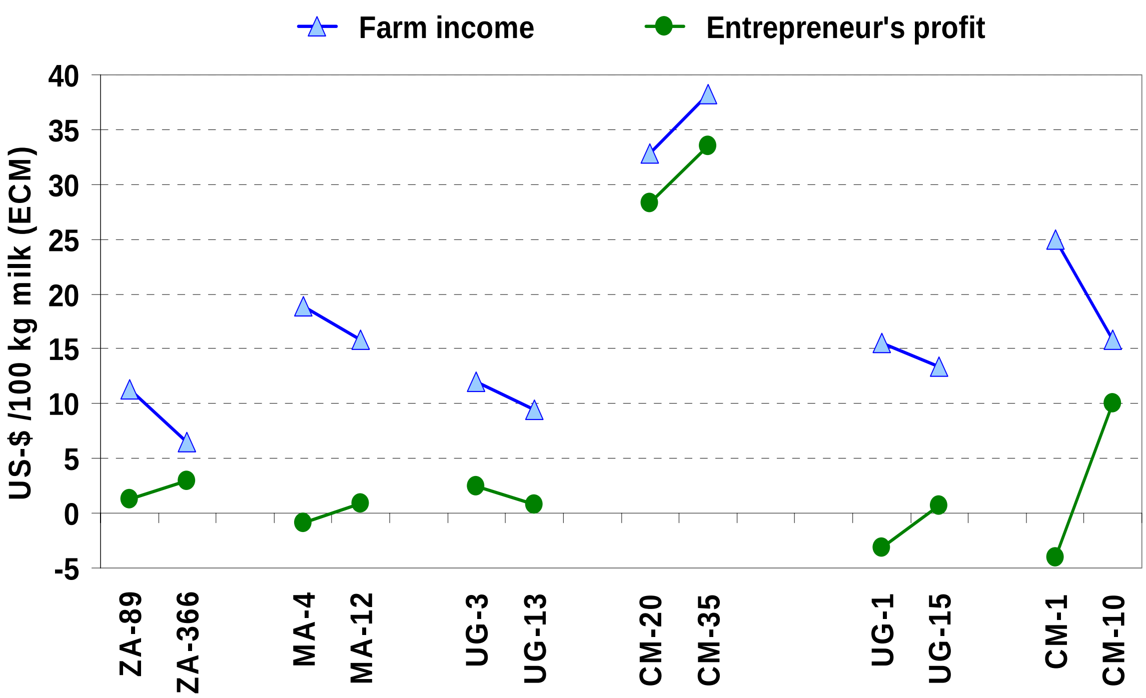


5.3.3 Farm profits

Farm income and profit

The extensive farms in Cameroon generate the highest income and make the highest farm profits per 100 Kg of milk produced on the farm. As concerns the entrepreneur's profit (Figure 5.1) the small intensive farms of Morocco, Uganda and Cameroon make negative entrepreneur's profits. Larger farms have higher incomes and entrepreneur's profits than smaller farms of the same production system and country, except in the extensive farms of Uganda where the 3-cow farm is more profitable than the 13-cow farm.

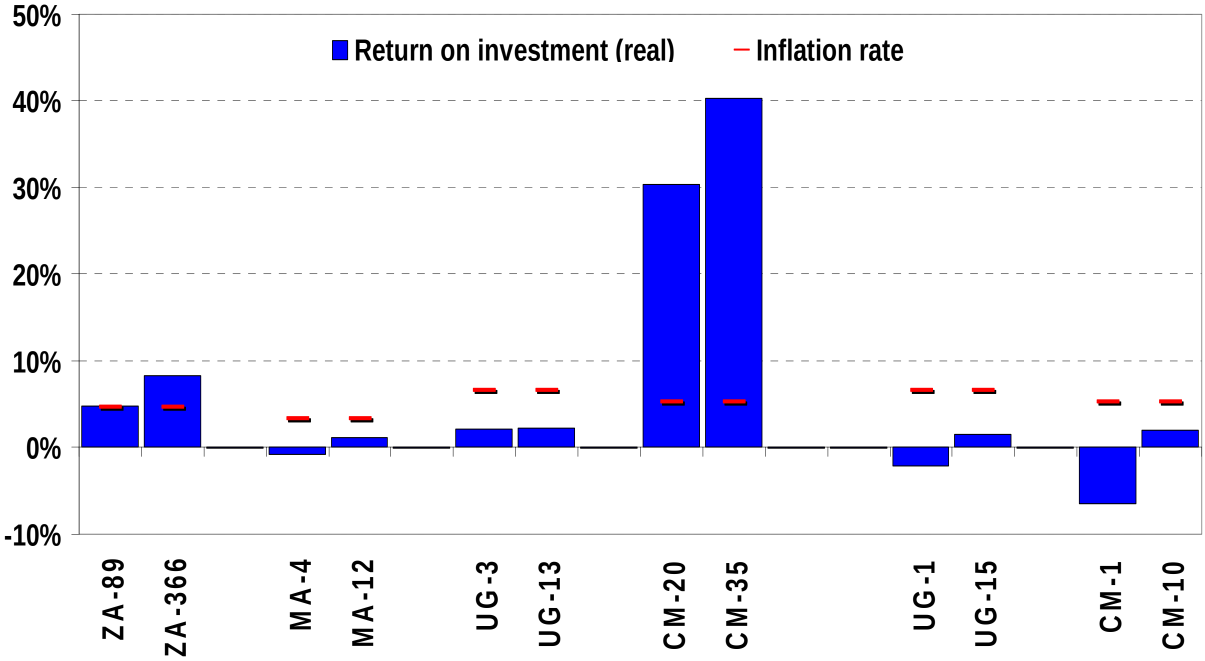
Figure 5.11: Farm income and profit of farms



Return on investment (real)

The return on investment was calculated as the percentage of farm profits on the investment costs, adjusted to the inflation rate. The extensive farms of Cameroon generate a very high return on investment as compared to all the other farms, followed by the intensive farms in South Africa (Figure 5.12). The small farms of intensive systems in Morocco, Cameroon and Uganda make a negative return on investment.

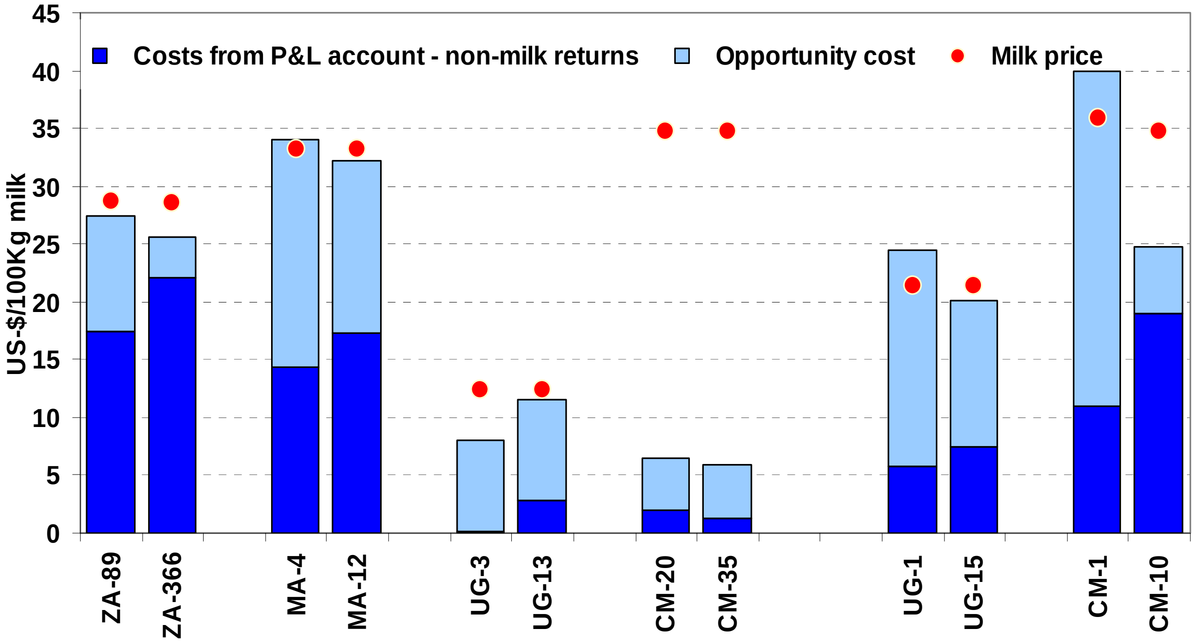
Figure 5.12: Real return on investment of farms



Cost of milk production only

An indicator of the cost of milk production "only" was calculated, based on the assumption that the total costs of the dairy enterprise are related to the total returns of the dairy enterprise including milk and non-milk returns (cattle returns). Therefore the non-milk returns were deducted from the total costs to show a cost bar that can be compared with the milk price. Figure 12 shows the resulting graph.

Figure 13: Cost of milk production only



The extensive farms in Cameroon have the lowest costs of milk production only. These same farms have very high farm gate milk prices of 35 US-$ per 100 Kg milk which results in a very high profit margin. By contrast, the intensive systems in Cameroon produce milk at very high costs, with the 10-cow farm facing production cost comparable to the 366-cow farm in South Africa and the one-cow farm in Uganda. A greater proportion of costs on the extensive farms as well as on the one-cow farms in Uganda and Cameroon consist of opportunity costs for family-owned resources.

5.4 Discussions

Because of the very low milk yields per cow in the extensive dairy production systems in Uganda and Cameroon, farmers are forced to consume nearly all of their milk, with very little left to market. A similar situation was also noticed by Boutrais (2002) in the Adamawa region of Cameroon, where only about half of the lactating cows were milked and up to two litres of milk were drunk per day by each household member. Ndambi *et al.* (2008b) showed that, this situation is usually aggravated when the distance to markets is longer and when transportation network is poor, thus discouraging farmers from selling, especially when they have very little quantities of milk. The one-cow intensive farms also consume relatively large volumes of total milk produced on the farms. This high household consumption is usually encouraged by NGO's that favour this production system, since one of their major aims is nutrition improvement. A similar situation was found in Kenya (Thorpe *et al*. 2000; Muriuki *et al*. 2001) where about one quarter of total production was consumed on such farms. However, if these farms grow larger in size (say two or more cows) then home consumption will become relatively smaller and marketable milk volume will increase.

The highest costs of production were found in Morocco and this is due to the very high costs of inputs. Morocco also had the highest returns from milk production which partly compensates for the high production cost and permits the 12-cow farmer to make a positive entrepreneur's profit. The high costs can be attributed to the very high land costs in the Doukkala region especially as it is an irrigated area. Animal feeding in Morocco is expensive as milk production relies much more on expensive concentrates than on forages grown on-farm. In some cases, because of shortage of land and/or water, expensive concentrates have to cover the dairy cow's basic metabolic needs before offering any further nutrients to support milk production. The farms in Morocco also have large capital costs because they obtain high loans in order to operate. Sraïri & Kiade (2005) also found a very high proportion of feed costs of between 44.1% and 98.9% of total farm costs in Morocco. The same study showed that the average cost of milk production in Morocco was 0.34 US-$/Kg (34 US-$/100 Kg) milk which is quite similar to the cost of milk production in this study (Figure 13).

The one-cow intensive production systems in Uganda and Cameroon produce milk at a very high cost as all farm resources are concentrated on a single cow. The highest input in such farms is usually family labour, where many family members spend much time to cater for this single cow. Olupot & Sseruwo (2004) also reported extremely high labour input for such dairy farms in Uganda. The performance of such farms could only be evaluated with regard to the existing situation. In a broad sense, these farms will make economic sense as long as farmers do not have a (more) lucrative alternative for their labour. Once better-paid alternatives appear, milk production will be less attractive and will require that such farmers increase labour efficiency on the farm and/or produce at a larger scale in order to be profitable.

Generally, small farms mainly rely on family resources for land and labour while larger farms tend to rely upon rented land and hired labour. Also, the extensive grazing systems in Uganda and Cameroon use less owned land than the intensive systems and in general, the intensive systems largely dispense with investments in buildings, machinery as well as expenses on feeding and animal medication as compared to extensive systems. This minimal investment in extensive systems was also noticed by Swai *et al.* (1993) in Tanzania, where extensive systems only invested in some veterinary services while more intensive systems also invested in animal feeding, breeding, credit, extension and training. The low inputs are also reflected in their returns which are very low. However, the return on investment of these farms is relatively high because they still produce and sell milk from an almost negligible asset base. Though the extensive farms in Cameroon generate high incomes per 100 Kg of milk produced, total farm incomes are quite low due to low quantities of milk produced per farm and the relatively low proportion of milk sold. This situation is even worse in the extensive farms of Uganda.

It has also been shown that South African farms have extremely low asset and low costs per 100 Kg of milk produced. The large size of these farms render the costs for land, labour and all investments on the farm to be quite low when evaluated per 100 Kg of milk. Since milk yields on these farms are also very high, farm incomes, though low per 100 kg of milk produced on the farm, would be very high when considered for the farm, especially as almost all (or all) of the milk is sold.

5.5 Conclusions

Several milk production systems exist in various African countries, each system specific in its input and outputs. Farm costs and returns depend on the degree of intensification of production as well as on the size of the farm. As farms grow larger in size, family resources (especially land and labour) become insufficient and there is a greater need for their acquisition from external sources. Though extensive systems with local cows produce milk at low costs, milk output per cow is very little, leading to very low net cash returns from the dairy enterprise. Large intensive farms such as those in South Africa produce milk at relatively low costs while receiving high returns for the milk sold. This indicates that intensification of production at a large scale is a better alternative for dairy improvement in Africa.

However, such systems require high input which is a major constraint to farmers, except in areas where credit is accessible at an affordable interest rate. Moreover, the role of smallholder intensive dairy systems in improving the nutritional status and generating daily income to poor farmers should not be overemphasised.

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Chapter Six

Application of the TIPI-CAL model in analysing policy impacts on African dairy farms

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Abstract

Dairy production has been envisaged as an important means of improving the nutrition status of, and income generation by African families. The need for a better understanding of the role of various policies and farm strategies on dairy farms in Africa has become more important especially as policy makers and donors wish to optimise the impact of their projects on livelihoods of farmers. This study applies an adapted version of the TIPI-CAL (Technology Impact Policy Impact model) to analyse the impact of different policies on the most typical dairy farming system in Uganda. In general, the policy impacts are very little on farms with local cows but can be magnified up to threefold, if the farms have graded cows. Policies which improve farmers' accessibility to markets have the greatest impacts. Genetic improvement of cattle breeds is recommended as an initial strategy, which will improve the impact of other farm policies.

Key words: Africa, Dairy, Household income, Policy impacts, TIPI-CAL model

6.1 Introduction

Malnutrition is still a major problem in Africa and milk has been envisaged as a major protein source that can improve nutrition in Africa (Meyer and Denis, 1999). There is a growing interest in dairy development as a tool for empowering rural families by improving on milk consumption within these families and also increasing their farm income from dairying (FAO/IDF, 2005; NEPAD, 2004; Ahmed et al., 2004). Studies on the priorities for agricultural research in Eastern and Central Africa concluded that milk was the most important commodity for research and development in the region, based on its potential contribution to agricultural GDP (ASARECA/IFPRI 2005). According to Staal (2004), cattle ownership improves child nutrition either by increased milk consumption or by increased family income. He also highlighted that, for a better realisation of these potential benefits, more understanding is needed firstly, on allocations of milk and control of resources within households and, secondly, on policy directions that encourage milk availability and consumption (Staal, 2004). In Kenya, for example, the small-scale specialised dairy production system has witnessed enormous growth over the past years, due to the huge adoption of policies favouring this system (Thorpe et al., 2000). Several policies have been suggested for development of the dairy sector of African countries, with each country laying emphasis on different parts of the dairy chain (Ndambi et al, 2007). Most policies sprout from a concept that the dairy sector will realise a great impact if production and productivity of milk are increased at the national level, thereby reducing imports (Ngwoko, 1986). The decrease in funds from sponsors over the years and the desire to cover a broader scope has pushed policy makers to be more cautious in project expenses.

There are many national and foreign support institutions in Uganda, whose intervention on the dairy sector could increase its chances of supplying milk to a potential export market which has recently been favoured by the lowering of export tariffs to Kenya and Tanzania in 2005 (Dobson, 2005). Also, Uganda being part of the COMESA (Common Market for Eastern and Southern Africa) opens its possibilities to trade with many other Southern and Eastern African states due to preferential trade agreements. In order to exploit these potentials, adequate policy measures need to be taken, including the provision of support services to farmers who are at the centre of dairy production. According to the International Livestock Research Institute, the right policies, marketing systems and technical support must be sought in order to foster dairy development in Africa (ILRI, 2003). This therefore implies that there is a need for understanding on the best policies and/or technical support services which support organisations can apply in order to improve on dairy production while maintaining minimum investment. For selection of these policies and support services, adequate analytical tools must be developed and applied especially in typical African agricultural systems where farms are very complex units. It is for this reason that this paper applies a systematic methodology to analyse the impact of different policies and support services on typical Ugandan dairy farms. It is alleged that other African countries, especially Sub-Saharan nations which have similar production and socio-economic patterns as Uganda could equally benefit from the outcome of this research.

This paper has been divided into five main sections covering an introduction, a description of methodology applied, presentation of results, discussion of the results and conclusions arising from the study.

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6.2 Materials and Methods

6.2.1 Choice of method

A number of methods have been applied in analysing policy impacts on agricultural systems. Most of such methods are based upon principles that apply to developed countries. Due to the complexity and heterogeneity of agricultural production systems in Africa, the applicability of such methods can be problematic. In addition, analysis tools may lay emphasis on particular aspects to the detriment of others. Table 6.1 presents a summary of some methods which have been applied in the agricultural sector of developing countries.

Table 6.1: Some models applied for analysing policy impacts on agriculture in developing countries

Method	Source	Applications	Disadvantages
AEO (African Economic Outlook model)	Bussolo and Gaudemet, 2003	Macro-economic model for short and long-term forecasts. It has a simple theoretical structure, parsimonious data requirements and scalability.	It has too shallow micro-foundations. The "structural" parameters are not policy-invariant and therefore the potential policy advice derived from it can be misleading.
CIDM (CARD international Dairy Model)	Fuller et al 2006	The model analyses the impacts of domestic and trade policy changes on international prices, production, consumption and trade volumes.	It analyses policy impacts generally but doesn't give a detailed analysis on farm level impacts
DREAM (Dynamic Research EvaluAtion for Management)	Wood, 2000; Maredia et al, 2000	DREAM helps to assess the potential benefits of investments yet to be made and also to investigate the impacts of past research investment.	It assesses possible impacts of policies at national and international levels but doesn't give a detailed analysis on farm-level impacts.
EXTRAPOLATE (EX-ante Tool for RAnking POlicy AlTErnatives)	Thorne, 2005; PPLPI, 2005	It assesses the impact of different policy measures on a pre-defined (status quo) situation of various stakeholders. It enables users to visualise the predicted impacts of policy interventions and rank them, based on a logical judgment.	Ranking of policies is done using a virtual scale with relative values: no real values are used.
IMPACT (International Model for Policy analysis of Agricultural Commodities and Trade)	Rosengrat et al. 2002	It can be used in analysing different scenarios, giving a long-term vision and consensus about the actions that are necessary to feed the world in the future, reduce poverty, and protect the natural resource base.	Impacts of annual climate variability on food production demand and trade are not embodied within the model or reflected in its results.
PAM (Policy Analysis Matrix)	Monke and Pearson, 1989	Measures effects of policies on producer incomes and identifies transfers among the key interest groups (producers, consumers, policy makers). It has indicators for competitiveness, comparative advantage and policy impact.	PAM assumes perfect competition when valuing. It does not allow simultaneous inclusion of economies of scale in marketing and production.

The TIPI-CAL model was selected for this analysis for its advantages over the other models described in Table 1:

- It enables ranking and comparability of results at farm, national and international levels on an unlimited sample of farms.
- It can be applied in areas where very little data on dairying is available.
- It runs an in-depth micro-economic analysis at the farm level and produces results which cover several parameters that can be selected and grouped as desired by its user; issues concerning farmers' response to innovation can be incorporated in the analysis, making the results look more real and, finally, the model can be applied for analysing policy impacts, both at a static and dynamic scale.
- The TIPI-CAL model has been applied for policy impact analyses in several studies. Three prominent areas of application are: the **Baseline** approach, where the impact of a single policy is analysed on one typical farm type over a period of 10 years; the **Static** approach, where impacts of several policies on several farm types are compared for a single year; and the **Inter-temporal** approach, where several policies are studied on one typical farm type, for ten years (Garcia et al., 2006, Ovaski and Sipiläinen, 2005; Holzner, 2004; Jägersberg and Hemme, 2003; Deeken, 2002; Hemme, 2000). For this study, the static approach was applied to compare scenarios before and after the policy impact.

6.2.2 Model description

The TIPI-CAL model (Hemme, 2000) is a production and accounting tool which was developed by the International Farm Comparison Network (IFCN). It applies the concept of typical farms, where a typical farm represents the most common farm type within a production system which has an average management and performance and produces the largest proportion of milk. This approach of typical farms and panel approach has been proven to be very practical and to produce in-depth results at the international scale (Isermeyer et al. 2003). Three criteria were used to compare policy impacts on typical farms: household income, return to labour and cost of milk production. These were calculated from the TIPI-CAL model as described in the next paragraphs.

The **household income** was selected as an indicator of the financial situation of the family. It is given by the simple function:

HI = FI + OI ………………………………….……………………………..1

Where **HI** is the total household income, **FI** is the farm income and **OI** represents off-farm income.

Farm income is obtained by deducting farm costs from farm revenue and adjusting non-cash components (depreciation, inventory changes, etc) as in equation 2 below:

FI = (rc + rd + gp) - (vc + vd + ft + pw + lr + il) - (δV + δH + δK) …………..2

Where **rc** is the return from crops, **rd** is the return from dairying, **gp** comprises government payments, **vc** is the variable cost of crop production, **vd** is the variable cost of dairy production, **ft** is the total fixed cost of the farm, **pw** includes all paid wages on the farm, **lr** is the paid land rent, **il** consists of paid interests on liabilities, **δV** is depreciation cost, **δH** represents changes in inventory and **δK** comprises capital gains/losses.

Substituting FI into Equation 1 yields:

HI = (rc + rd + gp) - (vc + vd + ft + pw + lr + il) - (δV + δH + δK) + OI …..3

The above equation summarises the parameters considered for household income calculations by the TIPI-CAL model.

Return to labour was selected to measure the economic output of every hour of labour used on the dairy farm. This is important because farmers who have alternative employment opportunities can decide as to whether they continue working on their farms, hire external labour, or to cease dairy production altogether. The return to labour of for the dairy enterprise was obtained by dividing the total returns from the dairy by the total number of hours per year spent on the dairy farm, as shown by Equation 4.

$$\mathbf{RL = \frac{RM + RL + RB}{h}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{4}$$

Where **RL** is the return to labour, **RM** is the return from milk sales, **RL** is the return from sale of livestock (calves, heifers, etc), **RB** is the return from beef sales and **h** is the total number of hours spent on the dairy farm per year.

The **cost of milk production** was selected as a criterion for comparison as it measures the cost-effectiveness of milk production. The cost of milk production was calculated as shown in Figure 6.1:

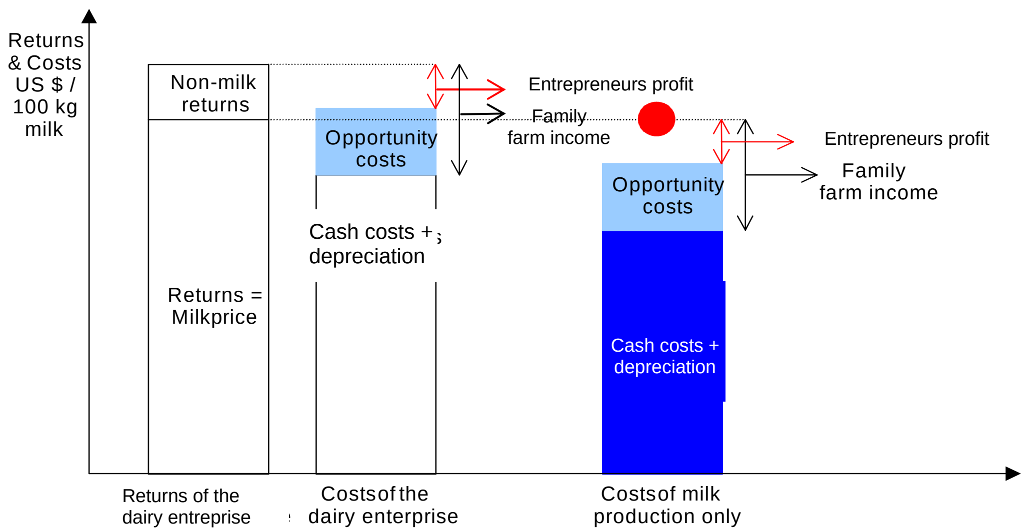

Figure 6.1: Cost of milk production

The total costs of the dairy enterprise are related to the total returns of the dairy enterprise including milk and non-milk returns (cattle returns and direct payments). Therefore the non-milk returns have been deducted from the total costs to show a cost bar that can be compared with the milk price. The figure above illustrates the method.

Returns of the dairy enterprise

Milk price: Average milk prices adjusted to energy corrected milk (4% fat & 3.3% protein, excluding VAT). These would be the returns if all direct payments and beef returns were zero.

Non-milk returns: Returns from selling cull cows, male calves and surplus heifers, +/- livestock inventory, direct payments and other returns, e.g. from selling manure (all excluding VAT).

Costs by cost items

Costs for means of production: All cash costs like fuel, fertilizer, concentrate, insurance, maintenance plus non-cash costs like depreciation for machinery and buildings (excluding VAT).

Labour costs: Costs of hired labour + opportunity costs of family labour.

Land costs: Land rents paid + calculated land rents for owned land.

Capital costs: Non-land assets * interest rate (equity * 3%, liabilities * 6%).

The analysis results in a comparison of returns and costs per 100 kilograms of milk. The estimation of opportunity costs has been carefully considered since the potential income of farm-owned factors of production in alternative uses is difficult to determine. In the short run, the use of own production factors on a family farm can provide flexibility in the case of low returns when the family can choose to forgo income. However, in the long run opportunity costs must be considered because potential successors of the farmer will, in most cases, consider the alternative use of their productive resources, in particular their own labour input, before taking over the farm. To highlight the effects of opportunity costs, these are depicted separately in the figures.

For the estimations and calculations, the following assumptions were made:

Labour costs: For hired labour, cash labour costs actually incurred were used. For unpaid family labour, the average wage rate per hour for a qualified full-time worker in the respective region was used.

Land costs: For rented land, rents currently paid by the farmers were used. Regional rent prices provided by the farmers were used as opportunity costs for owned land.

Capital costs: Own capital is defined as assets, without land, plus circulating capital. For borrowed funds, a real interest rate of six per cent was used; for owner's capital, the real interest rate was assumed to be three per cent for all farming systems analysed.

Depreciation: Machinery and buildings were depreciated using a straight-line schedule on purchase prices with a residual value of zero.

Adjustment of VAT: All cost components and returns are stated without value added tax (VAT).

Adjustment of milk ECM 4 percent: The milk output per farm is adjusted to ECM (Energy Corrected Milk) with 4% fat and 3.5% protein. ECM was obtained using the formula: ECM = Milk production / ((0.383* fat in percent +0.242 * protein in percent + 0.7832)/3.1138) (IDF, 2003).

6.2.3 Data collection

Data was collected on the most prominent dairy production system in the central region of Uganda, which is the small-scale extensive dairy farming system. Policy scenarios were built based upon the most typical farm size (3 local cows). To better understand the effects of genetic improvement, the same scenarios analysed for the local-cow farms were analysed simultaneously on graded-cow farms of the same herd size. This means that a scenario on genetic improvement (graded) was first of all made by replacing the three local cows with three graded cows and then all other policies were applied to this genetically improved farm, taking into consideration the changes in inputs and outputs.

The data collection procedure is summarised into four steps as shown below:

iv) Identification of stakeholders and building up of panels

Stakeholders of the dairy sector were identified with the help of officials of the Dairy Development Authority (DDA), based in Kampala, Uganda. DDA is a statutory body which falls under Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). It was established by the Dairy Industry Act 1998 and was mandated to take up the regulatory and developmental functions of the dairy sector. Selected stakeholders included farmers, government officials, veterinarians, extension workers, NGO officials, milk processors, milk vendors, feed vendors, veterinary medicine vendors, farm equipment vendors, credit institute workers, collection centre workers, etc. Panels of five to eight stakeholders (including two external researchers) were built for each policy area analysed, consisting of knowledgeable persons in the respective policy areas.

v) Panel sessions

Selected experts sat together in panel sessions where discussions were held during which relevant farm data was recorded into the TIPI-CAL model. This panel approach followed a modified Delphi Technique (Custer et al., 1999) having a good capacity of obtaining inputs from widely dispersed experts. The opinions of experts were discussed in successive sittings (usually three) until a consensus was arrived at. This approach has also been proven efficient in studying dairy farms in several countries of the world (Hemme, 2000; Kirner, 2003; Garcia et al, 2005; Garcia et al, 2006). During this initial stage, experts first of all described the most typical dairy farm type in the region and then identified and discussed possible scenarios that could arise from the implication of different policies on this typical farm. The key policy areas from which these scenarios were built had been identified in previous studies by Thorne et al (2005) using the EXTRAPOLATE (Ex-ante Tool for Ranking Policy Alternatives) model.

vi) Farm visits

Panel sessions were interspersed by farm visits where practical information was gathered to complete theoretical assumptions from the panels. A total of 14 typical dairy farms were visited consisting of at least one farm per policy area analysed.

vii) Validation of data

After all data entries had been made, an initial analysis was done and the results were discussed by the same panel of experts described above. At this stage, the feasibility of provisional results was assessed, aiming at adjusting incorrect data inputs. After this step, a last analysis was done and final results were obtained.

6.2.4 Description of the typical farms and policy scenarios

i) The typical farms

KY-3 (Status quo): This is a family farm which has about two hectares of land and access to other 20 ha. Cows on this farm produce an average of 420 kg of milk per year. Farm machinery comprises small tools including a hand spray for treating external parasites and syringes for injecting animals with medication. The animals are grazed by a hired herdsman who collects them in the mornings after milking and returns them in the evenings. One herdsman collects animals from three to eight of such farms and is paid individually by each cattle owner. The animals graze on natural pastures and are offered mineral supplementation from table salt. No concentrates are fed. Mature animals have no housing and sleep under trees. A small shed is constructed for calves from wood and local materials. Milk is sold to a local vendor, who collects milk once a day from the farm and pays on collection. Due to a low milk volume sold daily, the farmer has no incentive to deliver his milk to the collection centre (about three kilometres away). All policy scenarios described are applied on this farm as well as on a graded farm which is described in the next paragraph.

Graded: This farm is built upon the assumption that the farmer replaces his three local cows with exotic ones and uses appropriate technology to sustain them. The graded farm is a scenario for genetic improvement of the typical local farm (KY-3) and is also used as a typical graded farm on which all the other policy scenarios applied on KY-3 have equally been applied. This is a family farm which has about two hectares of land and access to other 1.5 ha. Cows on this farm produce an average of 2400 kg milk per year. Farm machinery is similar to that of KY-3 farm and in addition the farmer buys a bicycle for transportation of milk, since he supplies the larger volume of milk to the collection centre. The animals are not grazed; forage is cut and carried to the animals by a hired herdsman. The animals are offered concentrates and mineral supplements in addition to cultivated Napier and natural forage. Housing comprises of a cow shed and calf shed. In addition, the pasture land is fenced with barbed wires. Veterinary medicine and breeding costs are also significantly higher than in KY-3. These higher inputs result in significantly higher milk yields, shorter dry days, lower mortality rates and therefore higher sales. Equally important is the marketable milk volume, which is over 4 times higher than with local cows and the farmer finds it attractive to bypass the local vendor and deliver his milk to the collection centre at a 20% higher milk price. Direct milk delivery also increases the need and utilisation of available family labour. For the Graded scenarios, the same assumptions described below apply in the analysis, except for the fact that the initial situation “Status quo” consists of the Graded farm described above, which is not common in the region, and not KY-3 farm.

ii) Policy scenarios

Sch-Milk (School Milk Program): Groups of farmers collaborate in providing yogurt to the local school milk programme. Pupils consume it three times a week and parents pay about 5 US-$ (or 10,000 Shillings) per pupil per term. A typical farmer group or cooperative produces over 500 kg of yoghurt per day. This scenario assumes that the farmer with local cows supplies all his daily milk to the school milk programme, meanwhile farmers with graded cows only allocate half of their production to the school milk programme and deliver the rest to the collection centre. This scenario was analysed to see the possible outcomes of a proposed project by the Ugandan Ministry of Agriculture, Animal Industries and Fisheries. They also suggested that this project would increase nutrition, enrolment and retention of pupils and at the same time increase profit of farmers through the elimination of middlemen (Saamanya, 2005).

Demand (More milk demand): This scenario assumes that, due to campaigns and advertisement programmes, milk consumption increases, which in turn results in a farm-gate price as high as prices in the dry season (when milk demand usually increases). In other words, the 30% higher milk price that this farmer receives during the dry season is applied constantly throughout the year. This 30% higher price applied was assumed to be an average price over the year, considering the fact that seasonal changes could lead to price variations.

Q+Price (More milk quality control = higher farm milk prices): Milk adulteration by diluting milk with water was identified as the major cause of poor-quality milk post harvest. Assuming that if anti-milk-adulteration regulations are reinforced, national milk volume will shrink by about 16.67% (which is estimated by the panellists as the average proportion of water in diluted milk). Due to milk scarcity, the farmers' milk price is expected to increase by 0.04 US-$ per kg. This milk price increase is assumed to be passed on from the vendors to producers.

Q-Price (More milk quality control = lower farm milk prices): Assuming that regulations against milk adulteration are reinforced, it was agreed that informal traders would pay a farm milk price which is 0.03 US-$ per kg lower in order to meet these regulations and still make a profit. Panellists agreed that this price reduction is intended to compensate the extra money which the vendor would have obtained if he added water to the milk before selling. This is a milk price decrease of 20% passed on to the farmer.

The two scenarios under quality control reflect very opposite situations, though panellists confirmed that things could go in either of the directions. Milk vendors usually increase their purchase price at farm gate during the dry season when there is milk scarcity and reduce it in the rainy season when milk is abundant. This means that the farmer is also susceptible to any price shock felt by the vendor.

Cooler-Coop The farmer becomes a member of a dairy cooperative which owns a cooler**.** In this situation, the farmer delivers milk to his cooperative at the same price as he obtained from the collection centre. The cooperative sells its milk in the city at a profit and the farmer gets cooperative dividends of about 25 US$ at the end of the year. In addition, the farmer benefits from spoilage reduction. He now has no spoilage as opposed to 4% spoilage which he had when delivering to the collection centre, which had no cooler. In addition, his membership in the cooperative offers him possibilities to acquire credit for farm inputs from the cooperative.

Cooler-Privat*:* A private investor installs a cooler in the neighbourhood and offers 25 shillings more per kg of milk in order to attract farmers. The usual milk spoilage of 4% is eliminated as in the previous case. In addition, the farmer benefits from a regular market, secure payment every 2 weeks and sometimes upon delivery, training for members on production practices, etc.

Private-Vet*:* Several entities are supporting private veterinary services to reach out to more farmers. Panel discussions and interviews with farmers have revealed that, under current farm performance and prices for veterinary services and medicines, farmers like KY-3 are reluctant to use more of these services than they currently do. Farmers' general perception is that local animals have a low productivity and the use of such services is not cost-effective. The farmers only call the veterinarian in severe or emergency cases. Therefore, the KY-3 farmer does not make advantage of the presence of more private vets at his disposal. This will not also affect the graded cow owner since he already has full access to veterinary services.

Vet-Med*:* This scenario assumes that more public veterinary facilities are made available to farmers. Unlike in the previous case, the farmer is convinced by public veterinary workers who also act as extension workers to use more veterinary medicine. Experts agreed that an increase of 10% on veterinary costs will be incurred and that this increase in veterinary expenses will have a negligible impact on farm outputs of the local cow owner. This will not also affect the graded cow owner since he already has full access to veterinary services.

Vet-Med Disc (Veterinary and medicine costs discounted): Panellists agreed that animal medicine distributors could offer a 6% discount on their products to any organisation purchasing large volumes of medicine per year. This scenario assumes that the farmer joins a farmers group and benefits from this discount. The farmers are encouraged to buy more vaccines for their animals leading to a decrease in calf mortality of 10%.

Credit: Local groups are formed to save and lend out small loans to their members. When lending, these groups make a careful assessment of the lenders' repayment possibilities and farm assets, among other factors. The local-cow owner who operates a low-input system doesn't find it attractive to take loans if he has to continue using local breeds especially as interest rates are very high (4% per month). However, if the farmer with graded cows doesn't have enough capital to start up the farm, he takes a loan of about 240 US-$ which helps him in constructing the animal shed and fencing his pasture land. The high interest rate increases the cash costs and total farm costs compared to the situation where the farmer uses his own capital to acquire inputs, though the opportunity costs for his own capital are included as described in section 2.3.

FeedP-30% (Feed prices lowered by 30%): Experts agreed that major feed suppliers could cut down prices by up to 30% if an efficient feed chain were in place. This scenario assumes that the public services improve on transportation networks, thereby lowering the costs of supplying feed to rural areas. This price reduction was applied to all concentrates and minerals purchased. This policy has a very small impact on the farm with local cows, since it only uses very small amounts of mineral supplements. On the other hand, it leads to a decrease in total farm costs of 1.6 US-$ per 100 kg milk on the farm with graded cows.

***Water**:* Shortage of water for livestock use is a major constraint to dairy farming for several months of the year. This scenario assumes that the farmer increases water availability throughout the year by purchasing plastic containers of 25-30 litres and using one extra hour per day to carry and provide an extra watering to lactating cows. This results in an increase in milk yield of about 10%.

6.3 Results

The results are summarised in Figures 2-4 below. The first 13 scenarios in each figure show policy impacts on the KY-3 farm with local cows, while the last 11 scenarios apply the same policies, but assuming that the farmer replaces his three local cows with graded ones, and adapt his inputs to suit this breed. The effect of changing the breed alone is very high, increasing household income by 63%. The use of graded breeds also increases the return to labour threefold and at the same time increases the cost of milk production by 30%.

6.3.1 Household income

Depending on the changes in milk price, these policies either increase or decrease the per capita daily household income. The highest impact was noticed for three policies: the school milk programme, increase in milk demand and quality control policies (Figure 6.2). These policies result in an increased milk price to the farmer, which in turn increases his household income. Policy impacts on the local-cow farm are quite low as compared to the impacts of the same policies on the graded-cow farm. The policy impacts for the three policies that lead to an increase in milk price for the farmer (Sch-Milk, >Demand and >Q+Price) are multiplied by a factor of up to three in the graded-cow farm as compared to the local-cow farm.

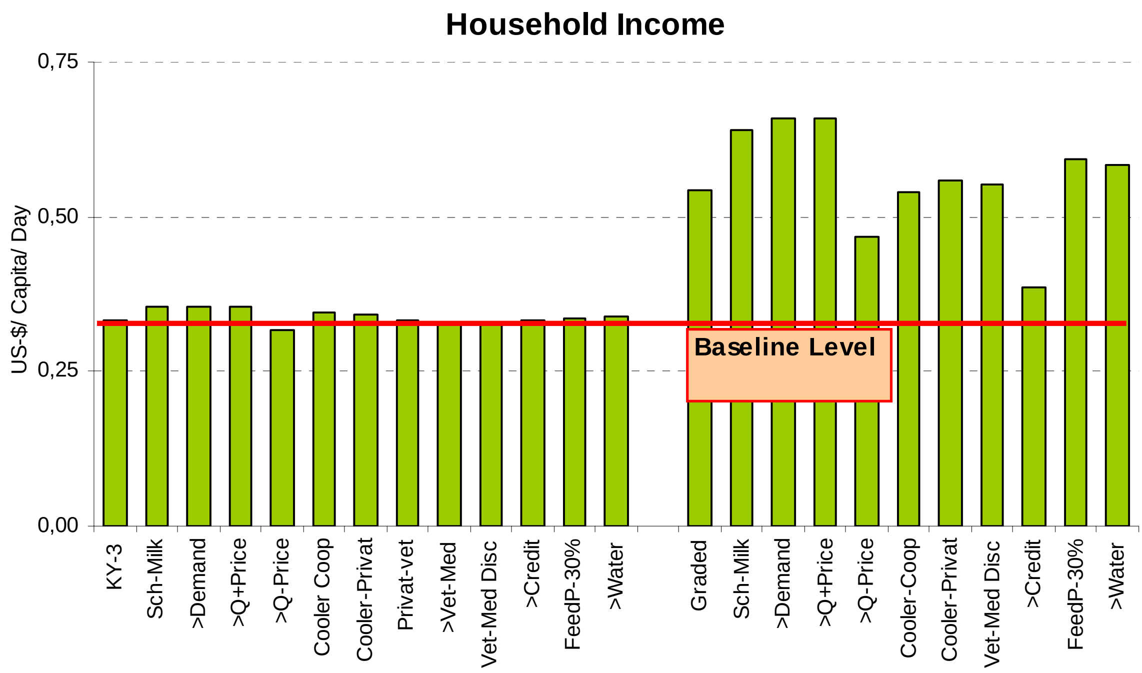

Figure 6.2: Policy impacts on household income of farms

6.3.2 Return to labour

The analysed policies lead to increased or decreased return to dairy labour of between +40 and -20% on the local-cow farm. None of these policies bring the return to labour from working on the local-cow dairy farm to what the farmer would earn from working on an off-farm job (Figure 6.3). This means that, whenever the family has an off-farm job alternative, producing and selling milk under these conditions will not be attractive. On the other hand, the wages paid to hired labourers on the farm are even much lower. These wages however do not include other benefits such as milk, food and housing which the hired labourer receives from his employer. With graded cows, the farm now has a very attractive alternative for family labour since the return to labour is now 40% above local wages. Also, with graded cows, two scenarios (>Q-Price and >Credit) show lower return to labour than the local wage level. In these cases, the farmer would earn more income if he shifted his labour input to another local job alternative, provided he has the possibility to do so.

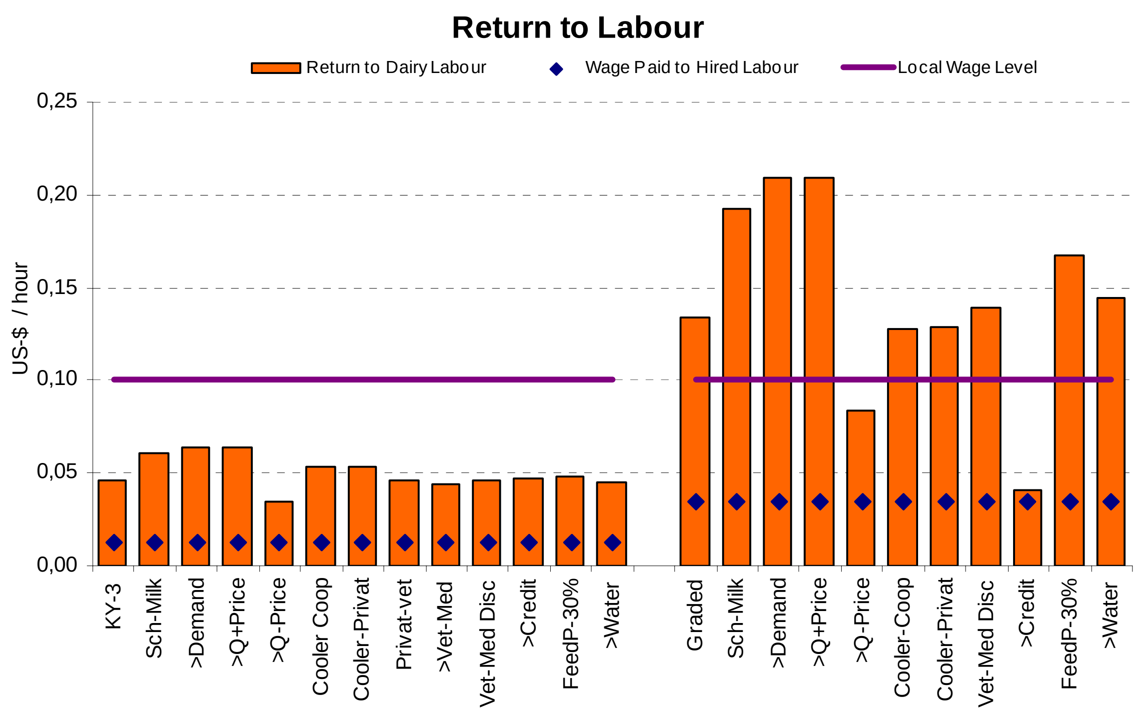

Figure 6.3: Policy impacts on return to labour of farms

6.3.3 Cost of milk production

On the farm with local cows, the policies have little impact on the cost of milk production (Figure 6.4). Exceptionally, when the farmer puts in more hours fetching water (>Water), opportunity costs increase by up to 20%, due to increase in family labour. With graded animals, the total cost of milk production is 40% higher than with local cows, meanwhile, cash costs are at 6 US-$/ 100 kg ECM (Energy Corrected Milk) instead of virtually zero with local cows. If the farmer with graded animals obtains credit (>Credit), his costs increase greatly because of very high interest payment. Milk prices remain very low (below 20 US-$ for all the different possibilities and is highest for two policies (>Demand and >Q+Price). The difference in milk prices between the local-cow farm and the graded-cow farm is due to the fact that the former sells to milk vendors who also make a margin on their sales compared to the latter who sells directly to milk collection centres.

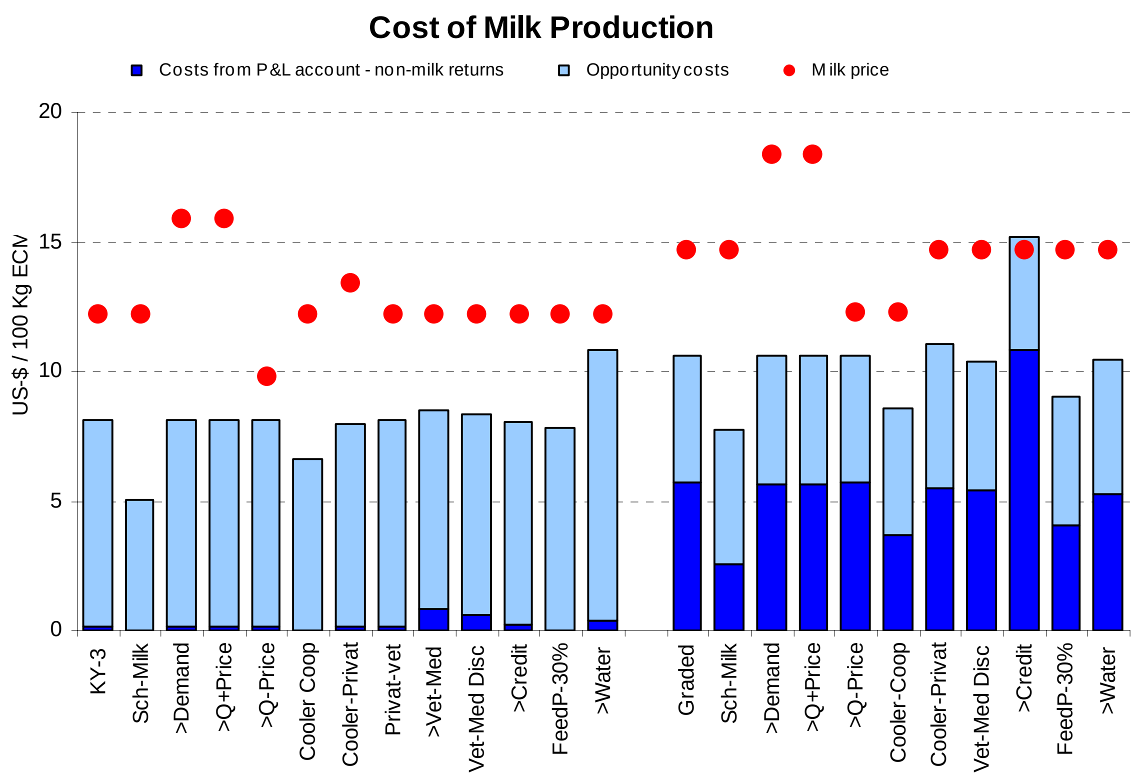

Figure 4: Policy impacts on cost of milk production

6.4 Discussions

Genetic improvement by grading the animals showed enormous changes in the household income, though farm costs also increased considerably. Farmers under such situations are more likely to sense the increase in cost than the increase in returns and for this reason; they are reluctant to accept graded breeds. Lack of resources is a major constraint to adoption of these breeds. They require very high costs and more labour, which might pose a problem to farmers (Ndambi et al., 2007). Further field investigations showed that, there is an increasing tendency of replacement of local breeds by exotic ones especially in the areas close to Kampala where there is a large market for dairy products. However, this transition is gradual; either through the use of a graded bull for breeding cows and upgrading the herd or by selling more local cows to buy fewer graded ones (not a direct switch from three local cows to three graded cows).

Generally, the policies leading to an increase in milk price for the farmers brought about the best impact on the farmers income. These policies did not only increase the milk price, but also brought a closer market to the farmers. The main problem which such farmers face is the extremely low milk price of less than US-$ 15/100 Kg ECM associated with poor infrastructure (transportation, cooling, etc). Therefore, the most important policies targeting income generation by such farmers should bridge the gap between farmers and markets, either by bringing the market closer to the farmer or by linking the farmers to a secure market outlet. Previous studies also show that the organisation of farmers into dairy cooperatives helps in linking them up to better markets (D'Haese et al, 2005). The importance of such policies was also noticed by Saamanya (2005) and Mutagwaba (2005) where the adoption of the school milk programme does not only improve the nutritional status of school children, but also improves the livelihoods of producers. In such smallholder systems with poorly developed market outlets, milk is sold through local vendors, who make a margin on the milk sold. Usually, as the sales channel gets longer, farm gate milk price tends to decline and the farmer is also subject to price fluctuations (Ngigi et al. 2000). In addition, other findings confirm that milk quality is likely to deteriorate as it passes through several handlers who might also adulterate the milk (Daily Nation Reporter, 2003).

The return to labour of dairy farms with local cows was always lower than the local wage level, implying that family members could earn more if they had the opportunity to work outside the farm. Despite this, farmers are still motivated to work on their farms because they hardly find jobs. Also, small-scale farmers often neglect not only their own labour, but also the opportunity costs of their land and other family-owned resources employed in the dairy.

At present local interest rates of 4% per month, the use of credits to facilitate the adoption of graded animals is discouraging as it doubles the cash expenses of the graded farm. This means that, if credit institutions cannot offer lower interest rates, farmers must save their own money in order to invest in graded animals. This makes it more difficult for local breed owners as they operate on a low income system and require much time to accumulate capital. According to Ahmed and Ehui (2000) and the Organisation for Economic Cooperation and Development (OECD, 2007), a set-up with a more incentive-based environment is required to support such private initiatives and the adoption of intensive agricultural technologies.

6.5 Conclusion

The policy scenarios studied in this paper show very low impact on the three-cow local farm. The main reason for this is that this farm type uses a low-input system which mainly relies upon natural resources and thus responds less sensitively to improved availability of off-farm resources. Genetic improvement through the use of graded breeds does not only considerably increase household income but also significantly increases the cost of farm inputs and hence the sensitivity of the farm to resource accessibility. This sensitivity to policy could be magnified up to threefold in farms with graded animals as compared to those with local ones. Policies which lead to higher milk prices and those that increase access to markets have the highest impact on the three performance indicators analysed. This is because most rural farmers face problems of low milk prices and a poor market network. The transition from the use of local breeds to graded animals is hindered by high input costs and with the present interest rates; farmers are discouraged from obtaining credit to acquire inputs.

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Chapter Seven:

Comparing the EXTRAPOLATE and TIPI-CAL models in analysing policy impacts on Ugandan dairy farms

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Summary

Studies on the priorities for agricultural research in Eastern and Central Africa concluded that milk is the most important commodity for research and development in the region, based on its potential contribution to the agricultural GDP. It has been presumed that the right policies, marketing systems and technical support must be sought for dairy development in Africa. In order to determine the right development pattern, appropriate analytical tools must be applied. The EXTRAPOLATE (EX-ante Tool for RAnking POLicy AlTErnatives) model was used to analyse the impact of different policies on two typical dairy farming systems in Uganda, which account for more than 70% of milk produced in the country. Seven influential policy areas were also identified: provision of veterinary services, consumption promotion, marketing promotion, input provision, credit access improvement, milk quality improvement and genetic improvement. The results obtained from this model were compared to those using the TIPI-CAL (Technology Impact Policy Impact model). This comparison shows a great deviation in the ranking of two policy areas: genetic improvement and provision of veterinary services, meanwhile the other policies were ranked in the same order by both models. Further analysis shows that both models could complement each other in analysing policy impacts on African dairy farms. However, differences in results from the models indicate that more emphasis should be placed on farmers' willingness to adopt new technology.

Key words: Africa, Dairy, EXTRAPOLATE, Policy impacts, TIPI-CAL

7.1 Introduction

With a continuous economic and population growth, and a shift toward higher-valued foods and livestock products, African dairy demand is expected to expand dramatically (Thorpe et al, 2000; Knips, 2004). Several African states, funding organisations and researchers have seen the importance of the contribution of the dairy sector to the livelihood of farmers and to the nation's GDP, leading to investments in this sector (African Studies Center, 2006; Brown et al 2006).

The decrease in funds from sponsors over the years and the desire to cover a broader scope has pushed policy makers to be more cautious in project expenses. This therefore implies that there is a need for a better understanding on the best policies and/or technical support services which support organisations can apply in order to improve on dairy production while maintaining minimum investment. For selection of these policies and support services, adequate analytical tools must be developed and applied especially in typical African agricultural systems where farms are very complex units. Due to a poor availability of dairy related data in most African countries, need has arisen for the development and application of analytical methods which rely to a lesser extent on available data.

This study aims at assessing the impact of different policies and support services on African dairy farms by the use of two models (TIPI-CAL and EXTRAPOLATE). It will also compare the results of the two methods used, bringing out the pros and cons of each method and, finally, propose an improved procedure for future studies on dairy farm policies in Africa. The two models, EXTRAPOLATE and TIPI-CAL were selected because they can be applied in regions where limited data is available on dairying. These models also have the ability to convert complex real situations into simple representative units (farm types, policy scenarios, etc).

7.2 Methodology

7.2.1 Study area

The farms analysed in this study were from Kayunga district in the central region of Uganda. This region is the second largest producing region, producing 34% of the total milk in Uganda after the South Western region (producing 36% of total milk). The central region includes Kampala, the nation's capital which is the highest consumption area for milk in Uganda (Bunoti 1996). Dairy farming in the Kayunga district is mainly extensive. Also, the central region is the area where the offices of the DDA (Dairy Development Authority) are located. This is an administrative body that aims at improving dairy production, processing and consumption in Uganda.

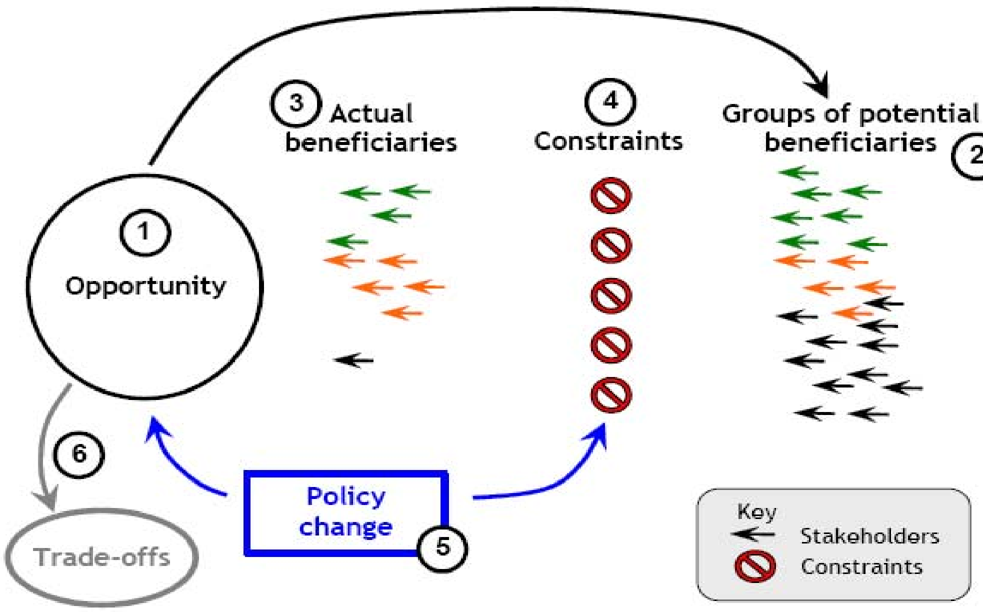
7.2.2 Data collection

Data for this study were collected from the two most prominent extensive farming systems: the smallholder extensive farming system represented by KY-3 typical farm and the medium holder extensive system represented by KY-13 typical farm. Policy scenarios were made for both systems on seven policy areas: provision of veterinary services, consumption promotion, marketing promotion, input provision, credit access improvement, milk quality improvement and genetic improvement. Data was collected into two models: EXTRAPOLATE and TIPI-CAL. For both models, data collection was done using the panel approach. The different farm types and policy scenarios were discussed in successive meetings by selected panels of experts consisting of dairy farmers, veterinarians, extension workers, researchers, feed vendors, milk vendors, milk processors, NGO officials, government officials and others. Farm visits were also conducted for data completion and validation of data entries. A separate panel was built for each policy scenario and each panel met at least three times. Further details of the two models used are described in the succeeding paragraphs.

7.2.3 The EXTRAPOLATE model

EXTRAPOLATE (EX-ante Tool for RAnking POLicy AlTErnatives) is a communication tool based on possible policy impacts. For any application, the user has to define the situation as it is now, before any policy intervention has been made. EXTRAPOLATE arose out of the need for a decision support tool to assess the impact of different policy measures. The tool facilitates discussion of the relevant issues and enables users to visualize the predicted impacts of policy interventions, based on a simple numerical analysis (Thorne et al., 2005).

Figure 7.1: Basic framework of the EXTRAPOLATE model



Source: Thorne et al: 2005

EXTRAPOLATE was selected as it is a rapid screening device, to allow the user to carry out quick assessments of likely candidate policy changes that may have particularly beneficial impacts on the poor in particular situations, the most promising of which can then be analysed further using much more rigorous (and time- and data-intensive) methods. The tool has the further characteristic that it is participatory in nature, encouraging stakeholder involvement and discussion around the likely impact of policy change. This model is made up of various elements (Figure 7.1), and various linkages among the elements. In an overview, the procedure starts from the identification of an opportunity (1), identifying potential beneficiaries from this opportunity (2), finding the actual beneficiaries (3) and determining the constraints of all potential beneficiaries from benefiting (4), before finding policies which could influence them and to what extent (5). The key elements include the stakeholder groups, constraints faced by these stakeholder groups, outcomes and policies.

The sequence followed by this study was as follows:

1. Define stakeholders and their livelihood status
2. Define constraints of stakeholders to dairying

3. Determine the relevance of the constraints to the different stakeholder groups
4. Define outcomes to livelihood status
5. Link constraints to outcomes and outcomes to stakeholders (to complete the definition of the current status quo)
6. Define policy interventions
7. Link policy interventions to constraints (and therefore run the model)
8. Rank policy interventions based on their prospective outcomes

Stakeholder groups

Stakeholder groups are the various groups of people who are involved directly in the dairy sector, and who may be affected (both positively and negatively) by prospective policy changes.

In the present analysis **"livelihood status"** has been used to define the current welfare status of each group of stakeholders, and estimates are made on how this might be affected by specific policy interventions. The livelihood status of each stakeholder groups is measured on a simple scale from "low" to "high" ("poorly endowed" to "well endowed") with 'one' as the least endowed and 'ten' as the highest endowed, based on a synthesis of the physical, financial, social, human and natural capital assets of each group. Where **physical capital** consists of machinery, equipment and buildings used in production; **financial capital** is the value of financial assets; **social capital** deals with social networks, trust, mutual understanding, and shared values and behaviours that make cooperative action possible; **human capital** comprises human assets such as skilled workers and **natural capital** deals with environmental issues in the form of ecosystem services.

A pairwise comparison facility (David, 1988) has been used to ensure consistency in selecting the livelihood status of the different stakeholder groups.

EXTRAPOLATE distinguishes between direct stakeholders and institutional stakeholders. Direct stakeholders comprise of homogenous groups of people who derive direct benefit from the policies implemented, for example, small-scale farmers, large scale farmers, small scale processors, etc. Institutional stakeholders include support service providers like transporters, extension workers, veterinary service providers, input suppliers, researchers and financial institutions. While the assignment of a livelihood status is appropriate for direct stakeholders, the model does not explicitly cater for institutional stakeholders. It rather discusses the impacts of alternative policy interventions on institutional stakeholders in a qualitative manner.

Constraints faced by direct stakeholders

A second element in the model relates to the various constraints that are faced by these stakeholder groups. In this context, a constraint is simply something that prevents a positive outcome being achieved by a stakeholder group. For example, poor market access caused by poor roads locally might make it difficult for smallholders to obtain inputs and sell their products. If constraints are relaxed then it might have positive impacts on smallholders in terms of increasing their livelihood status.

Definition of outcomes

The third element of the model comprises outcomes. Outcomes are things that can be quantified that directly affect, negatively or positively, the livelihood status of one or more stakeholder groups. The question to be asked here is: what is it that contributes towards the livelihood status of any particular stakeholder group? Appropriate outcomes may include cash income, milk production and level of food security; for commercial producers, profit margins and cash flow; for poor urban consumers, the price of food staples.

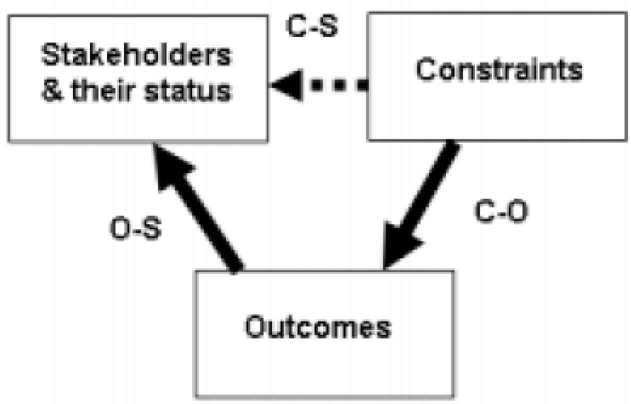
Model linkages and summaries

To define the status quo, three linkages must be defined: 1) the impact of constraints on outcomes; 2) the impact of outcomes on stakeholders and 3) the relevance of constraints to different stakeholders (Figure 7.2). Once these have been defined, the EXTRAPOLATE programme provides graphic summaries of the various linkages, which are very useful aids to discussing and revising them. The definition of the status quo is guided by a number of values which are shown in Table 7.1. Once the status quo situation has been defined, the policy interventions are defined and then linked to the constraints using the values shown in Table 7.1. This linkage completes the data entry process and allows the model to be run. A new situation (Figure 7.3) arises and as a result of the policies, there are trade-offs leading to a new initial position.

Table 7.1: Relationship matrices in EXTRAPOLATE and allowable values

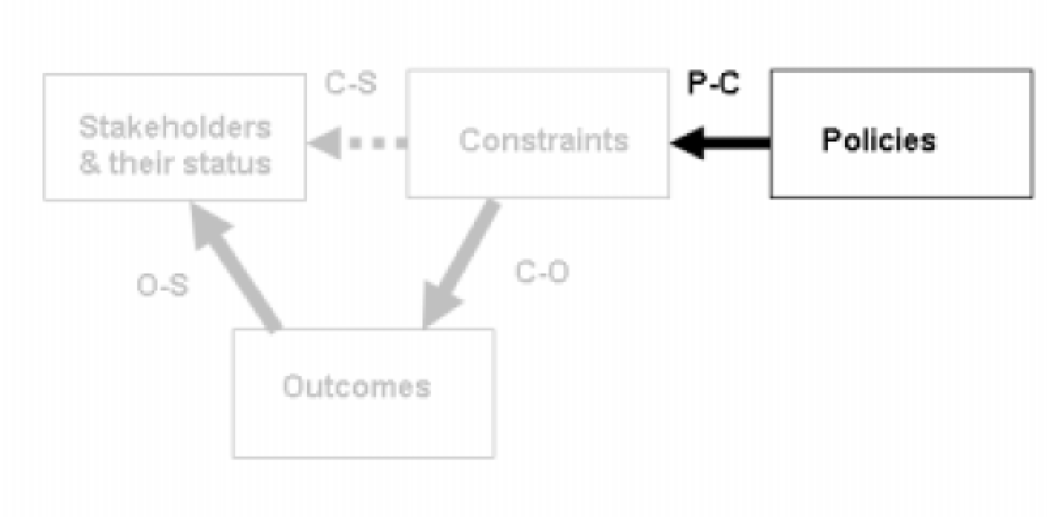
Relation	Type of Relationship	Allowable values
C-S	Relevance (of constraints to stakeholder groups)	0 (no relevance) to 9 (extremely relevant)
C-O	Impact (of constraint on outcomes)	-5 (highly negative impact) to 0 (no impact) to +5 (highly positive impact)
O-S	Impact (of outcomes on livelihood status of stakeholders)	-5 (highly negative impact) to 0 (no impact) to +5 (highly positive impact)
P-C	Impact (of policies on constraints)	-5 (highly negative impact) to 0 (no impact) to +5 (highly positive impact)

Figure 7.2: Status quo situation (before the policy changes)



Source: Thorne et al: 2005

Figure 7.3: Situation after policy changes



Source: Thorne et al: 2005

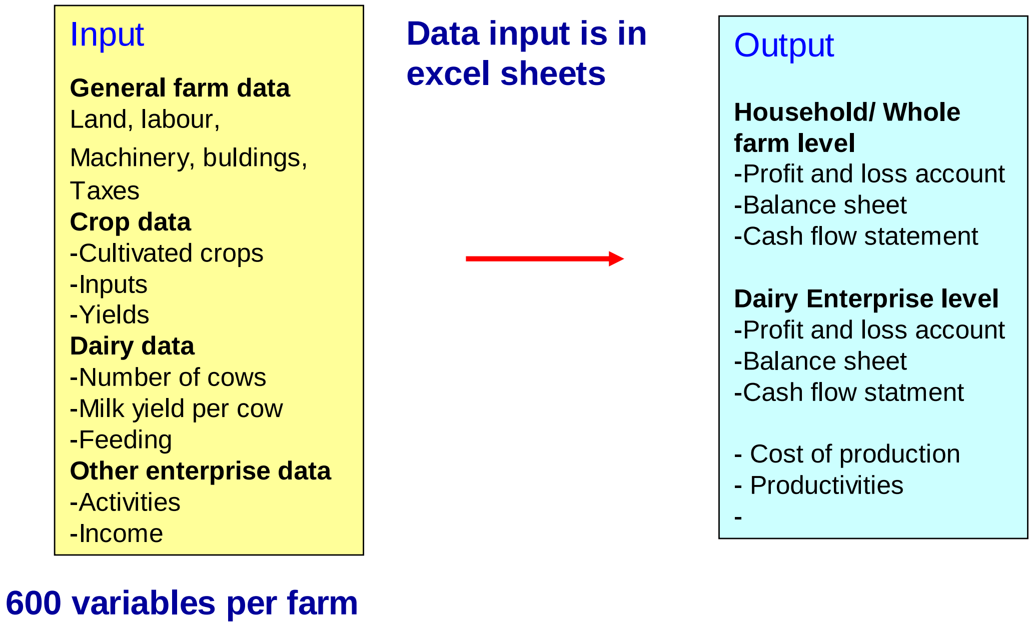
7.2.4 TIPI-CAL model

The TIPI-CAL model (Hemme, 2000) is a production and accounting tool which was developed by the International Farm Comparison Network (IFCN). It applies the concept of typical farms, where a typical farm represents the most common farm type within a production system which has an average management and performance and produces the largest proportion of milk. This approach of typical farms and panel approach has proven to be very practical and to produce in-depth results. It can be used to compare the performance of different farm types at the international scale (Isermeyer et al. 2003).

The model is an on-farm policy impact assessment tool. It assesses policy impacts to a detailed extent on farm variables (cost, revenue and farm structure changes) of typical farms, using real values (changes in household income, herd size, lactation yield, etc). The TIPI-CAL model enables ranking and comparability of results at farm, national and international levels.

It runs an in-depth micro-economic analysis at the farm level and produces results which cover several parameters that can be selected and grouped as desired by its user. Issues concerning farmers' response to innovation can be incorporated in the analysis by justifying his willingness to accept of the new policy through the panel approach, and this makes the results more realistic.

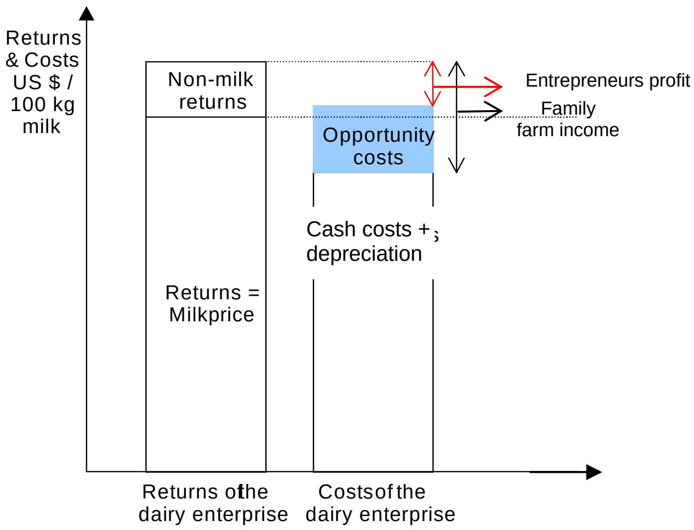
Figure 7.4: Framework of the TIPI-CAL model



The model is run using Microsoft Excel software. It comprises input sheets, where entries on different farm parameters are made, and output sheets which display the results (Figure 7.4). About 600 variables are inserted for every policy analysed, leading to a very diverse output that enables comparison at various levels. The output sheets have mathematical formulae that calculate required output measures which could be represented either in tabular or graphical form.

The family farm income from the dairy enterprise is calculated as shown in Figure 7.5.

Figure 7.5: Method of calculation of the family farm income from the dairy enterprise



For the dairy enterprise, the family farm income is calculated by deducting cash costs and depreciation costs from farm returns.

The **household income** which has been used for comparison in this study is calculated by adding the family farm income from the dairy enterprise with income from crops and other animals and income from off-farm activities as well. Equation 1 summarises the parameters considered for household income calculations by the TIPI-CAL model.

HI = DI +CI + AI + OI ……………………………………………………..1

Where **HI** is the household income, **DI** is the family farm income from the dairy enterprise, **AI** is the income generated from other animals (except dairy) in the farm and **OI** represents off-farm income.

The TIPI-CAL model has been applied for policy impact analyses in several studies. Three prominent areas of application are: the **Baseline** approach, where the impact of a single policy is analysed on one typical farm type over a period of 10 years; the **Static** approach, where impacts of several policies on several farm types are compared for a single year; and the **Inter-temporal** approach, where several policies are studied on one typical farm type, for ten years (Garcia et al., 2006, Ovaski and Sipiläinen, 2005; Holzner, 2004; Jägersberg and Hemme, 2003; Deeken, 2002; Hemme, 2000).

For this study, the static approach was applied to compare scenarios before and after the policy impact.

Some differences between the EXTRAPOLATE and TIPI-CAL approaches in policy analysis are:

- EXTRAPOLATE method incorporates identification of stakeholders and influential policies in its analysis, while the TIPI-CAL model only deals with stakeholder groups (farmers) and/or policy areas which need to be known or identified (separately), prior to analysis.
- EXTRAPOLATE assesses the impact of alternative policy interventions on stakeholders' livelihood status by assigning subjective weights to the impacts of each policy on the constituent components of the livelihood status. This is done on a virtual scale. The TIPI-CAL model weights impacts by assigning real values. For example, improved access to water will lead to increased milk yield of 80 litres per cow per year.
- Though several aspects are considered, an overall ranking by EXTRAPOLATE is based on one factor: change in livelihood status. TIPI-CAL, by contrast, allows for some flexibility in choosing the base for ranking of policies. It could be based on one or more parameters as desired by the user, for example, household income, dairy income, farm costs, etc.
- EXTRAPOLATE considers parameters like environmental degradation, security of livestock and nutritional security of the household while the TIPI-CAL model doesn't.
- EXTRAPOLATE shows policy impacts on a broader scope of stakeholders with more focus on society as a whole, while TIPI-CAL focuses on the financial wellbeing of farmers.

7.3 Methods for comparison

EXTRAPOLATE analysis uses *Livelihood Status* as the unit for ranking policies. In general, it takes into consideration the factors that can affect the wellbeing of stakeholders. For the purpose of this study, the following factors contribute to the livelihood status: production and sales of dairy products, profit margins, security of livestock assets from diseases and theft, nutrition status of the household, employment opportunities, and environmental degradation.

For the TIPI-CAL model, *Household Income* has been selected as the closest parameter to livelihood status as in the EXTRAPOLATE model. Household income includes: dairy income, off-farm income and other farm (crop and animal) income. A comparison of Livelihood Status and Household Income as ranking parameters is shown in Table 7.2.

Table 7.2: Livelihood status (EXTARAPOLATE) and Household income (TIPI-CAL) compared

Sub-components of policy impact parameters	
Livelihood status considers:	**Household income considers:**
Increased production and sales of dairy products	Increased income from higher production and sales of dairy products
Increased profit margins	Increased profits reflected in household income
Increased security of livestock assets	Increased animal mortality with less secure animals, hence reduced household income
Improved nutritional status of farm family members	Increased on-farm consumption of dairy products (reduced income from sales).
Increased on and off farm employment opportunities	Increased (or reduced) household income from on and off farm employment
Reduced environmental degradation	No impact on household income due to environmental degradation

The first three indicators shown in Table 7.2 will lead to a change in the same direction using both models. For example, if EXTRAPOLATE shows an increase in sales of dairy products (positive impact on farmers), TIPI-CAL shows an increase in income of farmers (also positive impact on farmers). This is not the case with the fourth and fifth sub-components. When the farmer's nutritional status increases because he consumes more milk from his farm, EXTRAPOLATE shows increase in welfare of the farmer. TIPI-CAL model rather shows a drop in income because the farmer will have to sell less milk if he consumes more. However, this effect might not show if the increase in milk production overshadows the increase in household consumption. If a policy is implemented which relieves the farmer of some farm work, EXTRAPOLATE will show a positive impact on the farmer because he has the opportunity to work off-farm. The TIPI-CAL model shows an impact only if the farmer actually benefits from this opportunity. On the other hand, if adoption of the policy leads to employment of hired labour on the farm, EXTRAPOLATE will show a positive effect due to the societal benefit from the creation of job opportunities. The societal benefit will not be represented by TIPI-CAL model because it only shows the effect on the farm, which in this case will be an increase in farm cost as salary for hired labour. In some cases, more than one scenario was predicted as an outcome of a given policy, using the TIPI-CAL model. The average value from the different scenarios was calculated and used for the comparison.

7.4 Results and discussion

The results from both models are presented side by side in Figure 7.5. In general, policy impacts assessed with the EXTRAPOLATE model are bigger than those assessed with TIPI-CAL. In addition, TIPI-CAL only shows the potential impact on stakeholders while EXTRAPOLATE also considers the relevance of the impact of policy implementation on stakeholders. This explains the reason for higher policy impacts on the smallholder farm than the larger farm using EXTRAPOLATE model.
Ranking of policies within each of the two models is the same for the smallholder extensive farms as with the medium holder extensive farms (Table 7.3). Ranking of policies 3 – 7 gives the same order in the two models. Two policies (Genetic improvement and Vet services) give completely opposite results in the two models (Table 7.4).

Table 7.3: Ranking of policies by extent of impact (1 = best policy)

Policies	**EXTRAPOLATE**		**TIPI-CAL**	
	KY-3	KY-13	KY-3	KY-13
1. Genetic+	7	7	1	1
2. Vet services	1	1	5	5
3. Marketing+	3	2	3	3
4. Quality control	6	6	7	7
5. Cons promotion	2	2	2	2
6. Input access	4	4	4	4
7. Credit access	5	5	5	5

Table 7.4: EXTRAPOLATE and TIPI-CAL results compared

Policies	**EXTRAPOLATE**		**TIPI-CAL**	
	% change in livelihood status		**% change in household income**	
	KY-3	KY-13	KY-3	KY-13
Genetic+	-6.0	-5.0	+39.2	+118.7
Vet services	+67.5	+33.75	0.0	0.0
Marketing+	+45.0	+21.25	+3.1	+14.5
Quality control	-1.0	-2.50	-4.7	- 11.6
Cons promotion	+46.5	+21.25	+6.7	+20.35
Input access	+42.0	+21.0	+1.2	+8.2
Credit access	+36.0	+18.5	0.0	0.0

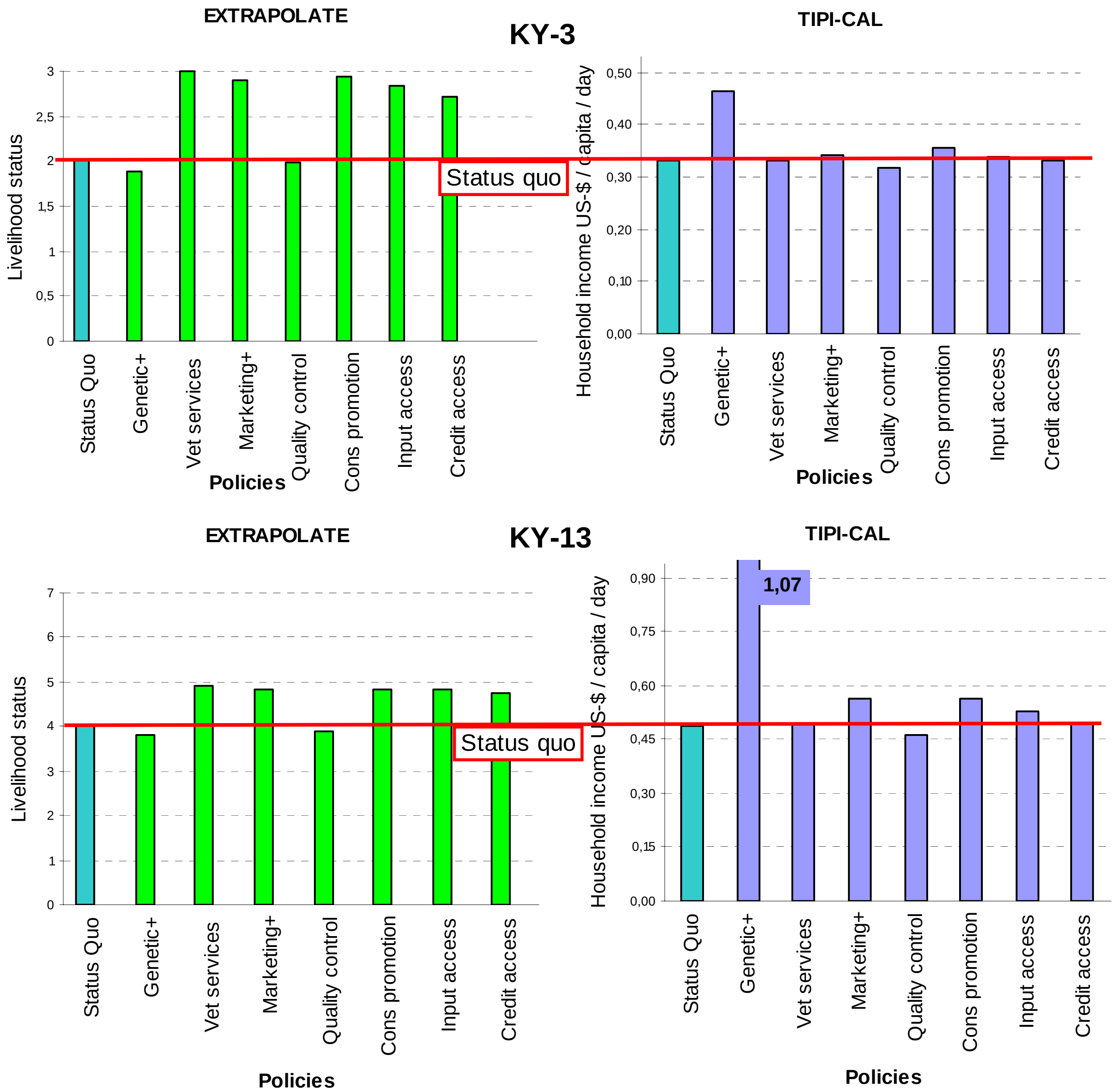
NB: Status quo Livelihood Status: KY-3 =2; KY-13 = 4

Status quo Household Income: KY-3 = US-$ 729/year; KY-13 = US$1075/year

While the results from the EXTRAPOLATE model show that the implementation of genetic improvement policies will bring about a reduction in the livelihood status of the KY-3 and KY-13 farmers, TIPI-CAL model shows that these policies will greatly enhance household incomes of the same farmers, hence their livelihood status. This difference comes from the fact that EXTRAPOLATE shows negative impact for the use of graded breeds due to higher input costs and labour utilisation for improved breeds, increased exposure of improved breeds to theft and hence reduced security of livestock resources and increased susceptibility of animals to diseases. The TIPI-CAL model considers higher inputs for graded breeds, and also higher milk yield and sales.

From the EXTRAPOLATE model, an improvement in the provision of veterinary services shows an increase in livelihood status of the small scale extensive (KY-3) and medium scale extensive (KY-13) farmers by 67.5% and 33.75%, respectively. With TIPI-CAL, this same policy does not show any impact on the farmers. EXTRAPOLATE assumes that farmers will adopt veterinary services, while TIPI-CAL assumes that they will not. The TIPI-CAL model focuses on a typical situation and only shows impacts which are plausible to typical dairy farmers.

Figure 7.5: Policy impacts on household income of KY-3 and KY-13 farms



Marketing improvement and the promotion of milk consumption lead to very positive outcomes using both models. Usually, marketing is a big problem to traditional farmers due to the small quantities of milk produced. The situation is worsened by poor transportation network, absence of cooling facilities, poor hygienic quality of milk and high transaction costs of milk vendors who collect from several small scale producers.

According to the analysis using EXTRAPOLATE, credit provision will increase the livelihood status of KY-3 and KY-13 farms by 36 and 18%, respectively. The TIPI-CAL model shows no impacts on both KY-3 and KY-13 farms for the same policy. According to the TIPI-CAL model, the current interest rates (about 14% per annum) are not able to attract farmers to take loans even if credit institutes are at their disposal. One major difference which can be observed from this case is that the TIPI-CAL model equally considers restrictions due to farmer adoption of the given policy under present conditions, meanwhile EXTRAPOLATE mostly shows the potential benefit to farmers and other stakeholder groups, if the policies were implemented and adopted.

7.5 Proposal for a future analysis method

From all understanding, both methods contribute strongly to policy analysis, though each has strengths and weaknesses. EXTRAPOLATE shows a more general picture with more emphasis on societal benefits. It is of particular importance when qualitative assessments intended to alleviate poverty are targeted, considering its more holistic view of the situation. TIPI-CAL has a more specific target on farmers and produces more detailed and quantitative results where impacts can be assessed in real value terms.

The differences observed in results are mainly based on the approaches of both models, since they use assumptions from experts in evaluating policies. The perceptions of panel members and researchers are guided by their past experiences, which will differ among a group of experts and between different expert groups. This can also influence the outcome of the analysis especially when several outcomes could result from the implementation of one policy.

In general, the EXTRAPOLATE model identifies stakeholders and influential policies and also provides a general picture of policy impacts, enabling ranking with strong emphasis on societal benefits and little on farmer adoption. The model however does not assess policy impacts in quantitative terms, for example, perspective change in family income ($), change in herd size, etc. The TIPI-CAL model on its part does not identify stakeholders and policies but provides a more detailed policy outcome of known policies in quantitative terms. It ranks alternative policy interventions with a stronger emphasis on farm benefits and farmer perceptions. The strengths and weaknesses of both models call for a combined approach of the two analytical tools. At the first stage, stakeholders and potential policy interventions should be identified, and general ranking of policies should be obtained using the EXTRAPOLATE model. At the second stage, an in-depth analysis of policy impacts at the farm level, based on the TIPI-CAL model, should be carried out. This analysis generates quantitative insights into the impacts of policies on the financial wellbeing of farmers.

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8. Concluding remarks

This study analysed economic aspects of milk production systems in Africa and assessed the impact of different policies on milk production and on the livelihoods of dairy farmers. This chapter summarises the key findings, draws conclusions for policy and business, assesses the extent to which the stated research objectives have been achieved, and identifies lines of future enquiry on the topic.

8.1 Summary of results and implications

This study has analysed several systems of milk production in different African countries and some patterns have been found depending on a number of factors.

The **geographical location** of the country or region influences the rainfall and vegetation pattern and also determines the **relative scarcity of land** for dairying. In the Northern African countries where water availability is a major problem, intensification of dairy production with high dependence on concentrates is unavoidable if high milk yields are expected as was the case in Morocco. Countries in the Western, Central and Eastern African regions still having low **population densities** such as Cameroon and Uganda, have a predominance of traditional systems. The Sahel countries which lie between the central African countries and Northern African countries still have a predominance of traditional dairy systems and are highly affected by water shortage. Because of water shortage and reduced **availability of inputs** these countries don't have intensive feed-based systems. The availability of inputs combined with the **consumption pattern** of inhabitants in South Africa influences production intensification. Here, milk consumption is higher due to the higher purchasing power of the people who can afford cheese, butter and other milk drinks. In the western and central African countries, fresh milk consumption is limited by low production, low purchasing power, and low education levels as well as social and cultural values. In these countries, butter and cheese consumption is only common among middle and high class people, while powdered milk consumption is more common since it is cheaper and easier to store. In eastern African countries, fresh milk consumption is more common because of a strong informal dairy market, leading to

higher per capita consumption of fresh milk as compared to western African countries. In northern Africa, butter consumption is very common and customary.
The overall results of this study have been summarised in Figure 8.1, which shows how several factors influence the predominance of farming systems in different African countries and hence can contribute to dairy development. In principle, three main factors can influence the farmers' choice of farming system: local demand for milk (market outlet), the availability and accessibility to production resources and influence from institutional and support services including political interventions. Farmers use their knowledge of these three main factors to produce milk, resulting in a local production volume. Depending on whether there is a deficit or surplus, the country will either import or export milk.

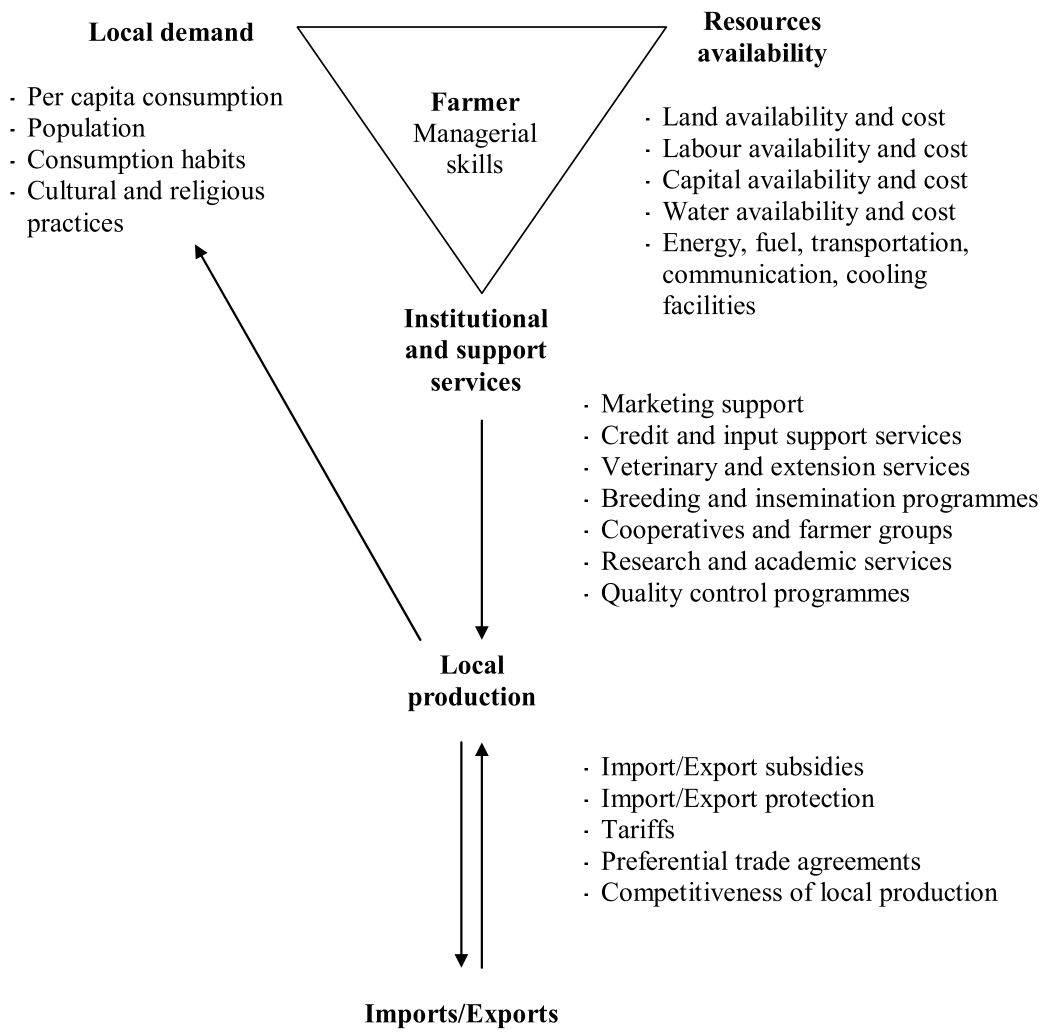
Local demand for milk is on the increase across Africa in general due to population growth and increased per capita consumption. Changes in consumption habits can be driven by urbanisation as is the case in Cameroon, where urban dwellers consume significantly higher amounts (40% more) of dairy and livestock products as compared to people of rural areas (MINEPIA, 2002). Cultural and religious practices influence production systems especially in traditional dairy production systems like those of Maasai, Borani and Fulani in Eastern and Western Africa. These pastoralist stick to their traditional systems and have a strong culture of subsistence. Also due to the fact that most of such people live in closed communities with poor access to **institutional and support services**, they have experienced very little progress in dairying.

With regards to **resources availability**, pastoral systems are only practicable in areas where land and labour are available at very low cost since they highly depend on these resources and have a minimum capital input. This accounts for the extremely low land and labour productivities in these systems as is the case in Cameroon and Uganda. On the other hand, intensive systems are very capital intensive and must be practiced where transportation systems, cooling facilities and communication networks are developed. This is the case in South Africa and Morocco. The shortage of water resources in the northern African countries has led to very high feed costs and extremely high land costs in irrigated areas. Combined, these two factors have resulted in very high cost of milk production. Thus, in Morocco the cost of milk

production is twice as high as in South Africa where production systems are also intensive but land and water resources are less scarce.
In countries like Cameroon and Uganda where traditional dairy production systems dominate, it was noticed that milk production became more intensive in areas closer to big cities. This was due to farmers' proximity to consumers and urban markets, access to capital resources and institutional and support services. This led to the presumption that **institutional and support services** and farm business strategies could make resources more available to local farmers and hence greatly impact on dairy production in rural areas. The formation of farmers' cooperatives or farmers groups was seen to be advantageous to local farmers because these attract a better market by collecting and selling their milk in bulk, hence reducing the transaction costs of processors or collectors who will not have to collect milk separately from individual farmers. This strategy could also be advantageous in enhancing the market power of farmers, strengthening their ability to acquire inputs buy buying in bulk and also improving on their eligibility to acquire loans from credit institutions.

Looking at rural areas, institutional and support services which are most likely to be influential on dairying include: veterinary services, extension services, breeding and insemination programmes, milk quality control programmes, credit and input support services and support from research and academic institutions. These services were shown to influence farmers either positively or negatively to different extents. It was found that, policies which support the improvement of marketing infrastructure in these rural areas had the highest impact on farm household incomes. This is because the farmers in rural areas, though producing very cheaply (at less than 20 US-$/ 100 kg milk) have limited access to markets due to lack of good transportation, poor communication networks and lack of electricity and/or cooling facilities for milk. These problems, coupled with the high tropical temperatures have led to the loss of very large amounts of milk through spoilage. This poor market access, combined with low yields of local cows (< 1000 kg/year), has discouraged local producers from continuously milking their cows.
Finally, the above-mentioned services are of external sources to the farmer. Their provision will require that the farmer applies his managerial skills and experience on the available resources and services in order to optimise benefits from them and to plan farm business strategies that will improve on his farm.

Figure 8.1: Factors influencing choice of dairy farming systems in Africa



8.2 Achievement of research objectives

This study was geared towards:

- reviewing the relevant literature on dairy production systems and dairy development policies in Africa;
- understanding the farm-level economics of typical dairy production systems in Africa;
- assessing the potential impacts of policies and farm business strategies on African dairy systems;
- improving on existing methods for analysing the impact of policies and farm business strategies on dairy farms in an information-constrained environment.

Claiming that all of these objectives have been fully achieved would clearly overstate the achievements of the thesis. In the literature review, due to lack of available databases and literature sources, detailed information on farming systems and dairy production could not be obtained for some countries. Also, some information in this review was retrieved from the grey literature: conference presentations, unpublished working papers and, in some cases, from expert estimates drawn from the experience of the interviewees.

This study was however restricted to four countries due to financial and time limitations. It was presumed that the selected countries could be representing production systems in their respective regions and hence in sum could be in some way representative of Africa as a whole. Description of farming systems followed the IFCN approach using the TIPI-CAL model. The use of typical farms to represent entire farming systems can be questionable especially if the definition of the typical farm is wrongly perceived. However, considering the depth of the studies on each of the selected systems and the volume of data entries that were required for each farm, time could not permit such deep studies on more farms. Also, due to lack of existing structured databases for the study regions, the TIPI-CAL model was found to be the most appropriate method for this analysis.

Policy impacts were only studied for one farming system in Uganda, though there are many other systems. The results obtained therefore have restricted applicability. However, placing the focus on the selected system was necessary as it accounts for more than 80% of milk production in Africa. Great differences were noticed in policy impact results obtained from the two applied models, meaning that methodological amendments are inevitable. The EXTRAPOLATE model showed results by looking from a general perspective, while the TIPI-CAL model showed only results of the typical case with some focus on adoption of the selected policy by the farmer.

Since the differences noticed in the results from the two models were linked to the data introduced and not the technical aspects of the tools, suggestions for improving on the methodology have also targeted improvement of data input. The restriction of the TIPI-CAL model to typical farms and the partial incorporation of adoption possibilities show a further need for inclusion of technology adoption to obtain better results. As discussed in section 8.1, though services could be provided to the farmer, he needs to use his managerial skills in order to optimise benefits from them and to plan farm business strategies that will improve on his farm. This study placed no emphasis on the willingness of the farmers to adopt new technology or to accept the support offered by external sources and to initiate useful business strategies for the farm.

8.3 Directions for future research

Section 8.2 reveals that the results of this study will greatly be improved by the inclusion of farmers' willingness to adopt new technology. Ouma (2007) postulates that the adoption new technology eases the exploitation of future livestock development opportunities leading to increased productivity in sub-Saharan Africa.

This study shows that access to markets is a major problem to farmers, especially to those in the more remote rural areas. It also shows that the replacement of local breeds with exotic breeds like Holstein Friesian could increase the impacts of policies on the farm by up to threefold. It is likely that market accessibility influences farmers' choice of breeds. A study by Baidu-Forson et al. (1997) on farmer preferences for socio-economic and technical interventions in groundnut production systems in Niger revealed that farmers showed preference for high-yielding varieties only when there were reliable markets for the produce. Different preference structures might arise from the constraints associated with different production systems, with cattle keepers trading off traits associated with adaptability and productivity. Jabbar and Diedhiou (2003) found evidence of preference changes from trypanotolerant cattle breeds towards trypanosusceptible White Fulani cattle breeds in South-west Nigeria as trypanosomiasis disease challenge decreases. The White Fulani cattle breeds are known for their large size and high milk yield. Uganda and Cameroon, whose traditional systems have been described in this study, lie within the African regions where trypanosomiasis is endemic. Therefore farmers' decision on the adoption of exotic breeds would consider this trait. Kassie (2007) suggested that in smallholder communities where livestock production is semi-subsistent, livestock development interventions should focus on a multitude of reproductive and adaptive traits that stabilize the herd structure, rather than focusing on traits which are only important to commercial purposes. In addition, Ouma (2007) showed that not only traits related to milk and beef production were important to local cattle owners, but also non-income traits such as traction potential and disease resistance.

Feed efficiency might be of importance in areas where feed resources are constrained. For example, Tano et al. (2003) showed that farmers of the subsistence system have high preference for cattle which are not selective in the type of grass they eat. This was not the case with mixed crop-livestock farmers who do not place emphasis on this trait since feed resources are not constraining and cattle are fed on crop residues. The choice of breeds and production systems might also be influenced by socio-cultural factors based on an ethnic community's belief system as well as cultural practices. Mwacharo and Rege (2002), for example, found preference for horn size and shape in cattle for socio-cultural reasons in Kitui and Kajiado districts of Kenya. Ouma (2007) also stipulated that household characteristics such as gender, education level, income and past experience in cattle keeping have not been included in most of the preference studies for cattle traits. The selection of breeds or farming systems might also be influenced by the demand side. For instance, Adesina and Zinnah (1993) showed that farmer perceptions of technology-specific attributes of rice varieties are the major factors determining adoption and use intensities in Sierra Leone. Morris et al (1999) showed that the adoption of technology varies considerably across agro-ecological zones. Furthermore, they showed that land tenure and ownership could significantly influence adoption of fertiliser use in maize farming systems in Ghana. Farmers who cultivated on their own farms were the best adopters, followed by those using rented land and then those on share-cropped land.

This study shows that a majority of farmers using traditional systems in Africa do not own land. This means that their weak power over the land might restrain them from adopting certain technologies for fear that ownership may change hands. An example could be the case of pasture improvement where farmers using communal grazing land are reluctant to improve their fields for fear of not fully benefiting from their investment. This study also shows that farmers of the traditional system are among those having the lowest level of education in their communities. Zepeda (1994) showed that the level of education greatly influences technology adoption and that more educated and experienced farmers stand a better chance of overlooking fears related to risks and uncertainties in adopting a new technology. Hisham et al (1999) shows that the adoption of capital-intensive technology on dairy farms is influenced by the age of farmers, climate and farm size. Larger farms were more likely to adopt capital and management intensive technology than smaller farms. Looking back to our traditional systems having less than 10 milking cows, one would therefore expect a slower adoption of capital-intensive technology.

Therefore, a major issue for future research of this nature should be the fortification of knowledge related to technology adoption of the proposed development strategies.

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9. Summary

The dissertation is a cumulative study composed of six articles, each tackling one or more areas of the African dairy sector. It gives an overview of dairying in Africa, potentials for its improvement through the implementation of different policies and farm strategies and also presents suggestions on a methodological approach for analysing policy impacts on African dairy systems.

Dairying in Africa – Status and recent developments

This paper reviews the literature on African dairy production systems, trends in milk production, processing, consumption as well as imports and exports in Africa for the years 1990 – 2004. The views of previous authors on policy impacts on the African dairy sector are explained and the need for better analytical tools for policy impact assessment is highlighted. Potentials for dairy improvement are also described in this review.

The quest for more knowledge on the African dairy sector has been increasing over recent years. Dairying has been envisaged as a means of improving on the nutritional status and income generation from poor African families. This has led to the implementation of a large number of developmental projects in favour of dairying. Dairy farming systems differ greatly in the different African countries with regards to farm inputs, returns and main objectives for farming. Though milk production has been increasing in Africa over the years, demand has also increased and the gap between these two is widening up. Different trends have been noticed in dairy sectors of different countries over the past years, with some countries increasing their production, others decreasing and others remaining stable. Pastoral systems dominate dairy production in Africa and account for over 80% of milk produced in sub Saharan African countries, though they have the lowest milk yield per cow. The persistence of these systems in Africa, despite the existence of higher yielding systems draws attention to deeper studies on the constraints these farmers face towards improvement. It is recommended that sector policies, organisational structures and support services for dairy farmers should be properly oriented to stimulate dairy development especially by strengthening the dominant informal sector and encouraging specialised small and large scale dairy production.

Milk production amongst Fulani grazers in the Western Highlands of Cameroon: Constraints and development perspectives

This paper is concerned with the specific problems faced by dairy farmers in Cameroon. The factors which prevent the dairy sector of a typical African country from exploiting its potentials described in the previous article are discussed. The origin of these problems and their effect on the dairy chain as a whole are shown.

Dairy development is becoming more popular in African countries and there is increased need for a better understanding of dairy systems. The expected outcomes of many dairy developmental projects are not met because, proper understanding of possible constraints to development is usually lacking prior to project implementation. This study covers the points of view of dairy farmers as well as representatives of all identified stakeholder groups of the dairy chain. The major constraints to milk production arise from the poor access of farmers to resources and information. The farmers of this system fall among the least educated people in their community and this may pose a problem in the adoption of new technologies. Though land is cheap and available in rural areas, population pressure reduces its availability. Also, due to poor land productivity and lack of proper land improvement techniques in such areas, the request for farmland and grazing land is increasing, leading to conflicts between crop farmers and cattle grazers over untitled land.

Such conflicts usually lead to loss of crops, animals, property and sometimes lives of farmers. These losses could be minimised by prompt and strict intervention of administrative authorities, which is usually difficult in some cases. It is suggested that the establishment of land tittles, enforcement of punitive sanctions to defaulters and loyalty in the execution of administrative duties for the authorities concerned would be prerequisites for a definite solution to be reached. The absence of market outlets hinders production while the availability of a closer and regular milk market to these farmers is seen to be a major motivating factor for milk production. From all the findings, suggestions are given on how different stakeholders can react to the identified problems in order to improve on the existing situation.

Milk production systems in Central Uganda: a farm economic analysis

This paper describes different dairy production systems in the Central region of Uganda. Farmers are grouped differently, based on their farming systems and it is most likely that farmers of the same farming system have similar perceptions. Therefore, it is necessary to describe the different farming systems in Africa in detailed economic terms.

The Ugandan dairy sector has been developing rapidly over recent years and is dominated by small-scale farmers owning more than 90% of the national cattle population. Due to market forces and higher competition for production factors, milk production systems in Uganda are intensifying. It became important to understand production systems, especially those around the capital city Kampala, where consumption is highest. Three intensive and four extensive milk production systems have been identified and analysed, using TIPI-CAL (Technology Impact Policy Impact Calculations model). The results show that the production systems are very different in many respects but share similar development trends. Whereas the intensive systems use graded animals and invest heavily into feeding, buildings and machinery, extensive systems use local breeds and invest minimally. Farms closer to Kampala, the capital city of Uganda, have better market outlets are more intensive and have a higher land productivity which covers the higher land cost, compared to farms further away from the capital. The total cost of milk production falls with increasing herd size, showing scale economies in production. Dairy returns vary among the farms from 18 to 35 USD per 100 Kg of Energy Corrected Milk produced. All systems made an economic profit, except the intensive one-cow farm, which can only make profits if no better alternatives are available for the family resources employed in dairying.

An economic comparison of typical dairy farming systems in South Africa, Morocco, Uganda and Cameroon

After a detailed study on the farming systems in Uganda, need arose to compare these systems with those from other countries. This paper analyses and compares economic aspects of milk production in selected African countries. This is done in order to get a clear picture of the most typical dairy production systems in Africa. This comparison includes a complete regional coverage of Africa, with Morocco representing North Africa, South African Republic representing South Africa, Uganda representing East Africa and Cameroon representing West and Central Africa.

Population growth, urbanisation and increased *per capita* milk consumption are main reasons for the recent increase in milk demand in Africa. Due to globalisation, it is important to know how competitive various production systems are, especially as most governments promote local production and disfavour dairy imports. The TIPI-CAL (Technology Impact, Policy Impact Calculations model) has been used to analyse and compare costs and returns of predominant dairy farming systems in South Africa, Morocco, Uganda and Cameroon. Results show that, as farms grow larger in size, family resources (especially land and labour) become insufficient and there is need for their acquisition from external sources. Though extensive dairy farming systems have the lowest cost of milk production (<20 US-$ per 100 kg milk), their input productivities and milk yields are lower, leading to very low net cash returns from dairying. Large intensive farms in South Africa have relatively low costs (<30 US-$ per 100 kg milk) and a high Return on Investment (ROI) due to a higher efficiency of input utilisation.

As conclusion, intensification of dairy farming combined with an increase in the scale of production will greatly enhance the productivity of farm inputs, thus recommended for development of the dairy sector in African countries.

Application of the TIPI-CAL model in analysing policy impacts on African dairy farms

An understanding of the dairy systems in Africa gives grounds for more solid policy impact studies. This paper shows the impact of different policies and farm strategies on dairy farms in Uganda. The need for a better understanding of the role of various policies and farm strategies on dairy farms in Africa has become more important especially as policy makers and donors wish to optimise the impact of their projects on the livelihoods of farmers. This study applies an adapted version of the TIPI-CAL (Technology Impact Policy Impact) model to analyse the impact of different policies on the most typical dairy farming system in Uganda. Seven policy areas are analysed, including genetic improvement, veterinary service provision, extension service provision, marketing improvement, consumption improvement, input provision and credit provision. Policies which improve farmers' access to markets have the greatest impacts since the absence of reliable market outlets is a principal problem for rural farmers. In general, the policy impacts are very little on farms with local cows but can be magnified up to threefold if the farms have graded cows. Genetic improvement of cattle breeds is recommended as an initial strategy, which will improve the impact of other farm policies. However, these systems require very high costs and more labour, which might pose a problem to farmers. It is recommended that, a set-up with a more incentive-based environment will be required to support farmers in taking private initiatives and in the adoption of intensive agricultural technologies.

Comparing the EXTRAPOLATE and TIPI-CAL models in analysing policy impacts on Ugandan dairy farms

This paper compares policy impacts on the major dairy production system in Uganda, using the EXTRAPOLATE and TIPI-CAL models. Dairy farming systems as well as policy impacts on African farms are very complex and therefore require well adapted evaluation tools. For this reason, improvement on methodological approach is of high importance.

A comparison of results from both models show a broad variation in ranking for two policy areas (genetic improvement and veterinary services provision) while the other five policy areas are ranked similarly in both models. These differences in ranking are due to two reasons: firstly, the TIPI-CAL model only analyses the typical case, thereby excluding the best or worse cases while the EXTRAPOLATE analyses a general situation averaging all possible cases. Secondly, analysis using the TIPI-CAL model also incorporates technology adoption possibilities to some extent, while the EXTRAPOLATE model does not. In general, the EXTRAPOLATE model identifies stakeholders and influential policies and also provides a general picture of policy impacts, enabling ranking with strong emphasis on societal benefits and little on farmer adoption. The model however, does not assess policy impacts in quantitative terms for example, actual change in family income ($), actual change in herd size, etc. The TIPI-CAL model on its part does not identify stakeholders and policies, but provides a more detailed policy outcome of known policies in quantitative terms and does ranking with strong emphasis on farm benefits and farmer perceptions.

The strengths and weaknesses of both models call for a combined approach of the two analytical tools. At the first stage, stakeholders and potential policy interventions should be identified, and a general ranking of policies should be obtained using the EXTRAPOLATE model. At the second stage, an in-depth analysis of policy impacts at the farm level, based on the TIPI-CAL model, should be carried out. This analysis generates quantitative insights into the impacts of policies on the financial wellbeing of farmers.

Zusammenfassung

Die Promotionsschrift wird in Form einer kumulativen Studie vorgelegt und besteht aus sechs Aufsätzen. Jeder behandelt einen oder mehrere Aspekte des afrikanischen Milchwirtschaftssektors. Die Arbeit gibt einen Überblick über die Milchwirtschaft in Afrika, Ansätze für ihre Verbesserung durch die Implementierung unterschiedlicher politischer Maßnahmen und Bewirtschaftungsstrategien und macht Vorschläge für einen verbesserten methodischen Ansatz zur Analyse der Auswirkung politischer Entscheidungen auf das System der Milchwirtschaft in Afrika.

Milchwirtschaft in Afrika – Ihr Stand und jüngste Entwicklungen

Dieser Artikel fasst bestehende Literatur zu Produktionssystemen in der afrikanischen Milchwirtschaft, zu Trends in der Milchproduktion, der Verarbeitung, dem Konsum, sowie Im- und Exporten aus den Jahren 1990 bis 2004 zusammen. Die Meinungen früherer Autoren zu Auswirkungen politischer Entscheidungen auf den Sektor der afrikanischen Milchwirtschaft werden erklärt und die Notwendigkeit besserer Analyseinstrumente zur Bewertung solcher Auswirkungen wird herausgestellt. Das Potential für Verbesserungen wird in dieser Zusammenfassung ebenfalls beschrieben.

Das Streben nach besseren Erkenntnissen auf dem afrikanischen Milchwirtschaftssektor hat sich während der vergangenen Jahre verstärkt. Der Milchwirtschaftssektor rückte als Mittel zur Verbesserung der Ernährungssituation und der Generierung von Einkommen für arme Familien mehr in den Fokus. Dies führte dazu, dass eine große Zahl von Entwicklungshilfeprojekten zu Gunsten der Milchwirtschaft initiiert wurde. Obwohl die afrikanische Milchproduktion im Laufe der Jahre zugenommen hat, vergrößert sich wegen ebenfalls ansteigender Nachfrage der Nachfrageüberhang fortlaufend. Hierbei waren in den vergangenen Jahren unterschiedliche Trends in den Milchsektoren der einzelnen Länder zu beobachten; in manchen erhöhte sich die Produktion, in anderen nahm sie ab und in wieder anderen blieb sie gleich. Viele neue Fragen sind aufgetaucht, die den Ausgangspunkt für weitere Studien zum Thema Milchwirtschaft und ihr zugrunde liegenden Triebkräfte bilden können. Es wird empfohlen, sektorale (Wirtschafts-)Politik, Organisationsstrukturen und unterstützende Maßnahmen für die Landwirte gezielt anzuwenden, um so die Entwicklung der Milchwirtschaft zu stimulieren – insbesondere durch Stärkung des dominanten informellen Bereichs und durch Förderung sowohl kleiner spezialisierter, als auch von großen Milchviehbetrieben.

Milchproduktion der Fulben in den westlichen Highlands Kameruns: Hemmnisse und Entwicklungsperspektiven

Dieser Artikel beschreibt die spezifischen Probleme, denen sich Milchbauern in Kamerun gegenüber sehen. Die allgemeinen Faktoren, die den milchwirtschaftlichen Sektor eines typischen afrikanischen Landes daran hindern, sein im vorherigen Artikel beschriebenes Potential auszuschöpfen, wurden dort bereits diskutiert. Die Ursachen dieser Probleme und ihre Auswirkungen auf die Produktionskette von Milchprodukten als Ganzes wurden dort aufgezeigt.
Die Entwicklung der Milchwirtschaft rückt in afrikanischen Ländern stärker ins Bewusstsein und ein besseres Verständnis dieses Systems ist äußerst wichtig. Milchwirtschaft wird als Maßnahme zur Verbesserung der Ernährungssituation ins Auge gefasst und als wichtige Einkommensquelle armer, ländlicher Familien angesehen. Die eigentlich erwarteten Wirkungen vieler hierauf abzielender Entwicklungsprojekte konnten nicht erreicht werden, da ein genaues Verständnis eventuell vorliegender Beschränkungen der Entwicklung, typischer Weise im Vorfeld der Implementierung eines solchen Projektes, fehlten. Diese Studie deckt die Sichtweise von Milchbauern, Landwirten und auch die aller identifizierten beteiligten Interessengruppen der Produktionskette ab. Die Hauptbeschränkung der Milchproduktion entstand aus dem mangelnden Zugang von Bauern zu Ressourcen und zu Informationen. Auch institutionsökonomische Probleme in Gestalt von unzulänglich gesicherten Eigentumsverhältnissen an Grund und Boden wurden als ein großes Problem erkannt, das zu Konflikten zwischen Futtermittelbauern und den Besitzern von Vieh führte. Es wurde im Hinblick hierauf angemerkt, dass die Einrichtung klarer Grundbesitzrechte, die Durchsetzung von Bestrafung von Verstößen hiergegen, sowie die Befolgung ihrer Dienstpflichten seitens der zuständigen Behörden Voraussetzung für eine erfolgreiche Lösung seien. Zugang der Bauern zu einem nahen Milchmarkt wurde als ein treibender Faktor der Milchproduktion gesehen. Basierend auf diesen Punkten wurden Vorschläge gemacht,

wie die unterschiedlichen Interessengruppen auf die identifizierten Probleme reagieren könnten, um die bestehende Lage zu verbessern.

Die Milchproduktionssysteme in Zentral-Uganda: Eine ökonomische Analyse der Betriebe

Dieser Artikel beschreibt unterschiedliche Milchproduktionssysteme in der Zentralregion Ugandas. Landwirte werden basierend auf ihren Anbaumethoden verschiedenen Gruppen zugeordnet. Es wird vermutet, dass Landwirte mit denselben Anbaumethoden ähnliche Präferenzen haben. Daher ist es nötig, die unterschiedlichen Anbausysteme in Afrika ökonomisch genau zu beschreiben.

Der ugandische Milchwirtschaftssektor hat sich in den vergangenen Jahren schnell entwickelt und wird von Kleinbauern dominiert, denen zusammen mehr als 90% der Viehbestände des Landes gehören. Aufgrund der wirkenden Kräfte des Marktes und härter werdenden Wettbewerbs um Produktionsfaktoren wurde die Milchproduktion in Uganda intensiviert. Es ist wichtig, diese Produktionssysteme, insbesondere jene in der Umgebung der Hauptstadt Kampala, zu verstehen, wo der Verbrauch am höchsten ist. Drei intensive und vier extensive Milchproduktionssysteme wurden identifiziert und unter Verwendung von TIPI-CAL (Technology Impact Policy Impact Calculations model) analysiert. Die Ergebnisse zeigen, dass die Produktionssysteme in vielerlei Hinsicht unterschiedlich sind, aber ähnliche Trends hinsichtlich ihrer Entwicklung aufweisen. Während intensive Systeme hochwertige Viehrassen verwenden und stark in Fütterung, Gebäude und Maschinen investieren, verwenden extensive Systeme lokale Rassen und investieren nur minimal. Die Durchschnittskosten der Milchproduktion nahmen mit zunehmender Herdengröße ab. Die Erträge variierten zwischen den Betrieben von 18 bis 53 USD je 100 Kg energiekorrigierter Milch. Alle Systeme erwirtschafteten Gewinn, mit Ausnahme der intensiven Ein-Kuh-Haushalte, die nur dann Gewinn erzielen würden, wenn keine Opportunitätskosten für Familienarbeitskräfte anfallen.

Ein ökonomischer Vergleich typischer Milchwirtschaftssysteme in Südafrika, Marokko, Uganda und Kamerun

Nach einer detaillierten Untersuchung der Anbausysteme in Uganda wurde es notwendig, diese Systeme mit denen anderer Länder zu vergleichen. Dieser Artikel analysiert und vergleicht ökonomische Aspekte der Milchproduktion in ausgewählten afrikanischen Staaten. Dies dient dazu, ein klares Bild davon zu gewinnen, wie die typischsten Milchproduktionssysteme Afrikas aussehen. Dieser Vergleich deckt alle Himmelsrichtungen Afrikas ab; Marokko wird stellvertretend für das nördliche Afrika untersucht, die Südafrikanische Republik vertritt den südlichen Teil, Uganda den östlichen und Kamerun repräsentiert West- und Zentralafrika.

Bevölkerungswachstum, Verstädterung und zunehmender Pro-Kopf-Konsum an Milch sind die Hauptgründe für das jüngste Wachstum der Nachfrage nach Milch in Afrika. Infolge der Globalisierung ist es wichtig zu wissen, wie stark der Wettbewerb für unterschiedliche Produktionsweisen ist, insbesondere da Regierungen in der Regel lokale Produktion fördern und Milchimporten kritisch gegenüberstehen. Das TIPI-CAL (Technology Impact, Policy Impact Calculations) Modell wird genutzt, um die Kosten und Gewinne vorherrschender Milchwirtschaftssysteme in Südafrika, Marokko, Uganda und Kamerun zu analysieren und zu vergleichen. Die Ergebnisse zeigen, dass mit zunehmender Größe der Höfe familiäre Ressourcen (insbesondere Land und Arbeitskraft) nicht mehr hinreichend sind und es nötig wird, diese aus externen Quellen zu beziehen. Obwohl extensive Milchwirtschaften die geringsten Produktionskosten haben (<20 USD je 100 Kg Milch), sind ihre Faktorproduktivität und Renditen aus der Milchproduktion geringer, was zu einem sehr geringen Netto-Gewinn aus der Produktion führt. Große, intensive Betriebe in Südafrika haben aufgrund höherer Faktorproduktivität relativ geringe Kosten (<30 USD je 100 Kg Milch) und einen hohen Return on Investment (ROI). Hieraus wurde gefolgert, dass die Intensivierung der Milchwirtschaft bei gleichzeitiger Erhöhung der Produktionsmenge die Faktorproduktivität stark erhöhen wird.

Anwendung des TIPI-CAL-Modells auf die Analyse der Auswirkungen politischer Maßnahmen auf afrikanische Milchwirtschaftsbetriebe

Das Verständnis der Milchproduktionssysteme in Afrika liefert die Grundlage für eine genauere Untersuchung der Auswirkungen politischer Entscheidungen. Dieser Artikel zeigt die Effekte unterschiedlicher politischer Ansätze und Bewirtschaftungsstrategien auf Milchwirtschaften in Uganda. Die Rolle unterschiedlicher politischer Linien und Bewirtschaftungsstrategien bei afrikanischen Milchwirtschaften zu verstehen ist wichtiger geworden, insbesondere da politische Entscheidungsträger und Geldgeber den Wirkungsgrad ihrer Projekte in Hinblick auf das Auskommen der Bauern optimieren möchten. Diese Studie verwendet eine angepasste Variante des TIPI-CAL (Technology Impact Policy Impact model), um die Wirkung verschiedener politischer Ansätze auf das typischste Anbausystem in Uganda zu analysieren. Sieben Politikbereiche werden analysiert, gentechnische Verbesserung, die Bereitstellung veterinärer Dienstleistungen, Ausdehnung von Service-Bereitstellung, Verbesserung des Marketings, Förderung von Konsum, sowie die Bereitstellung von Produktionsfaktoren und Krediten. Maßnahmen, die den Zugang der Bauern zu Märkten verbesserten, hatten die größten Auswirkungen. Typischerweise war die Wirkung dieser Maßnahmen auf Farmen mit örtlichen Viehrassen sehr gering, aber bis zu drei Mal stärker in Betrieben, die hochwertigere Rassen verwendeten. Genetische Verbesserung der Viehrassen wurde als Ausgangsstrategie empfohlen; sie wird die Wirkung anderer Maßnahmen erhöhen. Solche Wirtschaftsweisen verursachen jedoch sehr hohe Kosten und verlangen mehr Arbeit, was ein Problem für die Bauern sein kann. Ein stärker auf Anreizen basierendes Umfeld ist nötig um Landwirte zu unterstützen, private Initiative zu ergreifen und Techniken intensiver Landwirtschaft zu übernehmen.

Vergleich der Analyse von Auswirkungen politischer Maßnahmen auf ugandische Milchbetriebe im EXTRAPOLATE- und im TIPI-CAL-Modell.

Dieser Aufsatz vergleicht mittels des EXTRAPOLATE- und des TIPI-CAL-Modells die Wirkung politischer Ansätze auf das wichtigste Milchproduktionssystem in Uganda. Sowohl die Milchwirtschaftssysteme als auch die Auswirkung politischer Maßnahmen auf afrikanische Milchviehbetriebe sind sehr komplex und verlangen daher gut angepasste Evaluationsmethoden. Aus diesem Grund ist es wichtig, die methodische Herangehensweise zu optimieren. Ein Vergleich der EXTRAPOLATE- und der TIPI-CAL-Methode zeigt, dass beide Ansätze gut geeignet zur Analyse sind, wobei jedoch jede ihre Stärken und Schwächen hat. Die beobachteten Unterschiede ergaben sich hauptsächlich aus den mit der Nutzung des Modells zusammenhängenden Konzepten und nicht aus den technischen Aspekten der Modelle. Im Allgemeinen identifiziert das EXTRAPOLATE-Modell Interessengruppen und einflussreiche politische Ansätze. Es bietet auch ein allgemeines Bild der Auswirkungen von Politikmaßnahmen und ermöglicht so eine

Einordnung der Maßnahmen unter besonderer Berücksichtigung allgemein-gesellschaftlicher Vorteile. Das Modell gibt diese Auswirkungen jedoch nicht in quantitativen Größen wieder, wie z. B. die Änderung des familiären Einkommens (in USD), die Änderung der Herdengrößen, usw. Das TIPI-CAL-Modell seinerseits identifiziert weder Interessengruppen noch politische Ansätze, liefert aber ein detaillierteres Bild der wirtschaftlichen Auswirkungen von Politikmaßnahmen in den Betrieben. Ein Vorschlag für eine ideale künftige Analysemethode wäre, zunächst mittels EXTRAPOLATE die Interessengruppen und möglichen Ansätze zu identifizieren, um ein allgemeines Ranking dieser Ansätze zu bekommen, und danach mittels des TIPI-CAL-Modells eine tiefere Analyse durchzuführen, um die einzelbetrieblichen Effekte politischer Maßnahmen quantifizieren zu können.

Annexes

Annex 1: Dairy production systems in South Africa

Annex 2: Cattle breeds in Morocco

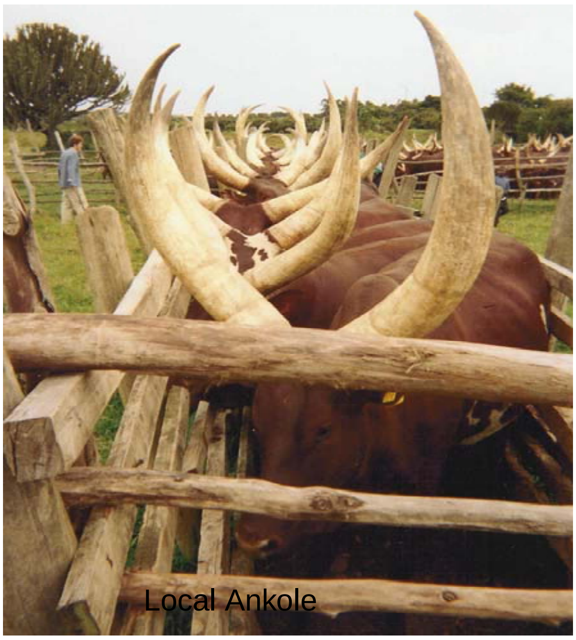

Native


Crosses


Montbéliarde


Holstein - Friesan

Annex 3: Cattle breeds in Uganda



Annex 4: Dairy cattle breeds in Cameroon