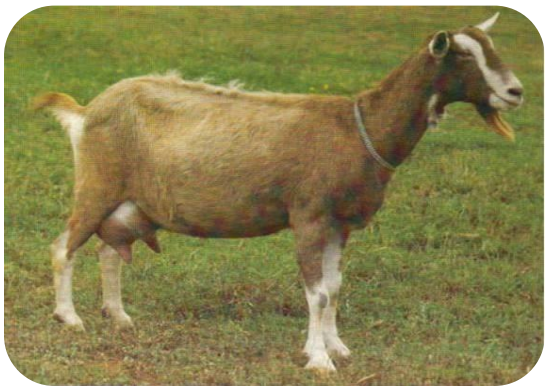
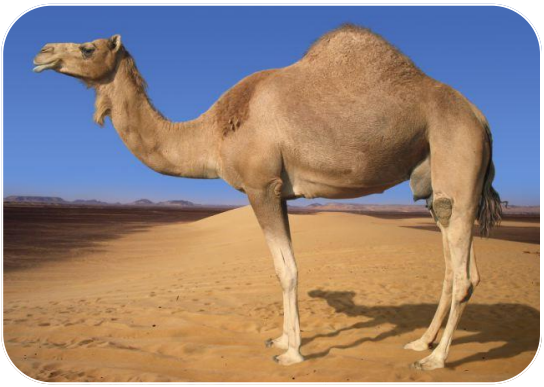
Republic of Kenya

Kenya National Dairy Master Plan

Volume I: A Situational Analysis of the Dairy Sub-sector





Hon. Mohamed Abdi Kuti, EGH, MP

FOREWORD

The National Dairy Master Plan (DMP) was first developed in 1991/1992, outlining the strategies for increasing efficiency and in productivity in the dairy sub-sector. However the document was not implemented due to the liberation of the dairy industry in May 1992 immediately after the launch of the DMP. We have therefore been operating for nearly two decades without an accepted dairy master plan while the economic environment has changed substantially over that period. There is therefore the urgent need to develop a dairy master taking into account the objectives and strategies in the current national economic blue print, the Vision 2030.

The government, with the support from Land O'Lakes commissioned VEDAMAN Consultants to develop the National Dairy Master Plan with a focus on realizing the vision 2030. The overarching development goal is to make Kenya a globally competitive prosperous nation with a high quality life by the year 2030 through, strategies aimed at enhancing food security and sustainable economic development. To realize this vision, the revitalization of the agricultural sector remains a prerequisite condition for achieving food security, economic recovery, economic growth, employment and wealth creation. Within the agriculture sector, the dairy sub-sector is the single largest and fast growing sector. The Government of Kenya, through the Ministry of Livestock has developed the DMP which shows the situational analysis of the dairy subsector to integrate and align to this new development vision and economic opportunities.

This is against the backdrop that the dairy subsector has potential to improve the livelihoods of the majority smallholder family farmers and pastoral communities and transformation from subsistence farming to competitive, commercial and sustainable dairy industry for economic growth and wealth creation. The document contains (the past/present developments issues of the dairy sub-sectors, challenges, existing opportunities, vision, mission, strategic thrust, plan of action and intervention measures) that , the government will undertake to propel the dairy sub-sector developments in line with other new development visions. The (DMP) was compiled through the process of detailed literature reviews, consultation forums with all stakeholders in the dairy value chain. The (DMP) is consistent with the new vision and mission of the Kenyan government development goals as stipulated in: Kenya National strategic goals - Vision 2030, Millennium Development Goals (MDGs), Ministry of Livestock National Strategic Plan 2008-2012, Agricultural Sector Development Strategy 2010-2020 and contents of this Dairy Master Plan.

Dear Kenyans and all stakeholders involved in the dairy value chain links, it should be recognized and appreciated that: Kenya has one of the most developed dairy sub-sector in Sub-Sahara and

the single largest contributor to agricultural GDP of Kenya. The contribution of dairy sub-sector is about (Kshs 100 billion worth) higher than Tea (Ksh 46.8), and Horticulture (Ksh 65.2). Dairying is a life line for the majority smallholder family farmers and entire pastoral communities of Kenya (3 million households) as sources of: (food, employment, cash income, manure to support crop production, and financing cash needs for social status). In this regard, the DMP is a document showing how the government wants to reverse the poverty, hunger and unemployment problems through transformation and revitalization of the subsector

The (DMP) contains the framework of how the huge potential of economic value of the dairy subsector can be tapped to drive development goals through transformation into a globally competitive dairy value chain that will provide high quality life and wealth creation. The document has developed strategies which will make the enterprise to increase market orientation, value addition, use of modern farming technologies and creating synergies at all levels.

Finally, I wish to confirm that my ministry has been in the fore front in instituting policy, legal and regulatory frame work for the effective implementation of DMP. It's envisaged that the DMP will be used to revitalize the dairy sub-sector and guarantee the sustainability of dairying as a major socio and economic activity in Kenya, thereby improving the livelihood of the poor resource based communities and enhancing Kenyan leadership position in dairy industrialization in the regional and global market.

Hon Mohamed Abdi Kuti, EGH, MP
Minister for Livestock Development

Printed August 2010

ISBN:

For further information contact:
The Permanent Secretary
Ministry of Livestock Development
P.O. Box 34188-00100
Nairobi
+254-20-2718870
Email: info@livestock.go.ke
Website: http://www.livestock.go.ke

PREFACE

Kenneth M. Lusaka, EBS

The Ministry of Livestock Development has a strategic plan which has been harmonized with the Medium Term Plans (MTP) for implementation in line with vision 2030. The Strategic Plan envisages collaboration with the various stakeholders in private and public sectors. The plan with clear vision, mission and objectives also identified (external and external) constraints limiting the implementation and use of the document in seeking funds to carry out activities of the ministry. The Dairy Master Plan was first developed in 1991/1992 though it was never implemented following the changing economic environment particularly the liberalization of milk marketing in May 1992. At that time there was only one main processor, the KCC.

Given the dairy sector's contribution to the national economy, the government with the support from Land O'Lakes, commissioned VADAMAN CONSLTANTS to develop a national dairy master plan in line with the current national economic blue print, the vision 2030. Currently, the dairy sub-sector experiencing one of the highest growth rates, estimated at 3 to 4 % annually and contributing 40% of the agricultural GDP and 4% of the national GDP. The development of the DMP is timely and necessary as it will help in realigning the development of the dairy sub-sector and enhance regional integration while helping in achieving the Millennium Development Goals (MDGs). .

The sub sector has massive economic potential to be tapped and targeted to achieve positive attributes is been faced by technical, social, economic, institutional and unfavourable environmental conditions. These are some of the challenges identified in the DMP and strategies developed to alleviate them. The DMP was developed in participatory approach with inputs from stakeholders in dairy value chain links and our staff. The document describes the status, constraints, potential opportunities, strategies and action plan to transform and revitalize the dairy sub sector. The ministry of Livestock development staffs are in the forefront in the documentation process and implementation framework.

Finally I wish to take this opportunity to thank everyone who was involved in the production of this Dairy Master Plan. In particular the efforts of the dairy task force members is highly recognized and appreciated. Indeed it will have not been possible to produce and launch the DMP without their efforts. The Role played by Marry Munene for her tireless effort and funding of the dairy Master Plan documentation through LANDO LAKES, Inc our international development partner is really recognized by the Ministry. It is my positive expectation that the DMP will be used as a road map to transform the dairy sub sector. I call upon all our ministry staff and other stakeholders to

work together in achieving the set objectives of the dairy sub sector contained in Our Strategic Plan and this DMP.

Kenneth .M. Lusaka, EBS

Permanent Secretary, Ministry of Livestock Development

ACKNOWLEGDEMNT

The production of this dairy master plan was made possible by the support and contribution of USAID through LAND O'LAKES international nongovernmental organisation many stakeholders. Special recognition and thanks goes to the Minister for Livestock Development Hon, Dr, Mohamed Abdi Kuti, MP, and Assistant Minister for Livestock Development, Hon. Adan Bare Duale, for their leadership and commitment in advocating for the livestock sector development initiatives.

Many thanks are due to the Permanent Secretary Ministry of Livestock Development, the Director of Livestock Production, Mr. Julius Kiptarus, the Director of Veterinary Services, Dr. Peter Ithondeka, Mr. Machira Gichohi Managing Director, Kenya Dairy Board and his staff, for their active contribution in the entire process, active participation at various presentation stages and during the launch of the Dairy Master Plan at Kenya Agricultural Research Institute.

The Ministry wishes to acknowledge the efforts and valuable comments made by the Dairy Task Force members. Indeed, they have made compiling the document a success. We cannot possibly mention all of them; we will however mention a few. Mr. Samuel O Matoke, chief of Dairy and Beef Production branch in the Ministry of Livestock and his technical staff, for the helpful review, comments and suggestions which led to further improvements throughout the document. Their technical contribution and complete review of the final version of the document is highly lauded and appreciated.

Finally the Ministry is indebted to VEDAMAN CONSULTANTS LTD for steering the whole process of documentation, presentation at every stage of the write up and taking time to incorporate the views and comments of all the stakeholders'.

EXECUTIVE SUMMARY

A master plan is a strategic policy document that indicates the general framework for planning the development of a sector, sub-sector or a region. A master plan provides the necessary framework to guide the progressive development of future investments. It also gives some level of certainty and predictability for possible interventions and investments in the short, medium and long-term scenarios. A master plan gives direction for positive changes, indicates how much and what kind of interventions are possible in terms of policy, programmes or projects.

A national dairy master-plan is therefore an action plan guide to dairy stakeholders who include dairy farmers, milk processors, input and service providers, retailers, planners and policy makers. The plan, which takes the value chain approach in examining the dairy sector, focuses on opportunities, constraints, future possibilities and also risks and external factors that impact on the sector.

In 1991 Kenya developed a 20 year National Dairy Masterplan (DMP) which outlined strategies for improving efficiency and productivity in the dairy sub-sector. The implementation of the masterplan was however overtaken by rapid events that led to the liberalization of milk marketing in 1992. Besides, the implementation timeframe of that master plan is soon expiring in 2011, at a time when the country is focusing on realising the vision 2030 overarching development goal of having Kenya become a globally competitive and prosperous nation with a high quality of life by 2030.

The dairy subsector is important in attaining the development goal of vision 2030. It is dominated by smallholders who produce over 80% of the domestic milk and sale raw milk directly to consumers. Milk marketing system is characterised by low compliance with safety and quality standards, diffuse market structure consisting of many small-scale market agents, low value products limited in diversity and weak participation of producer in policy formulation. Dairy subsector supports a large population of rural poor households. It is the single largest component within the agricultural sector, which in 2007 was larger in value (KShs. 100 billion) than horticulture (K.Shs. 65.2 billion) or tea (K.Shs. 46.8 billion) and has had high growth rate estimated at 3 to 4 % annually.

The government attaches importance to the dairy subsector and has developed a policy aimed at: improving the productivity and competitiveness of dairy products, increasing domestic consumption of milk and milk products, transforming the dairy industry into a net exporter to the regional and global markets and re-orienting milk processing towards long life dairy products. The growing need to realise these policy goals necessitates transformation of the subsector into a

globally competitive dairy value chain, which is possible through increased market-orientation, increased value addition and greater use of modern farming practices and be able to attract private investments that will provide gainful employment to Kenyan citizens and a pathway to wealth creation.

Responding to this growing need for transformation of the dairy subsector, a new master plan is developed to guide the desired transformation process for the next 20 years. The development of this master plan is a two stage process. Firstly, a situational analysis of the dairy subsector covering the period between 1991 and 2010, representing the period when the firsts and second dairy master plan development were undertaken because of there have been dramatic changes over the period, mostly due to liberalization of milk marketing effected in 1992. Situational analysis involved consultative engagement with broad representative stakeholders in the dairy industry including value chain operators, enablers and supporters through farm and field visits, regional workshops and dialogue sessions.

The 2009 Kenya population is 38.6 million people and is estimated to hit 58 million in the next 20 years. The current per capita milk consumption is estimated at 110 litres, which is projected to increase to 220 litres by 2030 due to envisaged better incomes and better marketing. This will translate into an increase from the current annual production of 4.5 billion litres to 12.76 billion litres of milk. This amount of milk representing the demand by 2030 cannot be achieved at the current national average productivity levels of 5 litres of milk per cow per day as the number of animals required would be too many. The path to meeting this increased demand in milk consumption is greater increases in animal productivity levels accompanied with some increases in the population of dairy cattle, dairy goats and camels.

Improved feed availability and quality will be a key strategy to realise the largest proportion of the needed animal productivity levels and supporting animal population increases. Feeding is the major constraint to achieving the targeted milk production because of heavy dependency on rain-fed forage and pasture production while there is poor adoption of conservation of animal feeds to smoothen seasonal fluctuations in milk production. Efficient utilisation of dairy concentrates is needed to match the high cost of quality concentrates and weak enforcement of standards that has failed to discourage infiltration of substandard commercial feeds into the market. The actions proposed to enhance better feeding for increased animal productivity include: Increase acreage under pasture and fodder, increase availability of seeds of improved forage varieties, promote adoption of feed conservation technologies, enforce standards of both raw materials and finished concentrates and train more farmers to make home ration formulation and on mixing of feeds. These feeding strategies when adopted will enhance reproductive performance in the national

herd.

Currently, the number of registered cows is very small for effective national genetic improvement programmes. The action proposed is: embark on aggressive engagement of farmers in promotion of herd recording with the Kenya Livestock Breeders Organization, encourage active farmer participation in national livestock improvement programmes to facilitate selection and use of quality bulls.

The disease prevention and control and delivery of veterinary services is currently weak. The action proposed include: harmonization of regulations of movement of animals and animal products within and across national borders and strict enforcement of the same. Rehabilitate, improve and equip current laboratory facilities and set up satellite laboratories in the dairy productive areas, streamline policies to discourage emergence of monopolistic and oligopoly tendencies and to make veterinary services and inputs affordable to farmers.

Milk marketing of is currently characterised by inadequate milk collection facilities, inappropriate distribution and location of cooling facilities, high transport costs and poor road network in milk producing areas, limited access and high cost of electricity, inadequate clean water and lack of waste disposal system. The actions proposed to address these include: mobilize milk producers to form groups/co-operative societies (hubs) to collect and transport milk to processors in a cost effective manner. Build capacity of players in milk value addition chain to reduce post-harvest losses, improve infrastructure, and promote quality based payment system for milk and quality audit along the milk value chain.

Currently diversity in milk products is limited, their domestic consumption low and volumes exported too low yet market potential is huge. The countries in the eastern Africa region are importers of milk and form a ready market The actions proposed to increase domestic consumption and expand export market share by 2030 include: Engage in promotional campaigns to increase domestic consumption, facilitate branding through promotional campaigns creating awareness of the nutritional health properties of milk, enable diversification of dairy products which are affordable. These actions will be implemented by the dairy associations, the Kenya Dairy Board and milk processors. Research institutions and milk processors have a role in diversification of dairy products. Increased exports will be through taking advantage of new trading blocks in the eastern, central and southern Africa regions and regional common market integration solidifies.

The country frequently experiences surplus milk during the rainy season due to feed seasonality. The action to overcome milk glut is expansion of processing facilities to produce long life products, implementation of strategic milk reserves policy by the government.

The human resource pool required to move this plan will require revamping the existing institutions to be able to offer relevant trainings with reviewed curricula responsive to the new challenges. Public and private partnerships attracting investment in relevant research (feeds, milk quality and development of new dairy products) will be required. Priority research areas will have to be identified and the research findings disseminated to the relevant users with improved approaches reaching value chain operators more efficiently.

A key driver to the plan actions will be accessibility of credit facilities to investors. Currently, though credit is available from many sources in the market, primary producers experience difficulties accessing the credits because of stringent conditional requirements including high interest rates. Actions on targeting credit to dairy investors will be needed.

To benefit from information technological advancement, e-dairy uptake is strongly recommended. Information will be required by the primary producers on issues that affect them (farm gate milk prices, prices of inputs) and by all players in the milk chain. The action includes formulation of new policies to strengthen new initiatives in the master plan. Regulatory bodies with a role in dairy will need restructuring to be able to enforce the new envisioned policies.

The action plan proposes ways to mainstream cross cutting issues in the dairy value chain which include gender and youth roles along the value chain, the HIV/AIDS pandemic, provision of adequate and clean water for the dairy service and drinking requirement. The depletion of vegetation cover affects water quality and its availability while at the same time exacerbating soil erosion and land degradation.

Lastly, increased milk production must be produced in a sustainable environment. With reality of climate change and the now acknowledged role of livestock on greenhouse effect, the action plans recommends initiative for interventions mitigating and enabling adaptation to climate change in all the dairy production systems. Disposal of waste from the animals and along the value chain must take into consideration environmental concerns.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AFC	Agricultural Finance Cooperation
AIAKEFEMA	Association of Kenya Feed Manufacturers
ASAL	Arid and Semi-Arid Lands
ASDS	Agricultural Sector Development Strategy
BDS	Business Development Services
CAADP	Comprehensive Africa Agriculture Programme
CAIS	Central Artificiel Insemination Station
CBO	Community Based Organisation
CDF	Constituency Development Fund
COMESA	Common Market for Eastern and Southern Africa
DFBA	Dairy Farmers Business Association
DFID	Department for International Development
DMP	Dairy Master Plan
EAC	East African Community
EADD	East Africa Dairy Development Programme
ECF	East Coast Fever
ERS	Economic Recovery Strategy
ESF	Economic Stimulus Fund
FAO	Food and Agricultural Organisation
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
GMP	Good Manufacturing Practice
ICT	Information and Communication Technology
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
KACA	Kenya Agricultural Commodity Exchange
KAPP	Kenya Agricultural Productivity Project
KARI	Kenya Agricultural Research Institute
KCB	Kenya Commercial Bank
KCC	Kenya Cooperative Creameries
KDB	Kenya Dairy Board
KDMP	Kenya Dairy Master Plan
KEBS	Kenya Bureau of Statistics
KLBO	Kenya livestock Breeders Organisation
K-LIFT	Kenya Livestock Finance Trust

KNBS	Kenya National Bureau of Statistics
KRDP	Kenya Rural Development Project
KSDCP	Kenya Smallholders Dairy Community Programme
LATIF	Local Authority Transfer Funds
LRC	Livestock Recording Centre
LSD	Lumpy Skin Disease
MDG	Millennium Development Goal
MOA	Ministry of Agriculture
MOCDM	Ministry of Cooperative Development and Marketing
MOLD	Ministry of Livestock Development
MOU	Memorandum of Understanding
NALEP	National Agriculture and Livestock Extension
NGOs	Nongovernmental Organisations
SDCP	Smallholders Dairy Commercial Programme
SDP	Smallholders Dairy Project
SRA	Strategy for the Revitalisation of Agriculture
SWOT	Strengths, Weaknesses Opportunities and Threats
TAD	Trans boundary Animal Diseases
UHT	Ultra Heat Treated

LIST OF TABLES

LIST OF FIGURES

1: INTRODUCTION

1.1. Dairy Master Plan

A master plan is a strategic policy document that indicates the general framework for planning the development of a sector, sub-sector or a region. A master plan provides the necessary framework to guide the progressive development of future investments. It also gives some level of certainty and predictability for possible interventions and investments in the short, medium and long-term scenarios. A master plan gives direction for positive changes, indicates how much and what kind of interventions are possible in terms of policy, programmes or projects.

A national dairy master-plan is therefore an action plan guide to dairy stakeholders who include dairy farmers, milk processors, input and service providers, retailers, planners and policy makers. The plan, which takes the value chain approach in examining the dairy sector, focuses on opportunities, constraints, future possibilities and also risks and external factors that impact on the sector.

1.2. Rationale for Dairy Master Plan

Kenya in 1991 developed a 20 year National Dairy Master Plan (DMP 1991) outlining strategies for improving efficiency and productivity in the dairy sub-sector. The implementation timeframe expires in 2011 at the times when the country is focusing her development priorities and goals towards realisation of the Vision 2030, the eight Millennium Development Goals (MDGs) and entering the regional common market. The government is therefore conducting a situational analysis of the dairy subsector to align its development to these new development goals and economic opportunities.

The overarching development goal of vision 2030 is to have Kenya become a globally competitive and prosperous nation with a high quality of life by 2030 through sustained annual average GDP growth rate of 10% to create wealth and employment and reduce poverty. Vision 2030 sets to achieve an agricultural sector growth of 7% in the first 5 years. Strengthening the agricultural sector growth remains a prerequisite condition in Kenya for achieving economic recovery and growth. Within the agricultural sector, dairy sub sector is (Kenya Vision 2030, ASDS, 2010) the single largest component (K.Shs. 100 billion worth), larger in value than horticulture (K.Shs. 65.2 billion in 2007) or tea (K.Shs. 46.8 billion in 2007).

The huge economic value of the dairy sub-sector can be tapped to contribute to the national development goals through a transformation into a globally competitive dairy value chain that provide a pathway to wealth creation and high quality life with high standards of public and

environmental health. This can be realised if dairy enterprises increase in market-orientation, increase value addition, use modern farming practices. The dairy enterprises have to become profitable economic engagements that attract private investment to provide gainful employment to citizens.

1.3. Objectives of the Dairy Master Plan

The master plan proposes action plans necessary for the transformations, policy changes and development strategies needed to further steer dairy development in line with the other national development aspirations. The action plans are proposed while remaining aware of, and responsive to the emerging challenges. The specific objectives of the analysis are:

i. To formulate relevant strategies and programs for the development of the dairy industry and design a mechanism for their implementation, monitoring and evaluation by all stakeholders while leaving room for the introduction and adoption of new technologies.
ii. Provide the government with sound justification for a more efficient allocation of the development and recurrent budget to the sector based on analysis and projections.
iii. Provide a roadmap for public private partnerships and promote such partnerships in order to private sector investment in the dairy sector nationally.
iv. Produce simple and clear pragmatic framework and identify tools for implementing interventions for impacts in all components of the dairy value chain.
v. Address cross-cutting and cross–sectoral thematic issues of importance in dairy value chain development.

1.4. Development Processes of the Dairy Master Plan

The development of dairy master plan went through four processes. Firstly, desktop study, reviewing the literature and sourcing relevant data from diverse sources, mainly the Ministry of Livestock Development and Kenya Dairy Board. Secondly, ground-true-thing field survey in major dairy producing areas. Thirdly, synthesis of information obtained from the literature and ground-true-thing field surveys and scenario analyses of transformation options. Fourthly, consultation with stakeholders in the dairy value chain about the synthesised information and scenario analyses for transformation options. Stakeholders' consultation were organised at regional levels in Eldoret, Nakuru, Nyeri and Mombasa and national level in Nairobi. Two national forums were organized to chart the transformation pathway.

Finally the consulting team prepared the dairy master plan strategic actions and implementation framework to steer dairy sub sector development to 2030. The strategic action plan is informed by the industry situation at national and regional levels and stakeholders' concerns. The report of

dairy sub sector situational analysis and stakeholder consultation forums forms first volume of this dairy master plan. A situational analysis is undertaken for the period between 1991 and 2010, representing the period for the development of the first and second master plan. The situational analysis identifies strategies needed to enable the dairy sub sector contribute to meeting the country's development goals aspired in the Vision 2030. Situational analysis examines the national development goals, the actors in the dairy value chain, and then projects demand and supply to 2030 based on production and consumption trends. The identified areas of action are packaged in action plan and implementation strategy, presented in second volume of the dairy master plan.

2: NATIONAL DEVELOPMENT GOALS

2.1. National Development Targets

Kenya is aligning her development programmes to vision 2030 development blueprint. The 2030 vision captures aspirations of the Millennium Development Goals (MDGs), regional common market integration and continent-wide commitments to agricultural development in the Comprehensive Africa Agricultural Development Programme (CAADP). The vision is anchored on three pillars: economic, social and political that prioritises sectors with growth drivers to the overarching vision of transforming Kenya into a globally competitive and prosperous nation with a high quality of life. The vision aspires to sustain annual average GDP growth rate of 10% in the economic sector to create wealth and employment and reduce poverty.

This target GDP growth rate in Vision 2030 is about two times higher than the target (5.5%) set at the time of developing the DMP 1991 (KDMP, 1991). Attainment of the goal is premised on past successful realization of economic growth from a GDP of 0.6% in 2002 to 7.0% in 2007, through the implementation of the Economic Recovery Strategy for Wealth and Employment Creation (ERS) (Kenya Vision 2030). Successes of the ERS implementation made some contribution to the attainment of the MDGs. Economic Survey (2008) shows that between 2003 and 2007 the country achieved a per capita income growth from 360 to 660 US$, poverty level reduction from 56.8 to 46.0%, primary school enrolment from 6.1 to 8.2% and a reduction in HIV/AIDS prevalence from 13 to 5.1%. These developmental changes came primarily through rapid utilization of existing capacity rather than efficiency gains or much new investments. There is therefore optimism about achieving the 10% growth with more efficient use of country's resources.

It is estimated that 46% of Kenya's population are living below poverty line. Of these 70% are in the rural areas where the people engaged in subsistence farming account for over 50% of those living below the poverty line. The incidence and prevalence of poverty and hunger is most severe in arid and semi-arid lands (ASALs), rural areas and urban slums and among women. To reduce hunger, government spends an estimated US$ 40 to 65 million annually on famine reliefs in the ASALs and the figure is much higher, as the US$45-65 million does not take into account famine relief support from NGOs. People vulnerable to poverty and hunger are those who are heavily dependent on rain-fed subsistence farming. It is estimated that 50.6% of the Kenyans have no access to adequate food and, even when they do, the little food accessed is often of poor, intermittent and of low nutritional value. The government intends/plans to reverse the poverty, hunger and unemployment situations in the country by transforming the subsistence and pastoral farming into commercial production.

A key sector in the economic pillar of Vision 2030 is agriculture, which is envisaged to grow at 7% in the first 5 years from 2008 to support the set average GDP growth rate target of 10% to 2030. Because of its importance in the economic growth, agriculture is one of the six key sectors within the economic pillar. The other five key sectors are tourism and trade, where, a better and more inclusive wholesale and retail trade sector is envisaged; In addition, manufacturing for the regional market, business process off shoring (BPO) and financial services are also targeted for improvement. Emphasis on agriculture is placed on shifting from the dominant informal economy which presently employs 75% of the country's workers. Formal economy is favoured to stimulate economic growth, expand employment opportunities and reduce poverty and hunger from the resultant increases in jobs, incomes and public revenues.

2.2. Agricultural Sector Development Goals

Agriculture is the backbone of Kenya's economy and therefore growth in this sector stimulates the growth in the rest of the sectors. Currently Agriculture directly contributes to 24% of the national GDP and another 27% indirectly through linkages with the processing industry. The sector accounts for 65% of Kenya's total exports and supports about 80% of the rural population livelihoods.

The impressive growth of about 6% per annum in the agricultural sector achieved during the first two decades after independence that supported a progressive country's annual economic growth of 6% has, however not been sustained. Between 1880 and 1990, the growth was 3.5%, dropping to a low of 1.3% between 1990 and 2000 (SRA, 2004). However in 2006 the annual economic growth rose to 4.4%, but again dropped to 2.3% in 2007 (Economic Survey, 2008). The implementation of *Economic Recovery Strategy and Strategy for Revitalisation of Agriculture (*SRA) is reputed for reversing growth in the agriculture sector from negative 3% in 2002 to positive 5.4% in 2006, which contributed to economy growing from negative 0.2% in 2002 to about 6.3% in 2007.

The present agricultural development goals and strategies have shifted from those of attaining self sufficiency in food for feeding a rapidly growing population that was pursued in 1990s to wealth and employment creation. Agricultural development programmes now aim at agricultural transformation into a modern, innovative, and commercially oriented and globally competitiveness sector. Implementation of vision 2030 targets generating an additional Ksh.80 to 90 billion increases in GDP from increases in productivity, value addition and greater specialization in the presently smallholder dominated mixed crop-livestock systems. In addition, the vision aspires for more exports of dairy products and has identified creation of disease free zones and expansion in

utilised land that is currently idle and unopened as key strategic actions for satisfying phytosanitory requirements in the international market

Kenya's high and medium agricultural potential is only 16% of the land mass with 84% being ASALS currently used for ranching, agro-pastoralism and game parks. Expansion in utilised idle and unopened land for dairying require irrigation, legislation of policy reforms on land use, support to agri-food value chain development and enhanced exploitation of knowledge in science, technology and innovation (STI). Realization of the set development goals will require provision of competitive quality education, training and research for development.

Although agriculture remains a mainstay of Kenya's economy, its direct contribution to national GDP is declining: from 30.3% in 1980 to 28.9% in 1988, to 26% in 2000 and to 24% currently (2008-2010). To reverse this trend, the Agricultural Sector Development Strategy (ASDS, 2010) is designed to enhance contribution of the agricultural sector to support the 10 % annual economic growth rate envisaged in the Vision 2030. The strategy outlines the agricultural related policies and institutional reforms that the government continues to implement in both the short and long term and guiding the public and private efforts in addressing emerging development challenges in the agriculture sector.

The goals of ASDS (2010) align with the vision 2030 and the Comprehensive Africa Agriculture Development Programme (CAADP) which Kenya has made a commitment. CAADP goal is a sustained agricultural growth rate of 6% per annum and increased public investment in agriculture to at least 10% of the national budget. It is purposefully geared towards enabling African countries reach "a higher path of economic growth through agriculture-led development, which eliminates hunger, reduces poverty and food insecurity, and enables expansion of exports". This is a framework for attaining the MDG one of halving the proportion of people living in hunger and poverty by 2015 and MDG six of attaining environmental sustainability.

2.3. The Development Goals of the Dairy Sub sector

At the time of developing DMP 1991, the goal for dairy development was attaining self sufficiency in dairy products to feed a rapidly growing population, but without substantial expansion in utilised land acreage. The policy favoured dairy intensification through feeding to avoid milk production competing with the high value and high labour intensive crops for the scarce farming lands and to minimise land degradation through overgrazing (KDMP, 1991). In contrast, Vision 2030 has focused on wealth and employment creation and encourages expansion in land acreage, both currently idle and unopened through greater application of irrigation and land use policy reforms (Kenya Vision 2030).

Informing the goals set for dairy sub-sector in the vision 2030 is the recognition that dairy production has critical developmental roles in Kenyan economy. Dairy is one of the agricultural sub-sectors experiencing high growth, estimated at 3 to 4 % annually (National Livestock Policy, 2008). Dairy contribution to national GDP is estimated at 3.8%, which part of the 10 to 12% from livestock and 40% from agriculture. It is the single largest component within the agricultural sector, which in 2007 was larger in value (K.Shs. 100 billion) than horticulture (KShs. 65.2 billion) or tea (K.Shs. 46.8 billion). Milk based enterprises are attractive in Kenya, supporting over 1.8 million smallholder households engaged in dairy production.

Engagement of smallholders in dairy production provides a pathway out of poverty through enhanced household security in nutrition, food, incomes, employment and both human and environmental health. Dairy production offers regular incomes and asset accumulation to family, thereby contributing to MDG one of poverty reduction. It creates a job in both on- and off- farm from every 10 to 20 litres per day of milk collected, processed and marketed (ILRI, 2007). In addition, dairy represents one of the fastest returns to investment through regular income, job creation and spreading of income risks. It enhances household nutrition and food security, particularly for rural women, shielding them from rising food prices, which for milk are already high and projected to remain 50% above historical average over the next decade (ILRI, 2007). It has environmental advantages of enabling use of lower energy costs, use of manure to produce biogas for cooking and lighting and also to fertilise fish ponds while slurry recovered from ponds is dried to fertilise soil for improved crop productivity. Therefore high performance of dairy enterprises will contribute to realisation of Kenya's Vision 2030 and the MDGs but has to transform towards market-orientation, value addition and modern farming to be more profitable economic activities attractive to private investments.

The policy objectives of the dairy subsector in transformation into a competitive and sustainable dairy industry for economic growth in the 21st century and beyond include:

i. To improve the productivity and competitiveness of Kenya's dairy and dairy products;
ii. To positively contribute to the livelihoods of milk producing households;
iii. To increase domestic consumption of milk and milk products;
iv. To contribute to national food and nutrition security
v. To transform the dairy industry into a net exporter of dairy animals and their products;
vi. To maximize dairy exports in the regional and global markets
vii. To re-orient milk processing toward long life dairy products.
viii. To decentralise dairy services to be closer to the clients.

Targets for transforming Kenyan dairy sub-sector into a globally competitive dairy value chain envisaged in vision 2030 can be benchmarked against growths achieved in China, India and Australia. These countries have in common with Kenyan dairy industry, a low cost, rain fed pasture production system. China and India have in common with Kenya rapidly rising per capita milk consumption. Australia has in common with Kenya a prominent dairy industry in the country's economy.

Table 1 illustrates the projected likely level of growths to occur in total and per capita milk consumption in China and India under "Livestock Revolution'' phenomenon while Table 2 illustrates the realised growth changes in Kenyan and Australian dairy industries between 1990 and 2009.

Table 1: The projected growth in total and per capita milk consumption in the developing countries by Delgado et al (2001)

Year	Developing countries	Sub-Saharan Africa	China	India
	----------Milk consumption (million tonnes/year)----------			
1997	194	17	10	60
2020	372	35	23	132
Change (%)	92	105.9	130	120
Growth rate (%/year)	2.7	3.3	3.5	3.2
	----------Per capita milk consumption (litres/year)----------			
1997	43	30	8	62
2020	61	37	16	104
Change (%)	41.9	23.3	100	67.7
Growth rate (%/year)	1.8	1.0	4.3	3.0

Table 2: Growth changes realised in the in the Kenyan and Australian dairy industry over 20 years

Country	Year	Dairy farms (000)	Dairy pop (000)	Milk prod (000 Litres)	Per capita milk (000 Litres)	Productivity (litres/cow/year)
Australia	1990	15,396	1.654	6,262	244	2,850
	2009	7,924	1.600	9,388	301	5,750
	% change	-48.5	-3.3	49.9	23.4	101.7
Kenya	1990	0.5	2,369	2,450	64	1440
	2009	1.8	3,403	4,200	110	1800
	% change	260	43.6	71.4	71.9	25.0

For period between 1997 and 2020 (Table 1), the highest growth in milk consumption is to occur in China, by a factor of 2.4 in total milk consumption and by a factor of 2 in per capita milk consumption. Translated for Kenyan milk demand by 2030, there is the potential for more than doubling of milk per capita consumption from the current 110 to 220 litres, which for the population projected to reach 58 million will present total domestic demand of 12.76 billion litres of milk. This projected domestic milk production of 12.76 billion litres and the per capita milk consumption of 220 litres are therefore the target this dairy master plan has to formulate strategic actions to realise.

The growth trends over 20 year period for Kenya show rapidly rising per capita milk consumption but with minimal change in the animal productivity. The increases in milk per capita have been met with increases in the population of milking animals whereas Australian case shows (Table 2) that milk productivity can be doubled over 20 year period on low costs, rain fed pasture production system. Milk production in Kenya is also based on rain fed pasture systems, implying the targets are potentially achievable. Therefore, to be able to supply the domestic milk demand by 2030 will require more than doubling the current levels of milk productivity (Table 2) if the country is to satisfy the growing milk demands from domestic production without unsustainable explosion in the population of milking animals kept.

2.4. The Vision and Mission of the National Dairy Master Plan 2010

The national development goals have high priority on transforming subsistence and informal dairy production and trading into a sustainable and globally competitive dairy value chain for wealth creation and high quality life and in compliant with requirements for high standards of public and environmental health.

Vision

The strategic vision of the Dairy Master Plan of 2010 is:

> To transform milk production and trade into an innovative, commercially oriented and globally competitive dairy value chain by 2030.

Mission

The mission of the Dairy Master Plan of 2010 is:

> To enable the development of sustainable milk production and trade for wealth creation and high quality life compliant with high standards of public and environmental health

3. CHALLENGES IN THE DAIRY SUB SECTOR

3.1. Development Trends in the Dairy Sub sector

Kenya is reputed to have the most developed and a thriving dairy industry in Africa. The industry was founded on large-scale commercial milk production operated under formal structured dairy industry that colonial white settlers developed in the central highlands in the early 1990s. This commercial milk production was characterised by single objective enterprise model of farmer behaviour, high levels of both inputs and outputs, nutrient surpluses in both farm and household and processing bulk of the milk for domestic and export markets.

To support commercial milk production, the colonial settlers developed supportive input services and output market organizations. These include: the Veterinary Research Laboratories in 1910; the Kenya Co-operative Creameries (KCC) in 1925; the Animal Husbandry Research Station in 1935; the Central Artificial Insemination Station (CAIS) in 1946; and in 1958 the Kenya Dairy Board (KDB) to regulate dairy marketing.

These supportive services sustained operations of formal structured dairy industry characterised by:

- High compliance with safety and quality standards
- Concentrated market structure consisting of relatively few, large-scale, vertically integrated market agents
- Industrial processing, based on capital intensive technologies at all market levels
- Value added products, mostly non-liquid and diverse
- Little diversity in market enterprise types
- Strong voice and large role in dairy sub sector policymaking

The formal structured dairy industry that the colonial white settlers developed was rapidly transformed after Kenya attained independence in 1963 and further accelerated by liberalisation policy implemented since 1980s. Post independence development policies redirected the supportive services towards the development of smallholder dairying with the goal of attaining self sufficiency in dairy products and developing rural areas. Policy actions had the former large-scale farms and the dairy herds in the highlands subdivided and sold to smallholder farmers. Donor support from 1970s added to further growth of smallholder dairy adoption with the goal to bring rural development and alleviate poverty. Combined impact of pre and post independence policies produced smallholder producers and traders.

The smallholder production is characterised by multi-objective household model of farmer behaviour, low levels of inputs and outputs and nutrient deficits at both farm and household levels. Smallholders keep 2 to 3 cows on 0.2 to 3 hectares holding concentrated in the high rainfall zone highlands. They integrate dairy with crop enterprises to maximize the returns from declining farm holding and limited capital.

Successful integration of dairy into cropping is because of large Kenyan communities with a strong tradition for dairy production and milk consumption, favourable agro-ecology for dairy and crop production in the highlands and expanding urban milk market opportunities. Crop- dairy integration offers opportunity to achieve multiple livelihood objectives. Households increase livestock and farm productivity, generate income from sale of milk, improve nutrition and food security, create employment and transfer money from urban to peri-urban and rural areas. Households build capital assets while sustaining crop productivity with manure fertiliser.

Smallholders milk producers and traders handle more than 80% of all the domestic marketed milk. This milk marketing system is characterised by:

- Sell of raw milk directly to consumers
- Low compliance with safety and quality standards
- Diffuse market structure consisting of many small-scale market agents
- Artisanal processing, labour intensive handling and transport methods
- Low cost products, mostly liquid and limited in diversity
- Great diversity in market behaviour and roles
- No voice or role in sub dairy sector policy making

Transformation of this informal milk marketing system to formal processing systems is a development objective in the DMP 1991 and vision 2030 as a strategy to meeting the growing urban demand while creating jobs, incomes and public revenues. Estimates in 1991 for meeting the growing urban demand by 2005 required 97% increase in milk marketed through formal markets. Therefore, the strategic actions to realise this goal must attract increased public and private investments in the sub sector processing the facilities. The strategic actions proposed have to contain the challenges of diseases, land degradation, droughts and climate change, low technology adoption rates and poor market infrastructure.

The framework for revitalizing, recovering and enhancing growth in the dairy sub sector has been laid with the implementation of specific policies. These include the Economic Recovery Strategy (ERS), the Strategy for Revitalizing Agriculture (SRA), the Vision 2030 launched in 2007 and the

Agricultural Sector Development Strategy (ASDS, 2010) with plan to enhance contribution of the agricultural sector to 10 % annual economic growth rate envisaged in the Vision 2030.

3.2. Challenges in Developing Competitive Dairy Value Chain

The strategic vision and mission of this dairy master plan is to develop a sustainable and globally competitive dairy value chain for wealth creation and high quality life while maintaining compliance with requirements for high standards of public and environmental health. A value chain is a series of sequential activities that add more value to the product at each step in the process that the product passes through. Figure 1 depicts the distinct steps in the Kenyan dairy value chain. They include Input and service providers; Milk producers; Collection, Chilling and Bulking group; Processors; Retailers and Distributors; and Consumers. Input and service providers include public and private sector players. They provide a range of services including feed supply, veterinary and AI services, breeding stock, extension services, testing and regulatory services. Access to these services is crucial to efficient functioning of a dairy value chain, especially for smallholder producers and traders.

3.2.1. Challenges in feed supply

Feed supplies to the rained pasture based dairy systems in Kenya are from diverse sources. These include own-farm sources or external sourcing of pastures from common properties for smallholders, stockiest and millers of concentrate feeds including co-operative societies and an emerging entrepreneurs investing in supplying hay and balled forages during droughts in the high potential dairy areas, especially in the peri-urban dairying. Research and seed companies have successfully introduced several high yielding and/or disease resistant varieties of pastures, fodder and leguminous trees, which studies by the Tegemeo institute (2008) show has increased adoption from 16% in 1997 to 53% in 2007 and the area allocated to fodder growing increased from 3 to 12% (*www.tegemeo.org/.../Trends-in-Kenyan-Agricultural-Productivity.ppt)*.

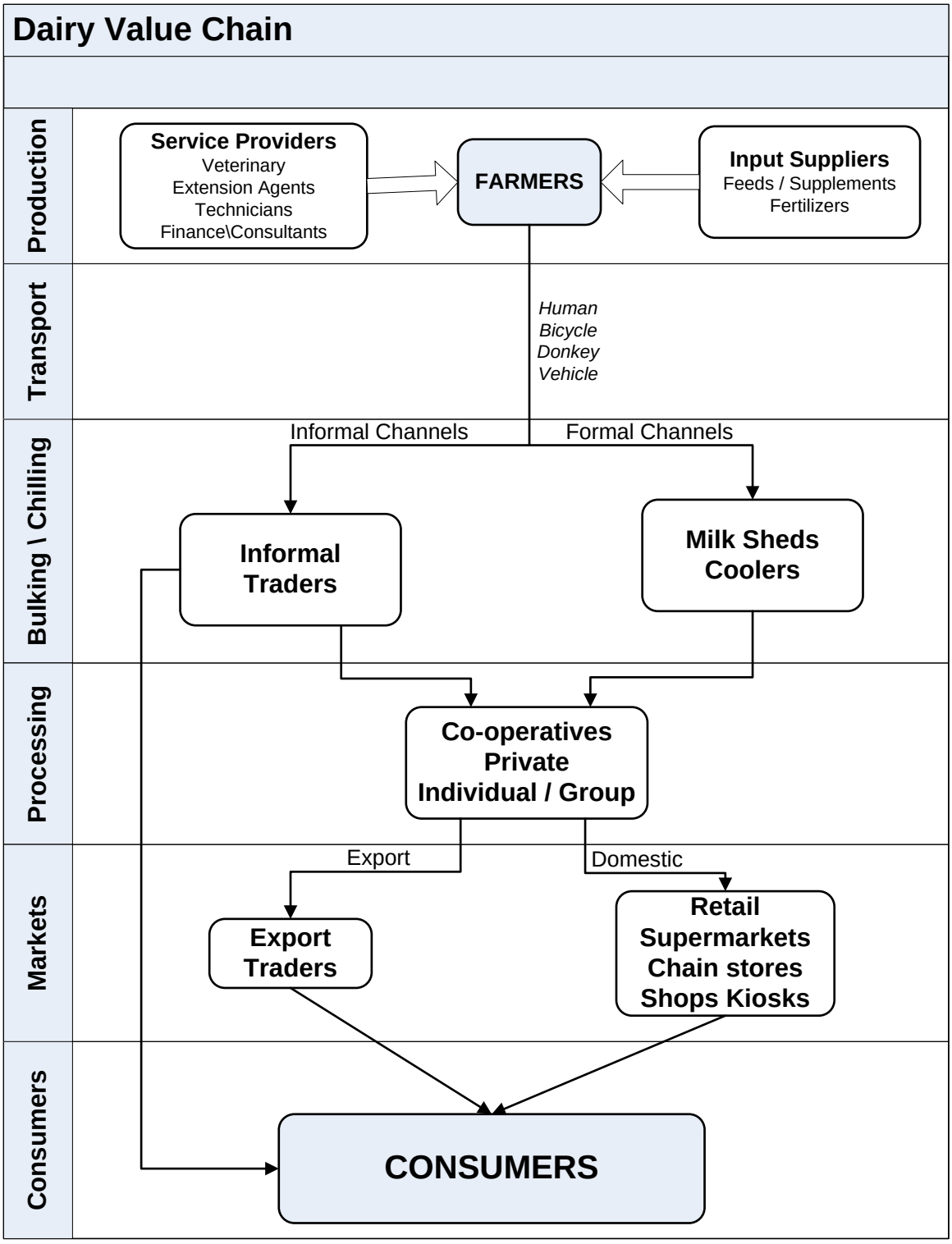


Figure 1: The actors in the dairy value chain in Kenya

Between 1992 and 2009, Kenya experienced a fourfold increase in the number of entrepreneurs investing in feed manufacturing from about 20 to about 80, particularly in Nairobi areas. This contributed to increased installed milling capacity and supply of compounded feeds in the market (Table 3) by 65% from 285,000 in 1996 to 472,000 tons in 2006 (Figure 2). The total dairy concentrates which constitute 35% of the concentrates manufactured, increased in the same period by 75% from 98,000 to 172,000 tons, reflecting that dairy enterprise is an attractive enterprise. The current installed milling capacity is only 48 to 65% utilised (Githinji et al, 2009). Extra installation is therefore not necessary in the short term in the implementation of this master plan.

Table 3: Regional Installed and Production Trend for the Last Six Years in selected regions

Region	Installed Capacity (Tons)	Actual Production (Tons)						
		2003	2004	2005	2006	2007	2008	2009
Nairobi	405,068	125,230	133,180	146,061	168,031	194,094	151,138	181,365
Thika	160,940	44,777	46,415	47,657	60,648	70,919	59,695.2	71,634
Kiambu	50,160	-	1,760	8,220	11,934	15,676	17,507	21,008
North Rift	37,030	4,249	12,536	15,621	16,658	23,142	18,235	21,882
Nyanza	19,536	12,000	10,000	11,200	12,962	12,690	8756.4	12,107
Nakuru	69,362	23,967	31,593	33,243	34,394	33,693	32,841.2	39,409
Mt. Kenya	25,320	1,840	1,990	4,056	4,240	3,732	3,880	4,656
Coast	76,150	7,400	6,900	6,950	9,723	19,409	19,086	22,904
TOTAL	843,566	219,463	244,374	273,008	318,591	373,258	311,139	374,967

Source: Feed Milling Industry Survey Report (Githinji et al, 2009).

Presently, the feed industry has a weak regulatory framework which is encouraging an influx of trade malpractices. Substandard feeds are being offloaded in the retail markets. Consequently, farmers are shifting from purchase of ready compounded feeds to own home made concentrates. This further worsens the situation as majority of them lack appropriate technical advice and are less knowledgeable in nutritional science to formulate home rations. This master plan recommends strengthening of extension service in teaching farmers about formulation of TMR feeding or compound homemade concentrates from locally available feed resources to help reduce the cost of concentrates and improve quality.

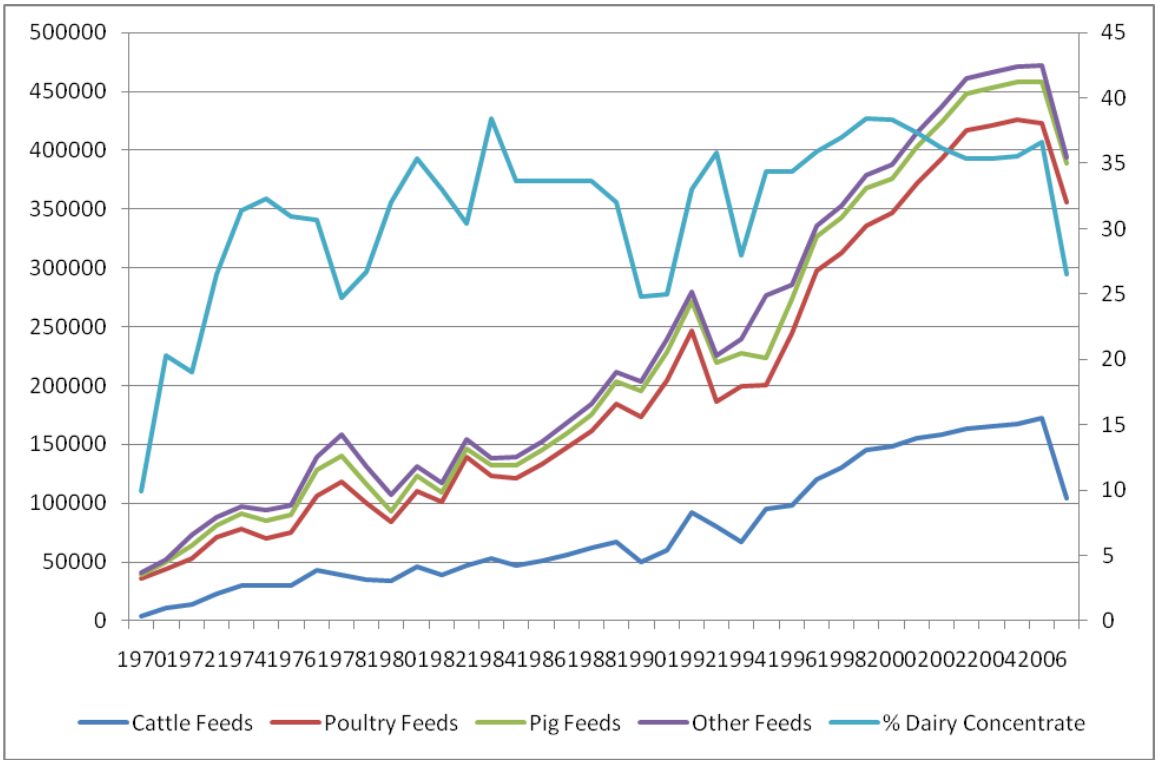


Figure 2: Amount of compounded feed manufactured in Kenya (ton/yr) (Source: Githinji et al, 2009: Feed Milling Industry Survey Report).

Commercial feeds are often costly for smallholder dairy producers because most of the raw materials are imported. This is a disincentive, partly contributing to non adherence to principles of Good Manufacturing Practices. Market surveys of raw materials available in the market reveal a large variation in quality and price, resulting in wide fluctuations of quality and price of commercial feeds in the market. Feed millers often buy substandard raw materials because of scarcity of raw materials. Protein sources are mainly imported from neighbouring countries while the amino acids are from Europe (Table 4).

Attention to water supply and quality is low on the farms, except in large commercial farms. This adversely impacts on animals' performance and is worsened by inadequate quantity and quality feeding. It is recommended that the government together with counties and municipal authorities and the extension service prioritises water supply, quality and use efficiency in dairy feeding as costs are increasing and scarcity will go up with the changing climate. The need for enhanced water use efficiency is even greater in milk production systems in the semi-arid and arid lands. There are water harvesting and storage technologies that extension service can disseminate to dairy producers and traders. In high rainfall areas, water harvesting using storage tanks and catchment dams while in rain deficit areas pans, dams and boreholes are recommended.

Table 4: The domestic usage of raw materials in feed manufacturing

Raw Material	Requirement (Tons)	Used (Tons)	Source		Source of Imports
			Local (%)	Import (%)	
Maize grain	88861	79662	98	2	Uganda, Tanzania
Maize bran	42399	40237	92	8	Uganda, Tanzania
Maize germ	62598	61517	90	10	Uganda, Tanzania
Maize germ cake	11570	10603	97	3	Uganda, Tanzania
Wheat grain	4281	2071	100	0.4	Not Indicated
Wheat bran	99374	86953	94	5.5	Uganda, Rwanda
Wheat pollard	83748	81636	92	8	Uganda, Tanzania Rwanda
Rice polishing	5937	4555	54	46	Uganda, Tanzania
Rice bran	10593	9042	94	6	Uganda, Tanzania
Soy bean meal	10608	9167	61*	39	Uganda, India, Europe
Full fat soybean	867	366	100*	0	-
Cotton seed meal	16052	15078	17	83	Uganda, Tanzania
Cotton seed cake	43079	38295	67*	33	Uganda, Tanzania
Sunflower seed cake	35539	33771	65.5*	34	UG, TZ
Copra cake	5391	4044	20	80	UG, TZ
Fish meal	5785	4797	51	49	UG & TZ
Omena	17546	16387	41	59	UG & TZ
Meat and bone meal	2223	1527	87	13	Not Indicated
Blood meal	450	428	100	0	-
Bone meal	14517	13633	100	0.4	Not Indicated
Limestone	22940	21141	100	0.1	Europe
Dicalcium phosphate	2799	2769	43*	57	Europe, Israel, Belgium, S. Africa, India, China,
Common salt	4295	4067	100	0.1	Russia
Poultry mineral vitamin premix	3043	3040	67*	33	Europe, Asia, Brazil, S. Africa, Israel
Molasses	11943	11807	68	32	TZ

Source: Adapted from Feed Millers Survey of Githinji (2009).

3.2.2. Challenges in veterinary services delivery

In the dairy sub sector, veterinary service is provided by the public, private and NGO sectors. Although policies exist on unauthorized use of, and restriction on veterinary drugs, self prescribed and administered drugs are common practice. The relative importance of these depends on the levels of infrastructure development and adoption of marketed milk system in a given part of the country. As expected, private veterinary services are concentrated where milk is commercially being produced, NGO-provided services are concentrated where level of infrastructure

development is still low, mainly the ASALs. Government veterinary service focuses on disease control vaccinations, diagnosis and surveillance with varying level of effectiveness dependent also on the levels of infrastructure development and adoption of marketed milk system.

The MOLD strategic plan 2009- 2018 has outlined implementation measures that ensure the livestock industry sustains healthy national herd and containment emergence and spread of livestock diseases. Currently, the veterinary department has 4 regional laboratories in Eldoret, Nakuru, Kericho and Mariakani supported by the national laboratory at Kabete, Nairobi for diagnosis and surveillance of animal diseases throughout the country. Disease surveillance is the responsibility of all the field veterinary staff headed by the Divisional or District Veterinary Officers. Public veterinary investigation laboratory services charge fees for services rendered, and are organized to enable farmers submit case samples directly to the laboratories or report disease cases to the nearest veterinary officer who examines the animal and may take and submit case samples to the nearest laboratory for further diagnosis. The laboratories issue a written report detailing the laboratory findings and the recommended treatment and control strategy. Similarly, private veterinary practitioners also submit samples to public laboratory for examination and diagnosis.

A useful veterinary service that has since collapsed in 2006 was the unit of epidemiology, surveillance and economics mandated with passive and active epidemio-surveillance network covering most parts of the country. The department has the mandate of collecting disease information for early warning and reaction with animal health database that is GIS compatible and captures disease information at the national and provincial levels. Revitalisation of this unit is therefore recommended to strengthen response to emerging disease challenges of public health concerns **(**brucellosis and tuberculosis), and those impacting on productivity which include trans-boundary diseases, tick borne diseases and diseases of intensification.

The supply of veterinary products (chemicals, biocides and medicine) is liberalized and therefore competitive as there are several companies involved, including small outlets in agro-vet shops in local market centres. But most of the smallholder milk producers have limited access to these services because costs are still relatively high. For instance, the high cost of acaricide treatment range from $2 to $20 per animal per annum, while curative treatment range from US $ 10 to $40 per animal per treatment for East Coast Fever. As a consequence, farmers buy drugs and do perform their own treatments, leading to misuse and abuse of drugs and high frequency of compliance with withdrawal and correct dose rate-which is a challenge. An integrated disease control strategy is therefore recommended to reduce costs and reach more farmers. In the high dairy concentration areas, incentives for private diagnostics are recommended.

3.2.3. Challenges in breeding services delivery

The Breeding services include provision of reproduction technologies (AI, Embryo Transfer), animal registration, pedigree and performance recording, which are offered by several institutions including public, farmer organisation, private enterprises and public-private partnerships. Table 5 summarises the major breeding institutions and the services they offer to the industry.

Table 5: The services of breeding institutions in Kenya

Institutions	Roles
Kenya Livestock Breeders Organisation (KLBO)	• KSB-Registration of all breeds of domestic livestock • maintains an upgrading programme
Livestock Records Centre (LRC)	• Runs National Dairy cattle breeding programme with two schemes: contract mating and progeny testing. • Estimation of Breeding values
Central Artificial Service (CAIS)	• Semen production and distribution maintains AI bulls • Bull purchasing committee
Kenya National artificial Insemination Service (KNAIS)	• Distributes AI services to dairy farmers across the country
Dairy Recording Services of Kenya (DRSK)	• Keep and process official milk records, butter and fat produce lactation certificates.
Breed societies	• Safeguards the purity of various breeds. • Set standards for the herd book register to promote the interest of specific breeders

Although all the above institutions aim at improving performance of the national dairy herd for farmers, some of them are ineffective, mostly due to poor coordination, thus are not benefitting the farmers as they should. Currently each of them is answerable to different ministry departments: CAIS and KNAIS to the veterinary department, LRC to animal production and KLBO and Breed societies to farmers. A strategic action in implementation of this master plan is proposed where all these institutions are placed under one umbrella body to enable better coordination, client-focus and efficient service delivery.

Although the national dairy cow herd is over 3 million large, there is a general shortage of “the demanded” quality breeding stock. Most farmers raise their own breeding/replacement stock, but a sizable number of farmers purchase replacement heifers from other farmers, especially the large scale farms. Smallholder farmers mostly lack resources to feed and manage replacement stock, thus, are not best suited for the production of such stock, even if they wanted to. Instead, a more integrated and better breeding and cow replacement programs should be explored because the current practice, whereby smallholders purchase culls from large scale farms is

counterproductive, given that the two productions systems are dissimilar, thus leading to large and negative genotypes-by-environment interactions.

A comprehensive, accessible and reliable national database has multiple beneficial uses in the dairy industry including estimation of breeding values, selection of bulls and bull mothers to produce bulls and replacement heifers. Besides, development of extension systems and making national plans and strategies for livestock development require reliable records. In addition, traceability requirement is becoming a universal requirement when exporting livestock and livestock products, thus reliable and authenticated records are important. The challenge is that such a database is presently lacking because of low farmer participation, especially by the smallholders, as there is little motivation for them to participate. Consequently very few dairy animals are registered, officially recorded and genetically evaluated (Figure 3) to give any credible results for the overall herd improvement.

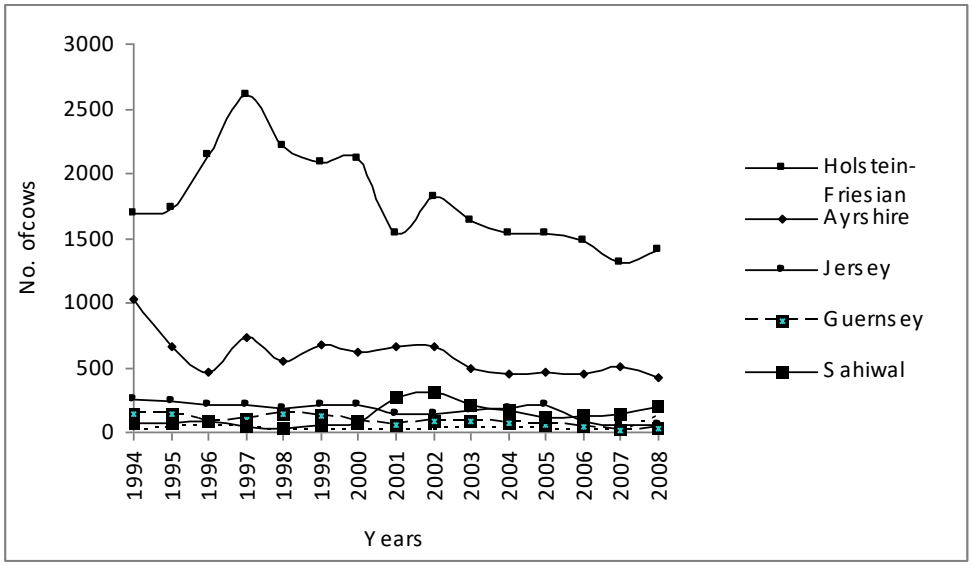


Figure 3: Trends in the number of dairy animals recorded since 1994

A strategic action needed is therefore to establish and manage a national livestock database service with new mandates to capture and coordinate access to all the important livestock data from each of a re-organized support institutional framework. This national institutional would undertake awareness campaigns to promote livestock registration and recording among smallholder milk producers with a target of reaching minimum 10% of total dairy population registered and recorded by the year 2030. This will give a reasonable number of registered and milk recorded animals as for selection and genetic improvement. Technological advancement in ICT, computing and biotechnology, especially in applied genomics, provide great opportunities,

but can only be exploited through correct and compressive performance and pedigree recording. Application of conventional Best Linear Unbiased Prediction (BLUP) procedures, genomics and assisted reproductive technologies would allow for more accurate identification of individuals with appropriate genotypes for the various production systems, enable their efficient delivery, and thus help achieve faster genetic improvement.

Reproductive technology most available is AI. The others such as Embryo Transfer and In vitro production of sexed embryos are yet to gain wider adoption, due to prohibitive costs. The AI semen production in Kenya is from cattle at a public facility: the Central Artificial Insemination Station (CAIS) where there is facility for production of Liquid Nitrogen (LN) used in the semen industry. Semen production from CAIS has over the years averaged 500,000 doses per year and in 2009, a total of 539000 doses of semen produced were only enough for 317059 animals, below the demand of 859000 doses (Figure 4), projected with the assumption of every conception requires 1.5 doses. Therefore, the present semen production capacity at CAIS is inadequate for meeting the increased demand for semen. This partly explains why smallholders have increasingly shifted from AI to bull service; though they would prefer AI to bull service, which is indicative of the failure of the AI service. Expansion in semen production capacity is therefore a strategic action for implementation to sustain the high genetic improvement needed in the transformation into a competitive dairy value by 2030.

Efficient delivery of AI services has to be strategically prioritized for Kenyan dairy sub sector to be competitive. Expansion in semen production capacity is therefore a strategic action for implementation to sustain the high genetic improvement needed in the transformation to competitive dairy value by 2030. Strategic research and capacity building activities breeding services delivery should part of the roles that a reorganized and new mandated national livestock dairy cattle research and development institute would play.

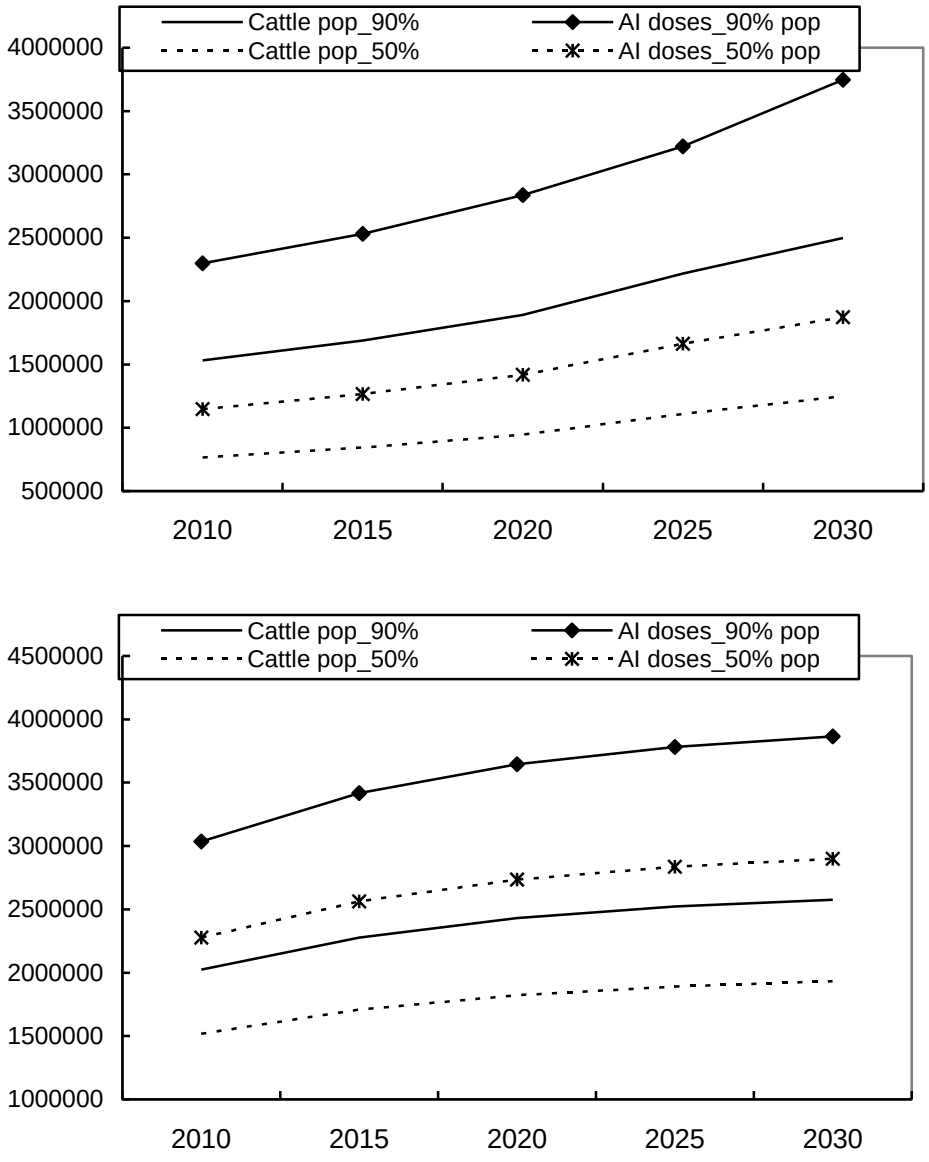


Figure 4: Projected semen doses needed for insemination of the dairy (A) and zebu (B) cattle at 90% and 50% of the population

3.2.4. Challenges in extension services delivery

Extension information and services are offered by public, NGO, co-operatives and private companies. Private companies package their extension information and services linked to sale of their products. Internal impact assessment of the National Agriculture and Livestock Extension Programme (NALEP) Phase 1 in 2006 showed that farmers still depend more on public delivered extension services than on private sector, NGOs or CBOs. Constraints to adoption of innovations in order of importance were lack of credits (30%), being ignorant (12%), having handout mentality (7.9%) and unreliable weather (7.2%). Farmers often adapt the extension recommendations to their

specific needs in implementing technological recommendation. For instance, NALEP promotes diversification in agricultural enterprises but only a few farmers (16%) diversified their enterprises.

Implementation of NALEP programme was found to have contributed to more farmers increasing their dairy productivity and sales by about 3%. NALEP introduced extension concept of Common Interest Groups to hasten commercialisation through facilitated access to local food markets for pooled products, value addition technologies and credit facilities. Extension staff benefit from NALEP in capacity building, collaboration with stakeholders.

Extension linked to other products and services in the dairy value being implement in dairy business hubs seems a more effective approach to reach and impact on farmers, which dairy master plan need consider promoting in the strategic actions.

3.2.5. Challenges in financial services delivery

The demand for financial service is for investment with which farmers may:

- purchase breeding stock for foundation herd or for herd replacement
- establishment of fodder fields
- purchase of equipment and tools
- erection of farm dairy structures
- Operating /working capital among other needs.

Other dairy traders in processing, transportation, collection need financial services for:

- Capital investment – for equipment such as processing plants, coolers, vehicles, etc.
- operating/working capital for milk and other purchases
- day to day transactions in paying, deposits or savings

In the 1990s poor resource dairy producers and traders only had access to modest credit from the commercial banks and Agricultural Finance Corporation (AFC). This situation has persisted to date (Livestock Policy of 2008). A study of dairy farm households between 1997 and 2000 by SDP (2000) showed that only about 3.8% of the dairy farmers had ever taken credit from Co-operative societies and commercial banks.

The low credit uptake is attributable to the unsuitability of the available credit for the dairy features. Table 6 summarises the range of credit facilities in the market. The conditions are rigid in formalities. For example, to receive credit services, a farmer is required to have Personal Identity Number (PIN), an account with the bank, be a member of a cooperative, delivering milk to big processors and presenting an acceptable financial/account cash flow and Ministry endorsed

project proposal. In addition to these process heavy formalities, costs are high with interest rates on a reducing balance basis of between 10 and 20%, processing fees of 1 to 3%, and allow 1 to 3 months grace period for loan payable within 2 to 8 years.

Table 6: The range of credit facilities in the market for dairy investments

Bank	Type of loan	Conditions/ Requirements	Costs	Grace period	Repayment period
Co-operative Bank	Maziwa loan/ microcredit channelled through a co-operative society	Bank account; Member of cooperative; Deliver milk to New KCC/ Brookside; Acceptable cash flow; Collateral, membership of a cooperative	1% for appraisal/ negotiation/ commitment; Interest rate 15% on reducing balance basis	1 month	12 months
Agricultural Finance Corporation		Written project proposal endorsed by ministry with: title deed; certificate of official search; PIN map and copy from District survey office; milk processor (KCC/Brookside) payment slips; Bank statement for one year; and latest pay slip for employed	processing/commitment cost of K.Shs. 3,000 – 3,500 Interest of 10% per annum on a reducing rate	3 months	2 to 8 years;
Kenya Commercial Bank		Be supplying milk to a processor who has an MOU with KCB; Have an account with KCB where milk dues are remitted	Initial 2% processing fees; 17% interest rate	1 month	6 months to 3 years
K-Rep	Juhudi Kilimo – Ukulima &	co-guaranteed by group members;	3% commitment/ application/	1 month	6 months to 2 years

	Maziwa loans; Micro-leasing	Provide 15% saving deposit on the value of the asset to be financed	processing fees; 18% interest rate		
Family		account with Family bank and a minimum of 3 deposits; delivering milk to a Processor	Commitment/ processing fee of 1 – 3% on principal; Interest rate of 18%	1 month	Repayable in 24 months
Equity	Maziwa loan	Bank account with Equity; Supplying milk to Processors (New KCC/ Brookside)	15 – 18% depending on amount borrowed	1 month	1 to 3 years

At the producer level, most financial institutions worry about the risks associated with livestock farming and the complications associated with the land tenure systems and therefore have problems with the use of land as collateral. Most of the financial institutions have attempted to ease requirements for credit security by: allowing the asset procured by the credit to be the security; combining insurance with the credit package; and/or by encouraging individuals to form groups for the purpose of guaranteeing each other. However, some institutions such AFC, which is the main agricultural financial institution, still require collaterals for the loan.

The alternative credit facilities are available through microfinance and banking institutions targeting micro-enterprises. Tegemeo institute (2006) studies show that 82% of those that tried to obtain some sort of credit actually received. However, among those who did not receive credit, 62% had tried to borrow for farming purposes, indicating that most farmers do not get the required credit. The Tegemeo report (2006) noted that informal money lenders and local traders/input stockists are more popular than the formal banking institutions. They provide about 20% of the agricultural credit to farmers in Kenya. Co-operative Bank has special product facility for dairy investment under a micro credit, the *Maziwa Loan*. There are other retail and wholesale loan products available to dairy producers and traders from channelled through Co-operative societies and the Kenya Livestock Finance Trust (K-LIFT).

3.2.6. Challenges to milk producers

Kenyan milk producers can be categorized as pastoral, smallholders, and medium and large scale farmers. The dominant group are smallholders who own holdings averaging 0.2 to 3

hectares with one to three 3 cow each. Such farmers are estimated to comprise 1.8 million of households and they account for over 70% of the domestic produced and marketed milk.

A large majority of smallholders (60%) hire labour for dairy activities but use low external inputs and production technologies, preferring those in which demand low costs and operational technical skills. Most smallholders achieve 5 litres per cow per day during lactation relative to 17 to 19 litres in large scale herds. Potential for milk productivity improvement exits as indicated by large variation in performance ranging from 1 to 7.2 litres reported. They sell their milk mostly in the informal sector.

Medium and large scale farmers account for less than 25% of the total domestic milk production. They keep large herds in the range of 20 to over 100 milking cows and attain milk productivity twice higher than those attained in smallholder herds with high external input use and production technologies. They produce high quality breeding for the industry but not accessible to smallholders because of high cost. They sell their ilk in the formal sector, to processors. These farmers are vulnerable to inefficiency in the processing step of the value chain, exposing them to stiff competition from smallholders and cooperatives that can supply bulk milk directly to processors.

3.2.7. Challenges in milk collection

Kenya's previous success in stimulating growth in the dairy industry was built on investments in the design, operation and maintenance of an organized and orderly milk collection system by KCC. This system collapsed following the poor performance of KCC in the 1990s leaving behind an erratic milk collection system.

After dairy liberalization in the 1990s, a number of dairy farmer co-operatives and membership has been growing, alongside formation of dairy farmer groups especially in areas where revival of collapsed dairy co-operatives was not successful. Presently, dairy co-operatives, milk processors and private milk transporters operate the functional milk collection systems. Farmers deliver milk to collection centres or collection points by the roadside. This is usually a shed, sheltered from direct sunshine and rain. The equipment of the centre consists of a weighing scale and basic quality control equipment. There is milk inspection and weighing on arrival before acceptance and bulking into milk cans.

Where coolers are lacking, the collection of evening milk is limited to the capacity acceptable to the processing plant. Some producer co-operatives and processors operating cooling plants are

able to receive milk from the afternoon milking for overnight cooling then delivering together with the morning milk next day.

Co-operatives dominate milk bulking and cooling services, but often have serious governance and efficiency problems. A recent study by Smallholder Dairy Project (SDP) showed that over 50% of 300 cooling and bulking facilities installed in various parts of the country were non-functioning and needed rehabilitation or replacement. These include 11 major cooling plants owned by KCC and 60 coolers that the Kenya Rural Dairy Development Project supplied between 1980 and 1989 to Dairy co-operatives. Most of these milk coolers were non-operational because were unviable or poorly maintained.

Well managed milk collection system motivates farmers to increase milk production. Raw milk collection is largely inefficient because feeder road system in most milk producing areas is inadequate and in most cases impassable during rainy season when milk production peaks. The collection and cooling centres are inadequate leading to congestion and rejection of a large volume of milk. Malpractices are also common, with high incidences of half filled cans. These are associated with high costs of milk collection and handling.

Some milk producer are adopting farmer-group business model in organizing viable milk collection system operating as dairy business hubs to enhance efficiency in milk collection system. Farmers group in Dairy Business Association (DFBA) to create and manage hubs of services that support their production and marketing activities. The kind of hub organized depends on whether they want to access the traditional or formal markets.

Hubs targeting traditional markets locate mainly in areas with low milk density or relatively low market access due to poor infrastructure or long distance from high milk demand centres. Activities seeks to achieve multiple goals: providing a range of business services to farmers and traditional traders, leveraging farmers' position with traditional traders through collective bargaining, improving the demand for quality milk. The hubs provide the link between farmer groups and larger market centres. Their role is to provide both milk marketing and business development services (BDS) to smaller groups of dairy farmers, either directly or through convenient, intermediary milk-collection centres. The milk marketing linkages between the farmer groups and traditional hubs is mainly through traditional milk traders moving milk from the farm to the market within an average radius of 60 kilometres.

Hubs targeting formal markets operate chilling plants, usually where there are large commercial dairy farms. The DFBA in these hubs develop greater influence over the dairy value chain as they

build, manage and expand chilling plants and accompanying hubs. They create a system to buy and sell quality milk for delivering to processors directly or processors organize bulk collection tankers.

Milk hubs model enhance milk quality on transit between the time of intake and final processing. They enhance efficiency in the dairy value chain where bulk of marketed milk is rarely cooled and majority of individual farmers are unable to invest on cooling facilities at the farm level. Dairy co-operatives, few milk processors and a growing number of small private entrepreneurs are engaging in establishing centres for cooling and bulking of raw milk.

3.2.8. Challenges to milk processors

Major milk processors are the New KCC, Brookside dairy, Limuru Co-operative Dairy, Githunguri Dairy Co-operative Society and Meru Central Dairy Co-operative Union. In total there are 54 registered milk processors with 34 operational, all combined handling 1.5 million litres per day but their installed processing capacity is 3 million litres. Therefore 50% of the processing capacity is unutilized. Installed capacity for Ultra Heat Treated (UHT) milk processing is 1.2 million litres per day with more than half of this capacity being new investments by the private sector.

The low capacity utilization is a result of four main factors:

- Intense competition for fresh/raw milk supplies from informal traders in key urban markets. An estimated 80 percent of milk consumed in Kenya is unprocessed.
- Supply fluctuations are experienced depending on weather patterns. Weather patterns determine not only foliage availability but also feeds supply and quality. Processors, therefore, believe there is room to optimize capacity utilization through better animal husbandry and greater product diversification.
- Renewed public sector dominance of the industry following the take-over of New Kenya Co-operative Creameries by government in 2003. This is seen by industry players as distorting the level playing field in the sector.
- The governance and leadership challenges in the co-operatives sector which dominates the cooling and bulking segments of the industry value chain. This has a negative impact on farmer incentives to produce milk.

Because of a huge underutilized processing capacity and low processing capacity, much of the glut milk goes to waste because supply surpass the demand for fresh milk, though bulk of processed milk is consumed in fresh form. For instance, milk production in the month of January 2010 reached 1.4 million litres per day with the New KCC receiving about 600,000 litres daily and

Brookside Dairy about 400,000 litres due to heavy rains in December 2009 and January 2010. The action needed now is to enhance use of this capacity in order to expand penetration into rural and regional export markets.

The key to success seems to be a combination of being able to source milk consistently at good prices, regular payment of milk suppliers combined with strong distribution and branding. Whilst the prices paid to farmers and Co-operatives are relatively low, willingness to buy regularly and to pay on-time offer sufficient incentives to farmers to supply at least part of their surplus milk to this channel. These latter benefits override the low prices and are important to farmers and Co-operatives in the peak production season when there are few alternative outlets. Supply contracts are struck but these appear to be no more than indications of intent as there are widespread breaches. Supplier and buyers frequently breach contracts when processors have enough milk, particularly in the peak production seasons.

Only the New KCC has facilities to convert fresh milk to powder milk. Powder milk is expensive to produce and its profit margin is very small. While the New KCC may wish to produce powder milk for its reconstitution during the dry weather and to sell to other processors, KCC could be contracted to producer powder milk as a food security reserve.

A government policy incentive introduced recently to zero rate taxes on inputs used in liquid milk processing and tax exemptions on investments to set up processing facilities in rural areas present attractive investment opportunities. The action needed is to enable dairy co-operatives and private investors to take full advantage of this investment incentive.

There are uncoordinated attempts to recreate the KCC network type of cooling centres into a national cold-chain. The bigger processors invest in cooling facilities in milk surplus areas where there are low cost producers. Support from NGO to community owned and managed cooling facilities enable link with cold-chains of large processors. They subsidise the technical input cost to open for a community a market for milk, even at relatively low prices. A case is Heifer Project International that has a successful scheme in Bomet / Siongiroi (10,000 litres/day) and is experimenting with others.

The large processors have increased investment in long-life facilities. Long life milk products currently accounts for over 20 % of their totals sales reaching rural and urban centres and exports to regional markets and Southern Sudan.

The large processors are unable to effectively competing with the raw milk supply by informal traders on price and quality. Small-scale milk processing and itinerant traders handle over 80 percent of the marketed milk, but generally use substandard processing technologies and inadequate skills, leading to manufacture of low quality milk products. Non compliance with quality and safety requirements is a concern in the informal trading of milk. Cases of milk adulteration starting on the farms are detected. Awareness campaigns are encouraging increasing adoption of milk testing to enhance quality and safety of marketed milk.

There are estimated 200 types of dairy products produced globally but only a limited range are processed in Kenya. There is fresh pasteurized and long life milk (UHT) distributed daily. Flavoured milk and yoghurt are available not on daily basis. Long life milk processing require specialized machinery only owned by the three big three dairy processors. There is limited processing of high value dairy products by the large dairy processors and specialized small dairy processors. These products include butter, cream, cheese, yoghurt and ghee. Long life milk dried whole milk and skim milk powders have ready export market but are produced in limited quantities because of low processing capacity. Cost of equipments is high and only New KCC has invested in drying plant facility for processing milk powder. Local consumption of these high value dairy products is low in the domestic market. They have large potential export market in the region, which Kenya dairy Board has to explore for penetration.

3.2.9. Challenges in milk retailing

Milk retailing is by small scale traders and supermarket chains and they retail mainly liquid milk. Small scale milk retail accounts for bulk of the milk reaching consumers, usually unprocessed and operations unlicensed. The mobile milk retailing hawkers are numerous and highly dynamic in trade entry and exit to the extent that their numbers is unknown. They operate in rural and urban centres, selling an average of 50 to 100 litres a day in diverse quantities at about half the price that of the processed milk. These small scale retailers are target for training in hygiene, safety and quality in milk handling to curb rampant malpractices.

A small number of small scale milk retailing are licensed and comply with safety and quality requirements. These are specialised retailers licensed as milk bars and may sell over 400 litres a day. Large scale milk retailing is linked to large processors for a range of products and multiple brands. Products are packaged in Tetra-Pak system of packaging, for historical reasons. Tetra packaging technology is expensive. The tetra rex or brick type of pack accounts for 40 to 45% of the price the consumer pays while the tetra classis (triangular shape packets) accounts for 28% of the price paid by the consumer.

To edge out cheap milk delivery from mobile hawkers, KCC introduced zero packaging or bulk milk vending, an innovative method of milk marketing of pasteurized bulk milk vending at selected milk shops/bars in Nairobi. At a price of K.shs 20/= per litre, the programme quickly became popular, sales short up and raw milk hawker was out competed.

The programme is not in the market anymore. Its revival is recommended to dispense milk cost effectively in high density low income urban areas. The strategy action is to encourage use of cost-effective milk packaging of acceptable standards as well as discouraging use of packaging materials that are environmentally unfriendly.

Experiments with pasteurized milk in pouches are slowly entering the retail market. Bulk packs are more common in the catering and institutional supply markets. Sachet packaging costs K.shs 0.90 to 1.30 per piece, half litre high quality plastic bottle cost processors only Kshs2.80. Packaging should, therefore, be determined by the products and the targeted niche market. Sachet packaging targets low income consumers while tetra rex and tetra classic packaging can targets the middle and high income consumers.

3.2.10. Challenges in management of Cooperatives and farmer groups

Dairy Co-operative movement in Kenya dates from 1925 with the formation of the giant national Kenya Co-operative Creameries (KCC) to collect, bulk and cool and process milk for domestic and export markets. KCC remained the dominant co-operative player accounting for over 95% of formal milk intake in the dairy sub-sector to early 1990 with government support. By this time had inadequate capacity to absorb milk delivered particularly during wet seasons. Financial status was worsening with debts rising, facilities deteriorating and milk intake declining substantially.

To revitalise KCC, DMP 1991 recommended three reform pathways for KCC aimed at attaining efficiency. One, allow entry of competitors to operate with KCC in the milk market. Reforms included through decontrol of producer and consumer milk prices, streamlining licensing procedures and strengthening governance structure while retaining KCC as a parastatal. Two, break KCC into smaller regional Co-operatives which competed for urban niche milk markets. Third, privatise KCC.

KCC eventually collapsed in 1999 when milk intake had declined to 200,000 litres a day from a peak processing of 1.2million litres per day. In 2003, option one of DMP 1991 was implemented and KCC re-branded to New KCC with government funding support to return to operations. However, the perception in the industry is that New KCC as a parastatal enjoys favourable

treatment from the government with favourable terms, obtain supply orders to government institutions. The industry is advocating for privatization of New KCC to enhance competition.

KCC is a parastatal offering a range of service delivery to smallholder milk producers and other small Co-operatives that include milk collection, bulking and cooling and sale to formal or informal market outlets. Others engage in veterinary and extension services to deliver AI, drugs and feeds while some provide credit facilities for inputs and engage in processing. Co-operatives differ from Self-help groups in the degree of sophistication and ability to borrow. They are mostly arrangements for marketing and have grown more popular due to mismanagement in the Co-operative sector.

The engagement of dairy Co-operatives in service delivery at all levels of the value chain does raise the question of whether they should build competence at the production and cooling/bulking level: or should they operate at all levels of the Dairy Value Chain? Most of the dairy cooperatives that came with liberalised milk market in 1990s have had their milk intakes decline and many subsequently collapsed due to weak management capacities, inadequate capital base, low economies of scale and poor governance structures. The skills base and governance structure of the co-operatives would indicate the need to consolidate efforts at the lower end of the Value Chain (support services, extension services, cooling and bulking, and provision of financial services to farmers). The competitiveness of the dairy industry will depend on high level knowledge and skills at farm level (husbandry practices, AI, feed supply and veterinary services) and farmer support services at collection, cooling and transport to processing points. Reducing wastage and enhancing productivity at this level would substantially improve income levels of small scale farmer members.

Currently the number of Dairy Farmers Co-operatives in the country is growing with membership and sales increasing from 210 Coops with 266,000 members in 1994 to 337 Coops with 344.000 members in 2000. There are 36 registered processors, mostly serving a limited geographical area. The New KCC and Brookside are the major milk processors with a few farmers co-operatives (Meru Central, Limuru and Githunguri) engaged in processing milk and value added products. Increasing numbers of registered cooperatives and increasing membership may reflect the growing importance of smallholder dairying rather than their success.

Revival strategy of most of the small dairy Co-operatives is to trade in raw milk in the urban centres to stabilise their milk intakes and tap the market of conservative consumers who favour fresh raw milk. However, small Co-operatives realise narrow profit margins from the sale of milk compared to private sector traders who are more efficient with minimal overheads. Many Co-

operatives are therefore becoming more like traders in method of operations, selling milk directly to consumers in urban centres or seeking to become processors. For instance, Limuru, Meru and Githuguri Co-operatives have become large-scale milk processors. However, they have lower capacity utilization rates relative to private processors and experience uncertain supply because members pass on the problem of disposal of surplus milk to the Co-operatives in the peak production periods.

Co-operatives well managed do reduce the cost of milk marketing through bulking and realise higher returns for farmers in an assured, reliable and remunerative milk market outlets. The priority areas to regain the role of cooperatives in advancing dairy development should be implementation and enforcement of management and governance reforms embodied in the amended Cooperative Societies Act of 2004. This offers possibilities for encouraging partnerships between cooperatives and other private sector players especially processors, promoting bulk purchases of farm inputs to minimize costs and improving competitiveness, and protecting producers and producer organizations from effects of collapse.

3.2.11. Challenges in capacity building and research

Training institutions of public and private ownership offering training in dairy production, processing and trade are several in the country and seems adequate to supply the human resource capacity needed in the industry. They produce certificate, diploma, degree and post graduate training. The institutions seems to under exploit the internship opportunities offered by the ministry of labour through training levy organization to which every employer contributes and from which every employer can claim training costs for their staff provided they undergo recognized courses. This facility is mandatory to employers and all qualify to use the facility for building human capacity in technical skills. Dairy organization also qualify, what they need is awareness and requesting relevant institutions for 'tailor made' course to their specific needs. Companies supplying imported machinery and technology can other specialized skills needed for use of those technologies.

Kenya Dairy Board (KDB) is the institution mandated to coordinate dairy research activities on behalf of the Ministry of Livestock, but has not set any research agenda. The research that goes on is hardly client based and consequently results are often of limited relevance to end-users. KDB has to support specific dairy stakeholder demanded research through contracts with relevant institutions with the capacity for the research question in demand. Funding for dairy research should come from the dairy industry through commercialization of research products including contracts and royalties for sustainability in addition to the government support. Exercising her mandate in the dairy industry, a strategic action for KDB is to conduct dairy sector

over view surveys twice a year on issues of importance to stakeholders and disseminate this information widely through a dairy review bulletin.

3.3. Challenges in Improving Milk Production

3.3.1. Challenges with the systems of milk production

Three major milk production systems are grassland, mixed crop-livestock and landless systems, per FAO classification on the basis of relation to land, integration with crops, and the mode of production identifies. The classification reflects management interventions of which important ones are: the level of confinement, climate modifiers, control of diseases and parasites, feed and water management, reproductive strategies and socio-economic characteristics including major uses and roles of the livestock. Milk is produced under diverse systems that may be grassland-based, mixed crop-livestock or landless systems.

Grassland-based systems include pastoral and ranching systems in which the animals obtain a large proportion of their forage intake by grazing natural or sown pastures. In pastoral systems, pastoralist move with their herds of camels and cattle and flocks of sheep and goats in an opportunistic way on communal land to find feed and water for the animals either from or not from a fixed home base. In ranching systems, livestock production is on privately owned rangeland with high level management intervention for productivity and commercial goals.

Milk from pastoral systems accounts for all the 200 million litres of camel milk worth K.Shs. 2 billion, about 15% of the 5.1 billion litres of cattle milk and a substantial proportion of milk from the 9 million beef cattle, 13 million goats and 10 million sheep consumed at home and a portion marketed. Market integration of this system will enhance flow of the milk to market. Milk from dairy ranching plays insignificant market role in the country where ranching is primarily oriented to beef production.

The mixed systems include crop–livestock, agro-pastoral and agro-forestry–livestock systems, in which livestock keeping is integrated with other agricultural activities, together forming a whole. The crop–livestock systems are those in which livestock production is integrated with crop production, predominantly in the medium to high rainfall agro-ecozones. The agro-pastoral systems are livestock-oriented production that have emerged from pastoral systems with some integration of crop production and grazing of livestock on rangelands. Farmers sometimes migrate with the livestock away from the cropland for part of the year. The agro-forestry–livestock

systems are those in which livestock production is integrated with the production of trees and shrubs.

Crop–livestock systems are the dominant milk production system in Kenya, utilising dairy and dairy crosses and dairy goats on small, medium and large scale production. The characteristic features of smallholder dairying are: multi-objective enterprise, low levels of inputs use, low outputs of milk typically less than 10 litres/herd/day, nutrient deficits in the farm and household, low uptake of production technology, and large variation in degree of market orientation. This is the system to target with research, inputs, services and knowledge products to enhance productivity, market value of products and transformation process to commercialisation.

The medium scale dairy farms are of 3 to 49 ha and large scale farms from 50 ha with a herd size of over 30 cows. These types of farmers account for about 25% of milk produced and marketed. They are the source of breeding stock and receptive to new technology, investment in inputs, borrow credit for farm development and market milk through formal channels. In contrast to smallholder dairying, production is: single commercial objective enterprise, high levels of inputs and outputs with surplus nutrients at the farm and household levels.

The landless systems include the industrial and backyard/scavenger systems in which livestock production is separated from the land where animal feed is produced. The industrial systems are large-scale landless production systems in which the production environment is highly controlled by management interventions. The backyard/scavenger systems are small-scale landless production in which the animals are kept in backyards and fed on household waste and/or other feeds, or fend for themselves with little feeding from farmers. Landless dairying is not yet a prominent in Kenya, but a few examples of industrial dairying are in the Nairobi peri-urban area while backyard dairying is restricted to urban slums where feeding animals on waste dump feeds and contaminated waters is common. This feeding practice present food safety concerns to consumers who are increasingly aware of, and sensitive to, food safety issues and their linkage to feeding practices.

The prerequisite managerial skills for transformation into an innovative, commercially oriented and competitive dairy value chain envisaged in implementation of this master plan are benchmarked on those achieved in China, India and Australia. The needed levels of managerial skills to adequately meet the emerging ecological, economic and societal requirements in milk production are largely lacking in the smallholder and pastoral milk systems in Kenya. Needed are actions that enhance up take of technologies in livestock housing, climate modification, disease management, feeding management, reproductive management and value addition. These are

actions that enhance productivity; product safety and quality and affordability to meet the requirements market, public and environmental health and conservation of natural resources and biodiversity.

3.3.2. Challenges in management of dairy enterprise

Substantial amount of milk is lost in the dairy herd due to poor reproductive performance. Calving intervals prolong to 450 to 500 days with estimated loss of milk at between 450 and 500 million litres worth over K.shs 4 billion. The problem is related to inadequate feeding, heat detection, herd health and lack of herd recording for decision making. Good reproduction helps producers attain self sufficiency number of female calves to produce heifers for replacement or culling of calves.

Substantial volume of milk is produced from 9 million beef cattle, 13 million goats and 10 million sheep for home consumption. The trend towards marketing of milk is greater for goat milk in the niche urban markets with branding of nutritional health property. Dairy goats are increasingly popular in high potential areas where land pressure is high and their popularity is extending to low potential areas of Kitui and Mwingi and Homabay. Their rising popularity is on perceived medicinal properties of the goat milk, reduction in land size, intensified extension service and distribution of dairy goats to smallholders by NGOs such as Farm Africa in Meru Dairy Goat Association of Kenya.

The NGOs have promoted dairy goats more prominently than the government for rural poverty alleviation based on development and utilisation of potentially high milk yielding breeds of Kenyan German Alpine, Anglo Nubians, Toggenburgs, and Saanen. Dairy goats are both stall-fed on fodder and crop residues or are tethered on along roadsides and small strips of farmland. Feed supplementation is often with commercial cereal by-products (bran, germ and pollard).

Camels in Kenya are estimated at 1 million and are mainly found in the ASALS producing an estimated 200 million litres worth K.Shs. 2 billion. Their productivity varies from 2 litres under traditional system management to 4 litres under improved ranch management. They are more promising for climate change adaptation for they continue to lactate during severe drought. A growing interest in camel milk in urban and export markets is driving evolution of peri-urban marketed milk system in the arid northern Kenya. Consequently, there is growing demand for potentially high milk yielding breeds. These peri-urban camel milk systems are identified targets for improving productivity to overcome the present challenge of implementing practical feeding supplementation, health management and systematic breeding programmes.

Zebu cattle are raised on natural pasture with minimum efforts towards improving the pasture or supplementation. Water supply present production constrains and animals are sometimes trekked long distances in search of pastures and water or grazed near watering points during the dry season. Milk produced from zebu herds is mostly consumed at home by the household and calves and limited sales in the informal markets. Producers of zebu cattle focus their objectives on multiple benefits: food (meat and the milk), services (drought power) with additional benefits from products (hides, manure). Their contribution to domestic milk supply cannot be ignored as they satisfy a nutritional need of the communities that rear them. The future of these animals as milk producers will depend on infrastructure development to open the areas where they are reared to allow entry into the market.

3.3.3. Challenges in expanding dairy production

Milk production in the country is concentrated in highland eco-zones with high and bimodal rainfall in the central and Rift valley provinces (Table 7). Dairy farming in the highland eco-zones is favoured by low temperatures (15–24^{0}C) moderated by high altitude, lower risk of diseases and a bimodal rainfall pattern that support high biomass production for forage-based dairying. The soils are predominantly nit sols, suited the growing of cash crops (tea, coffee, wheat and pyrethrum) and maize, which is staple food crop. Compared with lowland eco-zones, high and bimodal rainfall have more favourable agro-ecology for dairy and crop production and better market opportunities from high population with a strong tradition for consuming milk in their diets and concentration of urban centres.

Table 7: Districts where dairy farming is prominent

Province	District
Central	Nyeri, Nyandarua, Muranga, Kirinyaga, Muranga, Kiambu
Rift Valley	Trans-Nzoia, Uasin Gichu, Nandi, Bomet, Kericho, Buret, Sotik, Ngong
Eastern	Machakos, Embu, Meru
Coast	Taita Taveta, Kilifi, Kwale
Western	Lugari, Bungoma, Kakamega, Vihiga, Busia, Teso
Nyanza	Kisii, Nyamira, Migori

Based on annual rainfall received, the eco-zones are classified into high, medium and low rainfall zones. The high rainfall zone receive more than 1000 mm of rainfall annually, occupies less than 20% of the productive agricultural land and supports about 50% of the country's population. It is

the most important zone agriculturally, where most of the food and cash crops and livestock and over 75% of domestic milk are produced.

The medium rainfall zone receives between 750 to 1000 mm of rainfall annually and occupies 30% to 35% of the country's land area with about 30% of the population. There is a trend of high migration of the population from the densely populated high rainfall zone to the medium rainfall zone. Some areas in the medium and high rainfall zones are high population pressures and farmers have to stall-feed animals on farm fodder, mainly Napier grass. This zone supports large-commercial dairy herds on pasture grazing and keeping of cattle, sheep and goats, and growing of drought-tolerant crops.

The low rainfall zone receives 200 to 750 mm of rainfall annually and supports about 20% of the population, 80% of the livestock and 65% of the wildlife. The zone is highly vulnerability to climate change and variability in form of recurring droughts, unreliable rainfall, peak flooding, and outbreaks of climate-related Tran boundary Animal Diseases (TADs).

Milk production in the low rainfall zone utilises Boran, Sahiwal and Zebu cattle, camels, goats and sheep in the pastoral, semi-pastoral or ranching systems. Milk marketing is to a very limited extent, except for a growing marketed camel milk linking pastoral to urban markets. Feed availability for ruminants is a major challenge due to recurrent draughts and lack of forage conservation strategies, which limits livestock productivity and is a cause for economic losses through mortality and loss in weight and market value.

The land tenure systems in Kenya are broadly of three categories: communal land; government trust land; and privately owned land. The anticipated constitution dispensation may change these definitions. The communal land ownership system is based on traditional customary rights, and all individuals born in that community have a right to use, but not sell, the land. Government trust land is held by public institutions for public use such as buildings, forests, research, and national parks. Privately owned lands are registered and the owner holds the title under a freehold or leasehold system.

Significant dairy production is on privately owned land, which has encouraged investment and has been a key driver in development of the dairy industry. However, the potential dairy lands are diminishing, especially in the highlands where population pressure is high and land market is active.

Because of the rapid increase in population, land per capita fell sharply in the highlands during the 1980-1990s, which necessitates a change in agricultural policy towards a focus on productivity, intensification and diversification of agricultural activities. The low land per capita has contributed to rapid conversion of some high potential dairy areas for residential, horticulture and other emerging uses. Much of the agricultural land is however under-utilised. Smallholders who produce over 70% of the milk and crops utilise only 60 per cent of their crop land for agricultural production. Increase in productivity, therefore, will need to take place in the smallholder sub-sector and will involve efforts encouraging farmers to transform their subsistence to commercial enterprises.

3.3.4. Challenges in improving competitiveness in milk production

Most estimates of milk production costs in the 1990s and earlier indicated that the farmer was making losses if milk was sold through the formal market to KCC. Several recent studies of smallholder dairy production show they are competitive. On average, they operate at 75.48% level of technical efficiency from a study of milk producing smallholder farms in Trans nzoia and Kakamega (Mungayo, 2010) reproduced Figure 5.

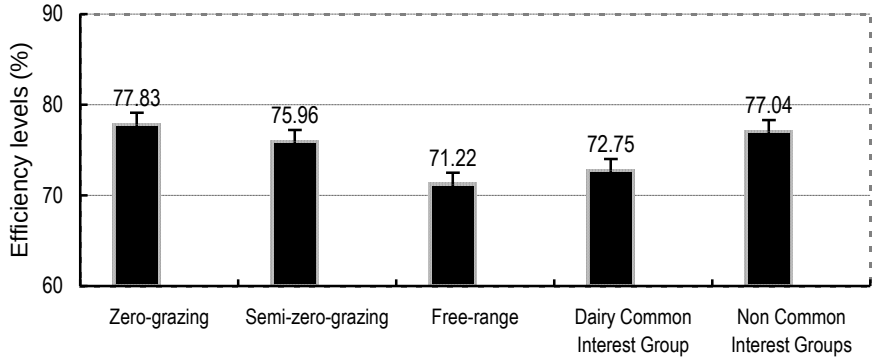


Figure 5: Mean technical efficiency in the milk production systems

Efficiency increased with increasing intensification from free-grazing (71.22%), through semi-zero-grazing (75.93%) to zero-grazing (77.83%) farms. Membership to Dairy Common Interest Groups, a new extension approach of commercialising milk production, is however not translating to better technical efficiency performance compared to remaining under conventional extension. Higher efficiency is achieved with use of more inputs: feed, veterinary services, labour and capital, with which farmers realise higher profit margins of 50 to 67% in free grazing than 31% attained in zero-grazing, as illustrated in Table 8.

Table 8: Costs and Return in Small scale Dairy Production Systems – (Payment to farmer 14/- per litre)

Variable costs	Numbers			Percentages (%)		
	Free grazing		Zero grazing	Free grazing		Zero grazing
	Nakuru	Nandi	Kiambu	Nakuru	Nandi	Kiambu
Labour	2.8	1.89	4.98	39.9%	51.8%	40.2%
Supplements	0.63	0.39	4.75	9.0%	10.7%	38.4%
Other Feeds	1.17	0.04	2.17	16.7%	1.1%	17.5%
Dewormers	0.65	0.18	0.13	9.3%	4.9%	1.1%
Vet Services	0.24	0.31	0.19	3.4%	8.5%	1.5%
AI	Bulls	Bulls	0.12	Bulls	Bulls	Bulls
Chemicals/Acaricides	1	0.84	0.04	14.2%	23.0%	0.3%
Salt	0.53	0.21	0.55	7.5%	5.8%	4.4%
Others	-	-	-	-	-	1.5%
Total	7.02	3.65	12.38	100.0%	100.0%	100.0%
Profit Margin	6.98	7.35	5.62			
Profit Margin %	50%	67%	31%			
% of supplements	9%	11%	38%			

Source: Tegemeo Institute – adapted from Nyoro, J.K., Wanzala, Maria and Awuor, Tom. Increasing Kenya's Agricultural Competitiveness: Farm level Issues (September 2001)

Table 9: Dairy Production Costs in Smallholder Farms in – Uasin Gishu

Cost Centre	Amount (K.shs)	Percentage (%)	Basis of calculations
Fixed Costs	8,550	10.9%	Milk – Total Litres = 7320
Variable Costs			Total Marketed Litres = 5490
1. Feeds and Salt	36,336	46.5	
2. Acaricides	3,036	3.9	*Costs of Production K.shs/Litre*
3. Dewormers	3,120	4.0	Total Milk = 12.30
4. Other drugs	2,880	3.7	Marketed = 16.40
5. A.I. Services	160		KCC price /Litre of milk = 14.00
6. Veterinary services	100	0.1	
7. Labour	15,600	20.0	
8. Transport	8,335	10.7	
Total costs	78,117		

Source: ASIP Secretariat, 1995. Agricultural Sector Review, Ministry of Agriculture, Livestock and Marketing (Section on Milk Production and Marketing)

The competitiveness is dependent costs of inputs, farm gate milk prices, geographical location of the producer, type and breed of the dairy animal and the feeding regime. Milk prices the formal markets are 14.63% lower than production costs for marketed milk (Table 9).

Box 1 is calculation based on 2006 information from Nairobi peri-urban milk producing farms on estimated annual return to family labour or the family earning from the dairy farm and is compared with non-dairy enterprises and employment. It showed that monthly family earning from the dairy enterprise, which can be considered as monthly salary for the head of the family, is a good return compared to alternative employment, which may also not be readily available.

Box 1: Income analysis for an Intensive Smallholder Dairy Farm for 2007 calculation for a Nairobi, dairy farmer using 2006 expenditures in Kenya shillings

Annual Gross Farm Revenue			
Milk sales	-	405,000	
Sale of bull calves (2)	-	8,400	
Sale of cow cull (1)	-	20,000	
Sale of manure (18 tons)	-	18,000	
		451,400	
Less variable costs			
Dairy feed (forages + concentrate)	-	162,000	
Labour (casual)	-	72,000	
Animal health	-	24,000	
Breeding (A.I)	-	3,000	
Structure maintenance	-	1,000	
Mortality (loss)	-	4,000	
Total		**266,000**	
Gross Margin		**185,400**	
Overheads			
Land rent	-	4,500	
Depreciation of cattle shed and Machinery (chaff cutter)	-	2,000	
Total		**6,500**	
Net farm income			**178,900**
Loan repayment			26,000
Value of milk consumed at home	-		18,250
Annual Family earning (152,900 + 18,250)			**171,150**

3.3.5. Challenges in feeding to improve milk productivity

Animal milk productivity in all milk producing livestock is presently low because feeding is based on use of crop residues, pastures and fodder which are supplemented with agro industrial by-products and limited concentrates for energy, protein, minerals and vitamins.

The constraints to address are summarised in Table 10 and includes inadequate quantity and quality of feeds offered, fluctuating high prices and quality of the commercial concentrates. Water availability and quality is a concern often ignored. In a study of costs and return in small scale dairy production systems, the profit margin on milk production on free grazing with minimal supplements was almost twice that of zero grazing (Tegemeo Institute, 2001). Improved feeding alone would yield immediate responses because farmers feed below the animal production potential.

Table 10: Issues identified as constraints, suggested remedies and actions

Issue	Strategic objective	Strategic Actions
Quantity	Increase	Higher yielding forage varieties, fertilizer application, avail certified seeds, eco-zone matching, Research
Quality	Improve	Better forage and pasture varieties, better management of forages (manure/fertilizer), quality control (concentrates) thro KeBS and self regulation thro AKEFEMA, Research
Fluctuations	Reduce	Feed conservation (hay and silage), use of non-conventional feed resources
Cost	Reduce	Increase availability of raw materials for concentrates thro domestic production, Strategic small scale feed mills (dairy coops at local level), bulk purchases, homemade rations, increased used of locally grown raw materials, importation of cheap grain for animals
Knowledge	Increase	Training in nutrient needs, feed quality assessment, feeding management, feed conservation, Improve and fund extension services, increase research extension linkages.
Trade malpractice	Strengthen regulator services	Regular inspections and transparent licensing of feed miller by authorities – KEBS, MoLD, enact and enforce Feeds Bill

Feeds constitute production costs of up to 56% under zero grazing and between 11 and 25% under free grazing (Tegemeo Institute, 2001). The strategies to achieve and sustain high quality level feeds for high milk productivity are in livestock feeds policy- (2009) draft meant to address

the short and long term objectives. Seasonality of feed quantity and quality with rainfall seasonality patterns is one cause of fluctuation in milk production, glut in wet season and deficiency in dry season. This can be evened out with feed conservation during excess for use in the deficit period. The other alternative is to pay premium for milk delivered in the dry season.

Based on the ministry reported herd structures in Table 11; the consumption of dairy concentrate per adult cow can be estimated to the levels computed in Table 12 for the adult cows only dairy per feeding practice. Table 13 is a comparison of the price of milk with that of concentrate to illustrate the relationship between concentrate use and farm-gate price of milk. In 2009, the price of milk increased which is reflected by the higher cost of concentrate.

Table 11: Dairy Herd Structure reported by ministry in 2005

Cows	Heifer over 1 year	Heifer under 1 year	Bulls and bull calves	Steers
45 - 55%	9 - 11%	12 - 14%	15 - 19%	11 - 13%

Table 12: Estimated concentrate intake by milking cows (1996-2006)

Year	Dairy cow population	Milking cows (45%)	Dairy concentrate	Kg/cow/yr*
1996	3.2	1.4400	98,147	68.2
1997	3.4	1.5300	120,640	78.8
1998	3.282	1.4769	130,613	88.4
1999	3.393	1.5269	145,418	95.2
2000	3.310	1.4895	148,306	99.6
2001	3.288	1.4796	154,980	104.7
2002	3.505	1.5773	158,001	100.2
2003	3.473	1.5629	163,469	104.6
2004	3.448	1.5516	165,104	106.4
2005	3.497	1.5737	167,300	106.3
2006	3.3	1.4850	172,500	116.2

Table 13: Trends in farm-gate prices of milk compared to price of concentrates

Year	Farm gate (K.shs/kg)	% increase	Cost of concentrate /70kg bag	% increase
2000	15*		780**	
2001	13	-13.3	780	0.0
2002	14	7.7	800	2.6
2003	14	0.0	830	3.8
2004	16	14.3	840	1.2
2005	16	0.0	900	7.1
2006	18	12.5	870	-3.3
2007	20	11.1	940	8.0
2008	22	10.0	1300	38.3
2009	24	0.1	1230	-5.4

*Average purchase by different processors throughout the year
**Average retail price of several manufacturers throughout the year.

3.3.6. Challenges in herd health to improve milk productivity

The three categories of disease presenting challenges to improving productivity of the dairy herd are trans-boundary diseases, tick borne diseases and diseases of intensification, mainly metabolic and mastitis disease incidences.

Tran boundary Animal Diseases (TADs) likely to impact negatively on the dairy industry are: Foot and mouth Disease (FMD) and Lumpy Skin Disease (LSD). Outbreaks of TADS present threats to sustainable productivity and viability of the dairy industry. The dairy industry is vulnerable. Direct economic losses are through mortality, reduced productivity, lowered product quality and lost trade opportunities (FAO, 2006). Outbreaks of TADS are more frequent with change in climate (droughts, floods – El Niño phenomenon). For instance in 2005/06 when the country experienced a severe drought, loss of livestock estimated K.shs 23 billion, pastoral households left without source of livelihood estimated over 14,000.

Indirect economic losses include increased sanitary and phytosanitary barriers to trade, possibility for trade disputes, increased food scarcity and prices, increased costs of health inspection and trade insurance and scare in tourism industry. Detection of any TADS outbreak in most of cases forces government to redirect huge amount of development funds to emergency responses, which planned management adaptations could minimise.

Outbreaks of these diseases are associated with reduced milk production and barriers to market during quarantine regulations not allowing sale of products to consumers. Recent survey findings summarised in Table 14 show that the prevalence of FMD in Kenya is 30%, 7% in Uganda and

5.9% in Rwanda. The prevalence of LSD in Kenya is 5.5%, in Uganda 19.6% and in Rwanda 5.9%. The objective is to contain prevalence of these two diseases to less than 3% per year.

Table 14: Percentage of households reporting common animal health problems in Kenya, Uganda, and Rwanda - 2009

Animal Health Problems	Dairy households indicating Animal Health Problems							
	All dairy households (n=652)	%	Kenya (n=253)	%	Uganda (n=230)	%	Rwanda (n=169)	%
East Coast Fever	276	42.3	126	49.8	134	58.3	16	9.5
Foot and Mouth Disease	97	14.9	77	30.4	16	7.0	4	2.4
Trypanosomosis	97	14.9	27	10.7	53	23.0	17	10.1
Lumpy skin disease	69	10.6	14	5.5	45	19.6	10	5.9
Mastitis	48	7.4	37	14.6	8	3.5	3	1.8

Source: EADD Report, 2009

Planned adaptation is prerequisite for minimising adverse effects of climate-related TADS when outbreaks occur. This involves understanding vulnerability of a system as first step in the prioritisation of planned management adaptation measures. This is based on the understanding of the likelihood of change, vulnerability of the specific production system and knowledge about the local-scale possibilities for adaptation. Vulnerability is a function of exposure to climate factors, sensitivity to the change and capacity to adapt to the change. The strategic actions needed is to undertake vulnerability assessment of dairy production systems, enhancing knowledge and information capture to build accurate knowledge of status, revitalise diagnostic and surveillance facilities.

Tick borne diseases constitute the largest component of all animal diseases that impact negatively on the dairy industry. The major diseases cited in this group are East Coast Fever (ECF), Heart Water (Babesiosis) and Anaplasmosis. East Coast Fever is the disease of importance to farmers: 49.8% in Kenya, 58.3% Uganda and 9.5% in Rwanda. Prevalence is high in areas with extensive free grazing pastures and in semi-intensive paddock grazing herds in lowland areas where risk reaches 30% per year and account for over half of all clinical cases. Risks in the highlands particularly in stall-fed dairies are less than 3% per annum.

The impact of tick born diseases is through high mortality rates and high cost of control through the use of acaricides and chemo-therapy. The high percentage of tick borne diseases recorded is attributed to the break down management of dips following the withdrawal of government support

in 1993. Since withdraw of this delivery support most smallholder farmers now use hand spraying of acaricides. At the present time (2010) it is estimated that less than 50% of the communal dips are operational in most areas in Kenya.

Strategic action needed is containing frequent misuse and abuse of drugs and high frequency of non compliance with withdrawal and correct dose rate. An integrated disease control strategy is therefore recommended to reduce costs and reach more farmers. In the high dairy concentration areas, incentives for private diagnostics are recommended.

Common diseases of intensification are metabolic, mastitis and lameness, which are of greatest importance in high yielding animals. Metabolic diseases of importance are milk fever, which frequently occur the time of parturition and lactating animal. The prevalence of this disease is less than 1% but cases may rise if mineral feeding supplements are inadequate. Lameness in dairy animals is a condition associated with dirty stalls and wet muddy or stony floors, which may predominate with heavy rains experienced with the changing climate. Increased incidences have been noticed with feeding lactating cows with high energy concentrates in the absence of regular mineral supplementation. Though cattle are predisposed to lameness and foot lesions due to confinement in the zero-grazing housing conditions, the incidence of lameness is less than 2% per month in a herd.

The prevalence of mastitis in dairy animals in Kenya has not been adequately established. However, a recent study (EDDP 2009) (Table 12) the prevalence of mastitis in Kenya was shown to be 14.6%, in Uganda 3.5% whereas in Rwanda it was 1.8%. In a similar study (Shitandi *et al*, 2002) conducted in Rift Valley dairy farms, the prevalence of clinical mastitis was 19.6 % (n=49) at cow level. These studies clearly show that mastitis is a major problem on dairy farms in Kenya and requires appropriate attention.

With the milk productivity targeted increases, ensuring that animals remain healthy all the time is priority management agenda. Mastitis causes significant losses to the dairy industry and affects milk hygienic and sanitary features. It is also of nutritional and great technological significance in milk processing as valuable components like lactose, fat and casein are decreased while undesirable components like ions and enzymes are increased of mastitis respond well to treatment.

3.4. Improving Milk Marketing

3.4.1. Improving milk collection

Transportation of milk from dairy farmers to the informal and formal markets is undertaken primarily by milk traders. The high cost of milk transportation in Kenya, relative to other successful dairy producing countries, has been attributed to the poor state of roads in milk producing areas. Poor roads are also a contributing factor to high incidences of spillage and delays in milk deliveries to cooling centres and processors, which results in wastage and reduction in milk quality. Simple transportation systems such as animal drawn carts, bicycles and small pickup trucks are utilized to transport milk from dairy farms to informal and formal markets. The margins made by middlemen for the transportation of raw milk from dairy farms to the informal and formal markets have been noted to be high.

Transportation of raw milk from processors' owned cooling centres to dairy processors is a function undertaken mainly by the dairy processors themselves, who utilize specially adapted heavy trucks to transport the chilled raw milk. Learning from previous KCC experience, improvement in transport system may be brought about by observing the following:

Processors take milk on contractual arrangements with farmers, but responsible business practices, contract enforcement mechanism and dispute resolution mechanisms in the sector are wanting. Frequent cases of processors violating contract terms with farmers include overly delayed payments and not collecting milk. Farmers on the hand violate contract terms frequently by receiving farm inputs on loans but diverting milk deliveries elsewhere to avoid meeting their loan repayment obligations. A strategic action is to commit to agreeable accord of good practice similar to the one existing in the horticulture industry. A low cost dispute resolution mechanism need be worked out by the stakeholders. It will be necessary to set up an industry umbrella association within the sector where the stakeholders can dialogue and lobby. The Government is planning to set up a tribunal to handle livestock industry disputes.

The Kenya Co-operative Creameries developed and operated an organized and orderly milk collection system, which collapsed following the poor performance of KCC in 1990's and 2000's. An exemplary case is dairy co-operative unions in Meru, Nyeri, Muranga and Kiambu that developed very extensive and orderly milk collection infrastructure complete with collection routes, vehicles, sheds, testing, grading and weighing equipments. The action now is to maintain and improve these infrastructures in functional state with the rural public funds by supporting dairy co-operative to continue delivering this service.

However, many other rural dairy producing areas have poor roads despite Government investing fuel levy funds and the Constituency Development Fund to upgrade roads and improvement in rural roads. Improving governance utilization of CDF and the cess by county councils for transparency and accountability will enhance faster rural infrastructure improvement with the level of investments currently government commits.

The bulk of marketed milk in Kenya is not cooled before processing, which does pose threats in safety and quality when targeting products for export market. Most of the coolers distributed by the Kenya Rural Dairy Development Project between 1980 and 1989 are not operational either because they are uneconomical to operate or have not been properly maintained. Currently there are more than 200 milk coolers in the country including 11 major cooling plants owned by the NEW KCC.

A major constraint to setting up coolers in the rural areas is lack of connectivity to electricity supply. Even when electricity supply is available, its cost is prohibitive for small cooperative societies. The action need is for the Government to step up rural electrification and explore other cheaper and more environmentally friendly energy sources like mini-hydros and wind power and solar. Government intervention through incentives like tax exemptions and public – private sector partnerships can encourage dairy co-operatives and private investors to set up coolers.

3.4.2. Improving milk quality control and assurance

Milk testing and quality control are an essential component for the successful development of a competitive dairy industry value chain. The high cost of milk testing equipment, inadequate skills on the use of the equipment, lack of milk quality management capacity and institutional gaps present a major hindrance to quality control and assurance. Milk quality is also negatively affected by a milk payment system based on volume purchased rather than on content and composition (e.g., butter fat and protein content).

The level of hygiene in handling and storage of milk for processing directly impacts on milk quality during transportation through increased bacteria load and reduced milk quality. Smallholder milk producers and transporters less frequently observe hygiene requirements in milk handling, storage and transportation. In the informal milk market outlets, use of plastic dominate, but being difficult to clean is associated with increased bacteria content of milk.

While government regulatory service have been able to ensure proper hygiene and quality standards for milk products that flow through large–scale marketing enterprises, hygiene and quality standards assurance for dairy products handled through informal marketing channels has

remained elusive. Due to the influence of the informal market, 80% of all milk reaching consumers is not exposed to any form of quality checks or control.

The standards for marketed milk in the regional markets are in place but the main challenge is the weak enforcement mechanism. The standards currently enforced are those of East African Community (EAC) which COMESA member countries have been advocating for adoption since 2007 for purposes of expanding the dairy industry trade in the region. Adherence to the EAC standards by the all actors in the value chain presents the path to ensuring quality products in the regional market. The Kenya Dairy Board (KDB) is at advanced stage of introducing and enforcing dairy industry regulations that will promote clean milk production and handling at all levels of the value chain. The KDB has initiated national Good Manufacturing Practice (GMP) training at the Dairy Training Institute for all the value chain operators, which should be sustained to improved milk and milk products handling hygiene and safety.

Priority action is therefore to strengthen regulatory service to ensure that dairy processors and manufacturers put in place quality testing and assurance systems that conform to national and international standards. These measures include provision of incentives, for milk testing equipment procurement and installation, stakeholder sensitization on the importance of safe use of antibiotics and other veterinary drugs at farm level, training on milk testing and operation of testing equipment, and strict enforcement of quality standards for both raw and processed milk products.

3.4.3. Enhancing shifts from informal to formal marketing channels

Before the liberalization in the dairy industry in 1992, milk marketing channels were few and well defined. Between 1991 and 2010 large shifts have occurred in the proportion of milk consumed at home, marketed and the market outlets through which milk reach the consumers. The industry presently has up to seven channels through which milk reach the consumers, illustrated in Figure 6. These channels are:

CHANNEL 1: Vertical Integration – The farmer does every stage of production and marketing, except retailing. Examples include Echuka farm in Kiambu and Chesumot farm in Kericho.

CHANNEL 2: Total Vertical Integration – The farmer carries out all production and marketing functions. Examples include: Delamere Estates- Under this channel there are farmers who hawk their own raw milk.

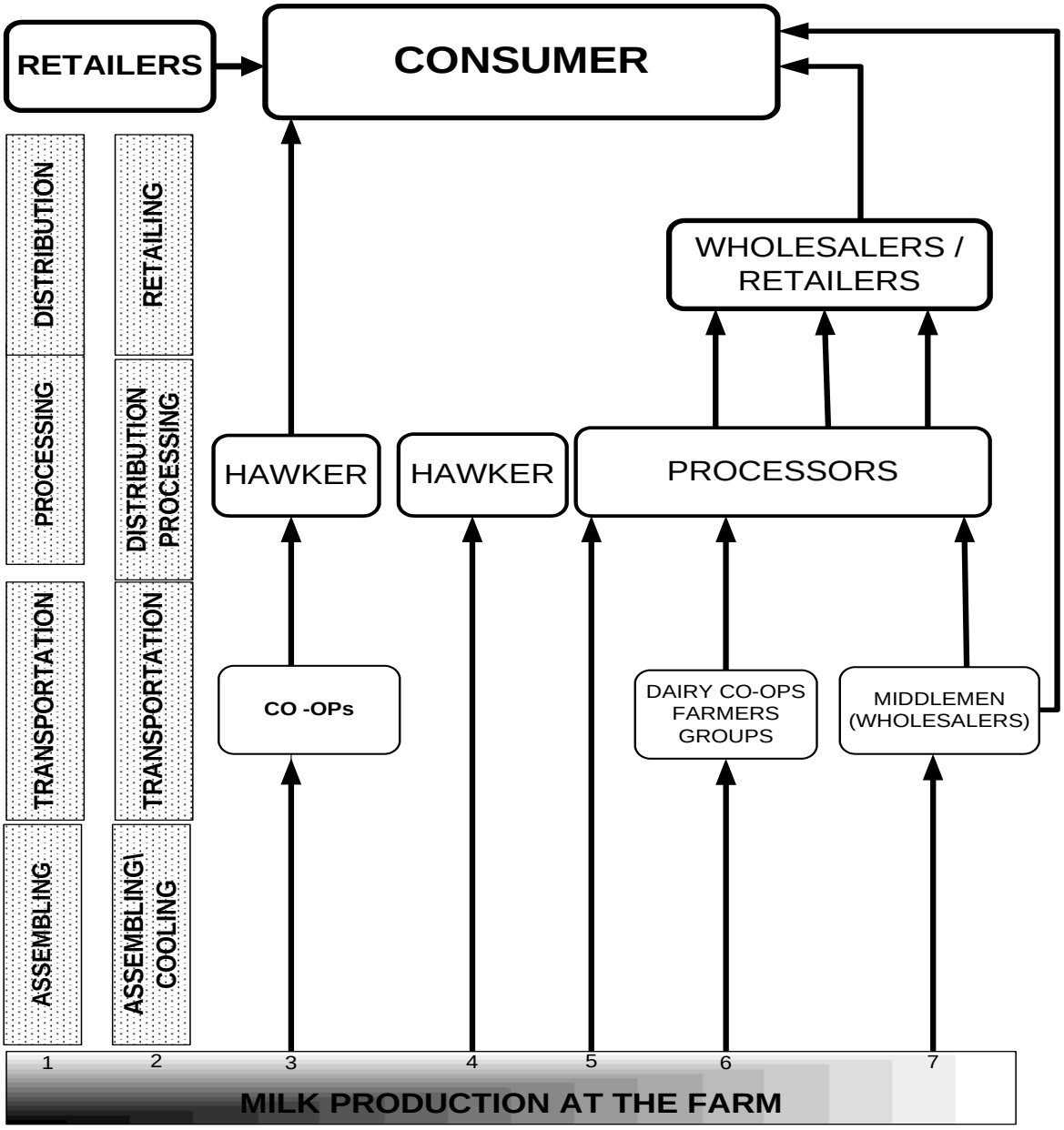


Figure 6: Milk Marketing Channel

CHANNEL 3: Common in the North Rift and parts of Central Kenya where dairy co- operatives are well established. Those co-operatives have difficulties in disposing of their milk to a processor either due to payment issues or transport difficulties.

CHANNEL 4: Farmers are far from the milk markets and there are no organized milk collection systems. Common in Uasin Gishu, Nandi and Trans Nzoia where co-operatives collapsed because of withdrawal of KCC services.

CHANNEL 5: This channel is found where there are large scale farms:- Nakuru, Timau in Meru, Uasin Gishu and Trans Nzoia. The arrangements are usually contractual. Donyo Lessos in Eldoret has such arrangements.

CHANNEL 6: This channel is common where dairy co-operatives and farmers' groups are well established – parts of Eastern Province (Greater Meru and Embu) and Central Province.

CHANNEL 7: This channel exists where there are substantial amount of milk, but the dairy societies or private business don't have processing facilities. A good example is Muranga where one businessman and two co-operative societies buy large amounts of milk cool it and sell to processors like Brookside and the New KCC.

It is estimated that informal market outlets dominated by hawkers presently handle between 55 and 70% of domestic marketed milk. While the Government appreciates the employment opportunities created for the youth in informal milk trade, there is also the worry about health implications on the population through this market outlet. In response, improved hygiene in milk handling is an action to continue with in form of training hawkers on hygienic milk handling practices, providing low cost appropriate technologies for the dairy sector; enabling these traders to acquire simple testing equipments like the lactometers and alcohol testing guns.

These small milk traders if trained and financed can fill the supply and demand gaps and collect small amounts in remote locations that cannot be easily accessible to dairy co-operatives and processors. Already they move large amounts of milk from milk surplus areas of Rift Valley to sell to milk deficit areas of Nyanza and western parts of Kenya.

Figure 7 illustrates the shifts in the proportion of milk consumed at home, marketed and market outlets to consumers between 1990 and 2010. More of the milk produced is marketed but increasingly reaching the consumers directly in raw form through informal markets, reflecting an increasing market orientation of the smallholder dairying that predominate milk production in the country.

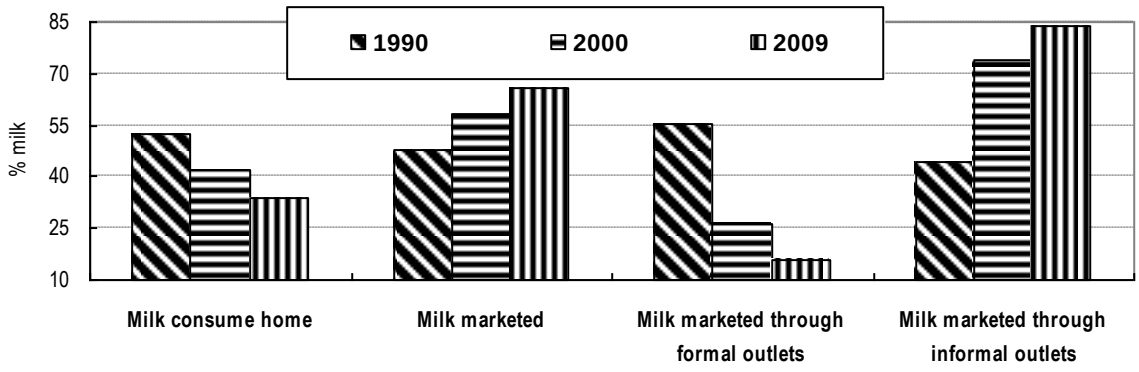


Figure 7: Shifts in the proportion of milk consumed at home, marketed and market outlets to consumers between 1990 and 2010

According to the Kenya Dairy Board, marketed milk production in 2005 was 3.32 billion litres. This is an increase of 4 percent from 2004 performance which stood at 3.2 billion litres. Only 8 percent of milk produced is processed, 24 percent is marketed unprocessed and 68 percent of unprocessed milk is consumed at household level or wasted. There has been debate on the need to increase the proportional of milk that passes through the processing channel of the dairy value chain. The target action is to shift more milk to market and a larger proportion through formal market outlets.

Using the values of 2005, the 2010 situation is projected and on their basis, the 2030 targets are set. This is represented in Figure 8 with values not shaded representing projected situation presently and those shaded representing the targeted changes by 2030. Presently the proportion of milk production marketed is 65% leaving 35% for home consumption. Of the 2.925 billion litres of milk marketed, 45% (1.316 billion litres) is handled in the formal market or through the processors. The remaining 55% (1.609 billion litres) is handled in informal market outlets dominated by hawkers. The targeted action is to shift the proportion of marketed milk in the informal market outlet from 55% in 2010 to 35% (3.350 billion litres) in 2030. The shift targeted is reducing from 35% (1.575 billion litres) in 2010 to 20% (2.552 billion) in 2030 for milk consumed at home of the total production, in order to shift milk through markets from 65% in 2010 to 75% (9.57billion litres) in 2030.

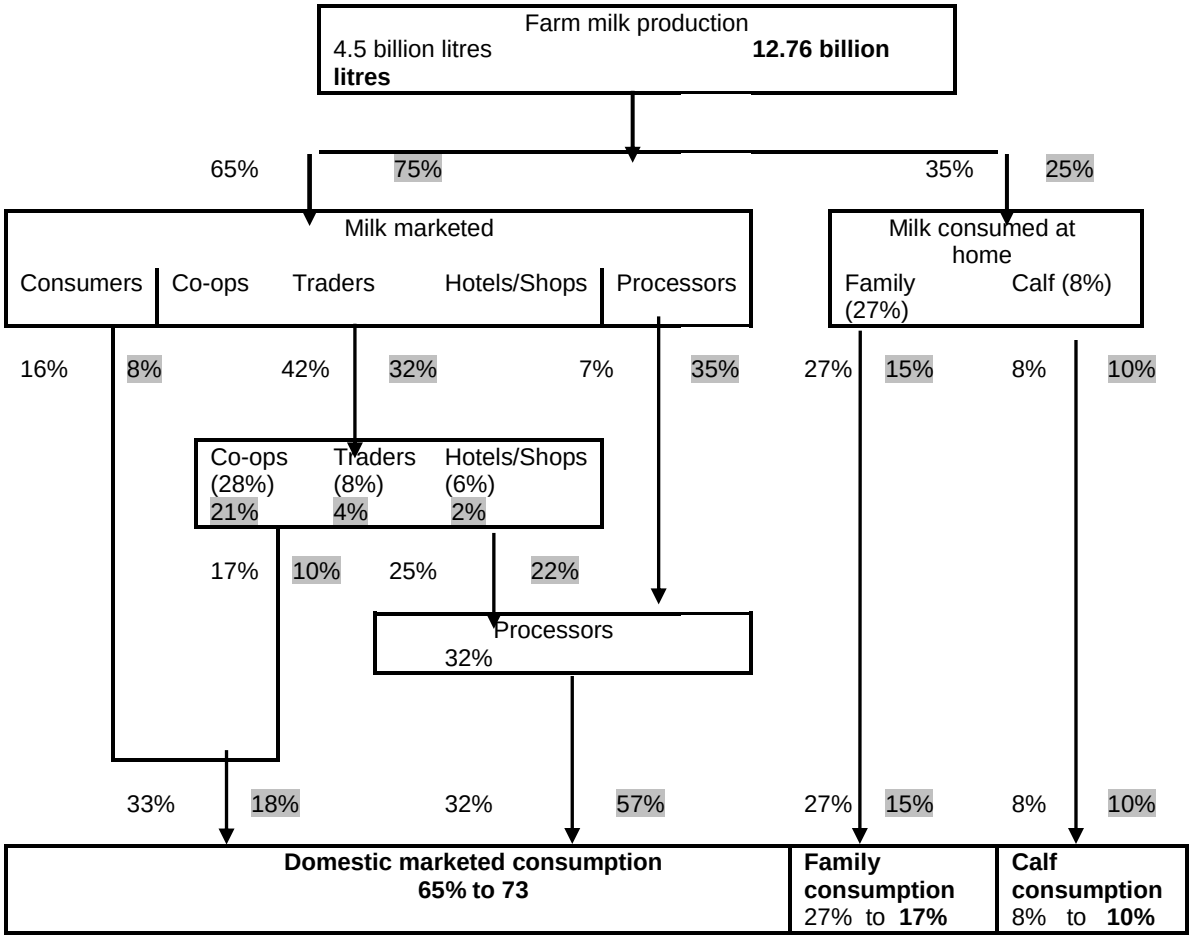


Figure 8: Projected shifts in the proportion of milk marketed through marketing outlets to 2030

3.4.4. Expanding sales of processed milk and milk products

Processed milk and milk products in Kenya constitute between 20 and 30% (0.395 billion litres) of the total marketed milk and dairy products an indication that there is a high preference for unprocessed milk. High preference for unprocessed milk compared to processed are: relatively cheaper, tastier, higher butter content, in flexible diverse quantity to customer needs, widely accessible or more within proximity of the consumers and conservative consumers with high preference for unprocessed milk.

The market segment for the processed milk and dairy products is usually referred to as the formal market sector. Traditionally, milk processors have tended to produce similar products irrespective of the target market. Some processors have, however, started looking for niche markets in the recent past. Low fat milk is such product. Others are flavoured UHT packed in

colourful and smaller packets. This type of product is popular with the youth. The other niche product is fruit yoghurt in cups. This product is also popular with the youth.

For a long time processors ignored sachet packaging for fresh milk despite the fact that the packet is popular among the poor and the lower middle class mainly because of the 2 to 3 shillings lower price difference with tetra packing. Virtually every processor now packs a significant portion of the processed milk in sachets. Githunguri Dairy Co-operative Society took lead in promoting this kind of packaging targeting the lower income groups in Eastlands of Nairobi.

The larger processors like the New KCC and Brookside Dairy should be encouraged to specialize in products like the UHT milk, cheese butter and powder milk for the local and regional markets while the smaller processors target the fresh milk, fermented milk and yoghurt for the local market. This can be institutionalized through policy like tax exemptions and promotional discounts from the Government.

There has been debate on the need to increase the proportional of milk that passes through the processing channel of the dairy value chain. It is estimated that over 60% of processed milk is sold as fresh whole/standardized milk with different levels of butterfat. Some of the whole/standardized milk is processed for long life (UHT) which is important for the market away from surplus areas.

Products such as fermented milk (mala, yoghurt), cheeses and others are mainly available in supermarkets although in some communities, a variety of these products are traditionally produced. Yoghurt and mala (fermented milk) have gained some popularity in most urban centres usually sold at Milk bars and consumed alone or with snacks as a light meal. Information on production of various dairy products is not readily available. Various Statistical Abstracts have provided generalised and incomplete information (Table 25).

To increase the level of milk production marketed through the processed channel (formal) and improve on value addition, the industry will need to aggressively promote consumption of packaged milk through price reduction on package because fresh raw milk is preferred for being cheaper.

Table 15: Milk intake and various products processed: 1996 – 2007

Year	Milk Intake (000 litres)	Processed Milk					
		Whole milk & cream (000 litres*)	Butter & ghee (Tonnes)	Cheese (Tonnes)	Dried whole milk powder (Tonnes)	Dried Skim milk powder (Tonnes)	Other products (Tonnes)
1992	362	336	4,231	218	1,493	2,731	433
1993	365	343	4,128	221	1,322	2,869	456
1994	358	204	2,409	126	2,237	2,121	218
1995	350	175	3,985	365	2,480	3,101	208
1996	257	165	1,964	426	973	2,349	349
1997	197	108	1,521	464	351	1,244	110
1998	126	83	360	342	396	434	30
1999	180	55	268	257	-	-	-
2000	137	60	113	315	139	64	-
2001	148	97	130	329	-	-	-
2002	178	128	177	448	-	-	-
2003	203	131	215	361	-	-	-
2004	274	178	563	328	-	-	-
2005	340	217	1,261	270	-	-	-
2006	361	226	1,549	243	-	-	-
2007**	423	290	1,752	215	-	-	-

Source: Compiled from information by Kenya National Bureau of Statistics, various Statistical Abstracts

* In whole milk equivalent

** Provisional

3.4.5. Improving policy and regulatory framework

Over the years policies formulation targeting dairy sector have shaped the growth of the dairy industry in Kenya. For instance, Swynnerton plan of 1954 that allowed commercial dairy farming for the Africa population, establishment of the Kenya Dairy Board to in 1954 to enforce regulations on quality of marketed milk and the standards in the dairy industry, the Structural Adjustment Programmes (SAPs) of 1986 and milk marketing and processing liberalization in 1992 that ended KCC's monopoly in milk processing and marketing and allowing for entry of new processors and milk marketers.

Liberalization policies of 1992 was somewhat implemented suddenly and without due consideration for transition process for public delivered services. Consequently those services (AI, clinical services and tick control) literally collapsed with all the attendant negative implications on the national economy, incomes and employment.

The Ministry of Livestock Development has dairy policy draft for strategy towards the development of a self- sustaining dairy industry. The policy aimed at guiding the dairy industry towards liberalization and market economy. The policy intended to hand over commercial services to farmers and the private sector while the Government provided policy and regulatory framework for the industry. The policy did not, however, solve the problems of the dairy industry mainly because there was no policy implementation programme and no adequate funding was provided to implement the programmes.

The process of reviewing the Dairy Industry Act CAP 336 to be in tune with the changing local and global environment started in 1995, but has not been completed. Indeed, the Act has never been revised despite the considerable changes that were brought into the industry by liberalization.

The process of separating feeds from fertilizers under the Fertilizer and Animal Feeds Act (CAP 345) started in 1995 and has never been completed. There have been very many unnecessary reviews of the Bill. In the meantime the quality of animal feeds is very low as the quacks have invaded the manufacturing of animal feeds and sale of animal feeds supplements. There is urgent need to take this Bill to Parliament for debate and passage.

The Kenya Government was experiencing difficulties in getting development partners support budgetary and development programmes before 2002 mainly due to disagreements on governance issues. The new Government elected into office in December 2002 developed a major policy paper: Economic Recovery Strategy (ERS) for Wealth and Employment Creation of 2003 to stimulate economic growth and development.

The strategy recognized the key role played by the agricultural sector in the national economy and recommended allocation of substantial resources to stimulate growth. The strategy acknowledged the importance of expediting the on-going reforms in agricultural sector – harmonization of agricultural legislation, harmonization of the marketing of cereals and other agricultural commodities and restructuring of marketing boards and farmers co-operatives.

The IP-ERS set specific targets that are consistent with Millennium Development Goals (MDGs) and which are intended to assist the agricultural sector realize its potential in reducing poverty and enhancing equity. The key IP-ERS targets are: Growth in the agricultural GDP should gradually increase to 3.1 percent in 2004/2005; 4 percent in 2005/2006 and 5 percent in 2006/2007;

Government had to put in place comprehensive reforms under the Strategy for Revitalizing Agriculture (SRA) in March 2004) for realising 5% growth annually in agricultural exports, increasing crop yields by 5%.

The Strategy for Revitalizing Agriculture (SRA) had the vision transforming the Kenyan agriculture to be regionally and globally competitive, made up of commercially oriented producers, accessing quality inputs and services. It aimed at providing food and nutritional security, increase incomes and gainful employment, promote farmers' productivity and lower the cost of agricultural inputs.

Several programmes and projects have been initiated to implement SRA (now ASDS): Kenya Agricultural Productivity Programme (KAPP), National Agriculture and Livestock Extension Programme (NALEP); Kenya Smallholder Dairy Commercialization Programme (KSDCP); Kenya Smallholder Irrigation Pragramme; Kilimo Biashara Programmes;

Overall the ERS and ASDS programmes are fairly well funded and some of the set targets have been met. Funds from the development partners have been pooled in one basket to implement the Agricultural Sector Development Strategy through a secretariat housed in Kilimo House. The pace of certain reforms like harmonization of legislation and implementation of value addition programmes has been very slow indeed.

The Ministry of Livestock Development together with the Stakeholders in the Livestock Industry has developed the: Dairy Industry Development Policy of 2007. The Paper has been approved by the Cabinet and is awaiting debate in Parliament to become a sessional paper. The theme of the paper: Towards a Competitive and Sustainable Dairy Industry for Economic Growth in the 21st Century and Beyond" is, indeed, appropriate.

This paper is, comprehensive and all inclusive in as far as the dairy industry issues are concerned. Policy statements are also well articulated. The Policy Paper is also complete in the sense that it has a policy implementation framework annexed to it. Currently the ministry is implementing the National Livestock Policy released in May 2008 to guide the livestock industry although sets no timeframe.

The vision 2030 prioritises ICT sector as one of the key drivers for growth and the achievement of the vision, which means that there is going to be a lot of focus in the industry and large amounts of investment resources directed into the sector.

A new effort in Kenya is in using cell technology to enhance profitability of rural farmers. The number of mobile phone subscribers increased from by 300% between 1999 and 2007 in Kenya. The Kenyan Agricultural Commodity Exchange (KACE) has linked up with Safaricom, Kenya's largest cell phone company, to equip farmers with up-to-date commodity market prices over their phones. For about $0.20, farmers can access commodity prices at markets throughout Kenya, allowing them to reduce transaction costs and bypass middlemen, who often charge below-market rates. KACE is also looking into using FM radio in rural areas to disseminate information about commodity prices at markets

3.4.6. Prospects for introducing eDairy information systems

eDairy is an innovative application of ICT towards achieving self sufficiency in national milk production. It is an effort to apply usage of information and communication technology in improving the lifestyle of the rural community that account for 70% of the country's population. The only option for easily resolving the problems faced by this community is the appropriate and effective use of ICT (Information and Communication Technology Agency of Sri Lanka).

The use of technology has become a common approach in every aspect of the life in minimising cost and time while improving on efficiency. Dairy farmers are making use of web and mobile technologies to achieve self sufficiency in milk production. User-friendly touch screen computer and SMS services have been introduced to lure the youth into this venture. Further use of the web has been introduced to make the youth generation more aware of the prospects of the dairy industry as an acceptable enterprise. There are tangible current trend of in the global community at all the levels to use ICT to bridge the existing gaps of the extension services.

Most of the industrialised countries provide a team of professionals that assist dairy industry throughout the country in the areas of;

- Dairy Business Planning
- Dairy Operations Performance Review
- Dairy Financial Projections and Analysis
- Human Resource Procurement and Management
- Continuing Education and Training Programs for Dairy Producers
- Risk Management Planning
- Dairy Performance Benchmarking
- Development of Standard Operating Procedures for Dairy Producers

The dairy industry can benefit substantially from information and communication technology (ICT) platform that enables information collection, analysis and dissemination from farmer to policy formulation level. While the value is potentially significant, fully integrated ICT solutions have not been tested at scale in Kenya,

Heifer International has initiated use of d two ICT pilots in Kenya, including use of smart cards and centralized database, and one pilot website. In the project, two ICT systems were piloted in Kenya to analyze their direct benefits and commercial viability in the dairy sector. General information of use and relevance to the industry is transmitted from central information banks to the benefit of farmers and processors where;

- Milk quality issues are recorded upon delivery
- Account balances can be updated immediately
- Animal health issues can be tracked immediately
- Facilitate spot purchases of product and price negotiations

3.5. Mainstreaming Cross cutting Issues in the Dairy Value Chain

Three cross cutting issues were identified in field surveys, which require attention. Firstly is gender mainstreaming in the dairy Industry. Opportunities in the dairy value chain are presently gender biased regarding access to production resources and information for women. First, all developmental interventions in Livestock industry and indeed Agricultural sector as a whole are likely to affect women and men differently. However, in dairy industry and in all activities pertaining to dairying, gender has been treated as neutral based on the assumption that bottlenecks and the solutions impact men and women in similar ways.

Women are the main producers in Livestock subsector. According to the National Livestock Policy (GOK 2008), women contribute between 60-80% of the labour force. Traditionally women work longer hours than men yet they lack access to land and credit facilities and are often not targeted with research and innovations. An effective gender sensitive approach in designing and implementation is to be adopted in the dairy master plan for the dairy industry in the country. Therefore, designs and implementation of interventions must recognize their roles realities. According to the Strategies for revitalizing Agriculture (GOK 2005), the government has ensured that reforms and other measures promote gender equity and the interest of the youth in the sector. The new National Dairy Master Plan must therefore take into account women and men's role and gender issues in all its components. Such issues like equitable distribution of benefits to the participating gender groups.

Gender mainstreaming is a strategy for addressing different needs, roles, and responsibilities of women, men boys and girls. It ensures that special needs and priorities of women and girls, as well as men and boys, are considered at all levels and stages of development activities. This includes design, implementation, monitoring and evaluation of planned action, including legislation, policies or programmes in any area and at all levels. Gender mainstreaming ensures more equitable and appropriate policies and programmes and outcomes.

Gender analysis is an important tool that supports gender mainstreaming processes. Gender analysis examines the roles of men and women and relationships between them. Good gender analysis is highly recommended as it will help ensure that women and men benefit equitably from dairy industry interventions. The field visits carried out in December 2009 revealed that field activities on dairying are not informed by gender analysis. It further revealed that there is acute need for capacity building in gender. District officers would shy away from talking about gender mainstreaming and further probing revealed that they lacked the skills and knowledge of gender mainstreaming. Lack of funding was another contributor to failure to gender mainstreaming. The institutions and government offices visited did not have personnel responsible for gender mainstreaming while few had personnel and limited budget for mainstreaming HIV/AIDS.

The action needed is mainstreaming gender in extension services, developing gender sensitive extension packages and adopting gender sensitive extension approaches.

Secondly, increasing insecurity in some areas discourage investment in dairy production and trade. The action needed is to improve security through strengthening of community services to and targeted Constituency Development Funds to building police posts where insecurity is a concern.

Thirdly, increasing adaptive and mitigation capacities for managing climate change impacts which impacts negatively on rain-fed and pastoral milk production. The Fourth Assessment Report (4AR) of Intergovernmental Panel on Climate Change (IPCC, 2007) together with the mapped climate vulnerability and poverty in Africa (Thornton et al., 2006) projects increased severity of climate change and variability in dairy producing agro-ecosystems. Already a number of hazards of climate change are experienced in Kenya. These include more frequent droughts, dry spells, intense rainfall and flush floods and increased heat stress. These climatic hazards are accompanied with more outbreaks of diseases and are already adversely impacting on food, health, water and income security in addition to water quality, energy and the sustainable livelihoods of the poor.

The strategic actions needed are improving better understanding of climate change implications for and adaptation in the dairy industry, low preparedness for impacts of climate variability and change, and enhancing better understanding of potential impacts to the dairy industry. The ministry and Kenya Dairy Board need to conduct regional feed base audit and systems resilience analysis, conduct regional scenario planning analysis to explore options and undertake inventory of management technologies and practices for dissemination

4. MILK DEMAND AND SUPPLY PROJECTION

4.1. Milk Demand Indicators

The DMP 1991 estimates of 1990 total domestic milk consumption were 1.52 billion litres with per capita milk consumption of 64 litres. This per capita milk consumption had a large variation: 19 litres for rural household consumption, 45 litres for own home consumption and 125 litres for urban household consumption. Marketed milk accounted for 53% (0.798 billion litres) and home consumption 47% (0.722 billion litres). Nairobi and Mombasa alone accounted for 83.6% of the total urban milk demand and their population grew at 7 to 9% between 1981 and 1990.

Table 16: Demand Indicators for milk in Kenya between 1995 and 2010

Year	Population (000)	Population Annual Growth % Rate	Annual Growth Rate (GDP %)	Per Capita GDP (US$)
1995	27,521	3.1	5.5	275
1996	28,274	3.0	5.5	281
1997	29,205	2.9	5.8	289
1998	30,073	2.8	5.8	298
1999	30,975	2.7	5.8	307
2000	31,750	2.7	5.9	317
2001	32,607	2.6	6.3	329
2002	33,455	2.6	6.7	342
2003	34,325	2.6	6.7 (2.9)*	356
2004	35,217	2.5	6.7 (5.1)	371
2005	36,097	2.5	6.7 (5.7)	387
2006	36,963	2.4	6.8 (6.1)	404
2007	37,550	2.4	8.2 (7.1)	427
2008	38,721	2.3	8.2 (1.7)	452
2009	39,612	2.3	8.3 (2.5)	479
2010	40,483	2.2	8.3	509

Source: Industrial Transformation to the year 2020: Session Paper No. 2 of 1996 and Kenya Bureau of Statistics (KNBS, 2008),

( ) * Actual GDP Growth Rate

Under most probable growth scenario expecting rise in urban milk demand with growth in per capita income and in urban population, DMP 1991 projected urban milk demand to increase to 61.2% of the 1.195 billion litres of milk marketed in 2000 and to 67.0% of the 1.536 billion litres of milk marketed in 2005. These projected growths represent growth of factor 1.1 in total domestic demand and factor 2.85 in urban demands. The dramatic increase in the urban milk demand corresponds to 45 to 49% higher milk per capital consumption than is in the rural households (SDP, 2000). According to 2008 National Consumer Price Index (CPI), milk and dairy products

take 10.57 % out of a total of 234 items in the basket. Table 16 presents the demand indicators for milk in Kenya between 1995 and 2010.

The annual growth rate in the human population is 2.6%, actual GDP growth 4.4% but with fluctuations between 1.7 and 7.1% and per capita GDP growth by 364 US$ annually, which represent 5% annual growth. Global milk market has recently recorded unprecedented rise in milk prices, doubling from $28 per 100kg to over $60 just in 2007. These are strong signals for continued steady rise in milk consumption demands.

4.2. School Milk Programme

Of the 1.52 billion litres of milk marketed in 1990, 6% was intake by the Government run School Milk Programme (SMP). This Programme had a goal of having each child in Kenya consume 0.4 litres of milk per week during the 40 weeks of school year to improve their nutritional status and also to provide milk market for the KCC especially during the glut periods. The programme provided KCC a substantial market for UHT processed milk which in 1988 represented 13.5% by volume and 19% by value of all KCC sales.

Though the programme accounted for 6% of the entire marketed milk, the actual demand was higher, estimated at 10% of all marketed milk at that time, but KCC could meet only 48.2% of the orders in 1987/88 and 63.9% in 1988/89. The government was unable to sustain the Programme due to:

- *Infrastructure:* poor roads was a major challenge to cost of and delivery of milk on time
- *Wrong recipients*: Milk was often delivered to the children of middle income families and of dairy farmers who did not need the milk. A survey in Meru District, by the University of Helsinki in 1985 indicated that 90% of the members of dairy co-operatives considered their children not needing the school milk.
- *The cost:* The Ministry of Education spent huge amounts of funds on this programme against many other priority areas of expenditure.

The enrolment in primary schools across the country in 2008 was about 8,563,700 children of 6 to 16 years old and about 9,420,000 children in 2010. Assuming an allocation of 0.4 litres of milk per child per week for the 40 weeks' academic year and coverage of 60% (5,652,000); demand would be 90,432,000 litres per year, representing 2.0% of domestic milk production or 3.6% of the marketed milk. The Programme would cost a huge amount of money, over K.shs 5,425,920,000 annually.

Notwithstanding the associated logistical and costs issues, the Programme provides a significant market outlet for milk. However, the challenges of the earlier programme are still there were the government to engage in a similar programme. Therefore, it is best not to revive the school milk programme under similar administrative and policy frameworks of the 1980 to 1990s. A feasibility study for its viability under present circumstances is recommended.

4.3. Urban Milk Demand

The highest demand for milk in Kenya is in the urban areas where per capita incomes are highest. The urban population growth is rapid with a change in the total population from 24% in 1999 to 30% in 2010. The projected urban demand is an average rate of 5% which has to be met with domestic production because Kenyan milk consumers have a strong preference for liquid fresh milk. Rising global milk price is an indication of expanding opportunities for opening the hitherto access barriers to global market for smallholders from which they can earn more from their milk as some manufactures seek alternative, less expensive milk.

The urban milk demand in 2010 is estimated at 1,348,083,900 litres, based on 30% urban population (12, 144,900 people) of the estimated 40,483,000 people with per capita milk consumption of 111 litres. With 2010 total milk production estimated at 4,500,000,000 litres, the urban milk consumption represent 29.9% of the domestic milk production

4.4. Milk Exports

Total volume exported in 2007 is less than 15 million litres in liquid milk equivalent (LME). This is about 3.5% of the total milk processed in the country, less than 1% of the dairy cattle production and about 2% of the marketed production. The volume of 2007 imports was less than 3 million litres LME, about 20% of the exports and less than 1% of the processed milk.

The potential to produce surplus for export exists with the large dairy herd, but productivity is below the animals' genetic potentials. The potential export market is large, given that the immediate neighbours including Tanzania, Rwanda, Burundi, Somali and the other countries in the West and Central Africa regional such as DRC, Gabon, Mali, Senegal countries are all milk deficit countries. Strategic action needed is to improve productivity per cow as opposed to increasing the number of cows, in line with the concerns of green house gas emissions by cows as well as the dwindling feed resources.

4.5. Milk Imports

Kenya imports only 2% of the processed milk and milk products to take care of certain consumer tastes and preferences mainly for the tourists and the expatriate staff in the country. This demand is not expected to grow significantly for various reasons:

- The expatriate community in Kenya is small and has remained constant over the years;
- A decline in milk and milk products imports in the recent past
- Kenyan dairy processors are diversifying their products range to meet various demands and tastes
- Limited local market for milk powder, the most common form of imported milk, because a large population of Kenyan communities are strongly conservative fresh milk consumers.

4.6. Milk Demand Projections

The projection of milk demand is based on trends of the past 20 years (Table 17) in human population growth, income growth, domestic milk production and consumption with simple growth rate model: $D_t = d_o * N_t (1+ y * e)^t$; where, D_t is the demand in year t; d_o is the per capita demand in the base year; y is the growth in per capita income; e is the expenditure elasticity of demand; and N_t is the projected population in year t. The demand comprise of home consumption, consumption by calves, milk sold to neighbours and milk marketed. A wastage/spoilage of 3% is allowed in calculating the per capita consumption.

Table 18 gives the projected human population, total milk demand and per capita milk consumption for 2010 to 2030 period. Growth will be at rates slightly lower than those previously attained between 2000 and 2010, highest between 2010 and 2015 then decline gradually towards the year 2030. Growth in population is projected to decrease from 2.37% between 2010 and 2010 to 1.53% between 2025 and 2030 while growth in milk demand estimated at 7.40% between 2010 and 2030 is to decline to 3.86% between 2025 and 2030. The growth in per capita milk is projected to decline from 4.92% between 2010 and 2015 to 2.32% between 2025 and 2030.

The per capita milk demand is projected to double from 111 litres in 2010 to 220 litres in 2030 and the total domestic milk demand increasing 2.83 folds from 4.5 billion litres to 12.76 billion litres. The economic growth of 10% envisaged to 2030 together with the growing urbanisation and urban population are good indicators for attaining this per capita milk consumption of 220 litres by 2030. Some estimates already put per capita milk consumption in Kenya at 145 litres, one of the highest Africa (ILRI, 2007).

Table 17: Milk demand projection variables

Year	Population (000)	Milk production (millions litres)	Inflation rate (%/y)	Per capita GDP (k.shs/y)	Per capita milk consumption (Lts)
1990	23715	2450	15.8	17802	64.0
1991	24477	2530	19.6	18334	68.6
1992	25240	2365	27.3	18882	72.2
1993	26002	2360	46	19446	77.5
1994	26762	2368	28.8	20027	83.6
1995	27521	2448	1.6	20625	86.3
1996	28274	2396	9.0	21075	82.2
1997	29205	2449	11.2	21675	81.3
1998	30073	2654	6.6	22350	85.6
1999	30975	2672	5.8	23025	83.7
2000	31750	2639	10.0	23775	80.6
2001	32607	2796	5.8	24675	83.2
2002	33455	3132	2.0	25650	90.8
2003	34325	2196	9.8	26700	62.1
2004	35217	2300	11.6	32457	90.9
2005	36097	3400	10.3	33441	91.4
2006	36963	3500	14.5	35510	91.9
2007	37550	3800	9.8	36000	98.2
2008	38721	4000	26.2	35611	102.2
2009	39612	4200	2.0	35925	105.9
2010	40483*	4500*	4.5*	37500*	110.0*

Source: Kenya National Bureau of Statistics (KNBS), Ministry of Livestock Development and estimates for 2010 (* 2010 values are provisional estimates)

Table 18: Milk demand projections and growth rates at 5 year intervals from 2000 to 2030

Year	Human population		Milk demand		Per capita milk consumption	
	people	Rate %*	(Litres)	Rate %*	(Litres)	Rate %*
2005	36,097,000	2.60*	3,299,266,000	8.13	91.4	5.54*
2010	40,483,000	2.32	4,500,000,000	5.84	111.0	3.85
2015	45,513,400	2.37	6,430,593,195	7.40	141.0	4.92
2020	49,705,400	1.78	8,448,150,000	5.61	170.0	3.77
2025	53,897,400	1.63	10,556,587,691	4.56	196.0	2.88
2030	58,089,400	1.53	12,760,000,000	3.86	220.0	2.32

* Average annual growth rate calculated for 4 year intervals of 2000 to 2005; 2005 to 2010; …..; 2025 to 2030

4.7. Milk Supply

Data available are inconsistent in determining the level of milk supply in Kenya. Reports reviewed are in consensus that Kenya attains self-sufficiency with exportable quantities and surplus milk during wet seasons (ILRI, 2007). Analyses of milk supply have identified farm gate price, animal productivity, herd size, access to support services and rainfall patterns as determinants for the domestic milk supply.

4.7.1. Farm-gate milk prices

Both producer and consumer milk prices in Kenya were government controlled before market liberalisation and price decontrol effected from May 1992. KCC which was quasi-government with monopoly in the dairy industry set formal market milk prices until 2000 when it collapsed. The real milk producer prices (deflated) since 1989 illustrated in Figure 11 indicates that producers were better paid before 1997 (from Kush 15.30 in 1989 to Kush. 7.70 in 2008) although in the nominal (current) prices have been rising from Kush. 3.75 in 1989 to Kush. 22 in 2008.

Presently, milk pricing mechanism in Kenya is complex because of multiple market channels dominated by informal market players. Those selling in the formal market are price takers. Milk prices are set by the 2 leading processors in the country presently. The farm gate price or the net realisable price is the factory gate price adjusted for transportation and other handling costs. Currently the price farmer gets ranges from about Kush 20 in some rural areas, Kush 35 in peri-urban areas to Kush 60 per litre in Nairobi market outlets such as high/tourist class hotels and other elite consumers.

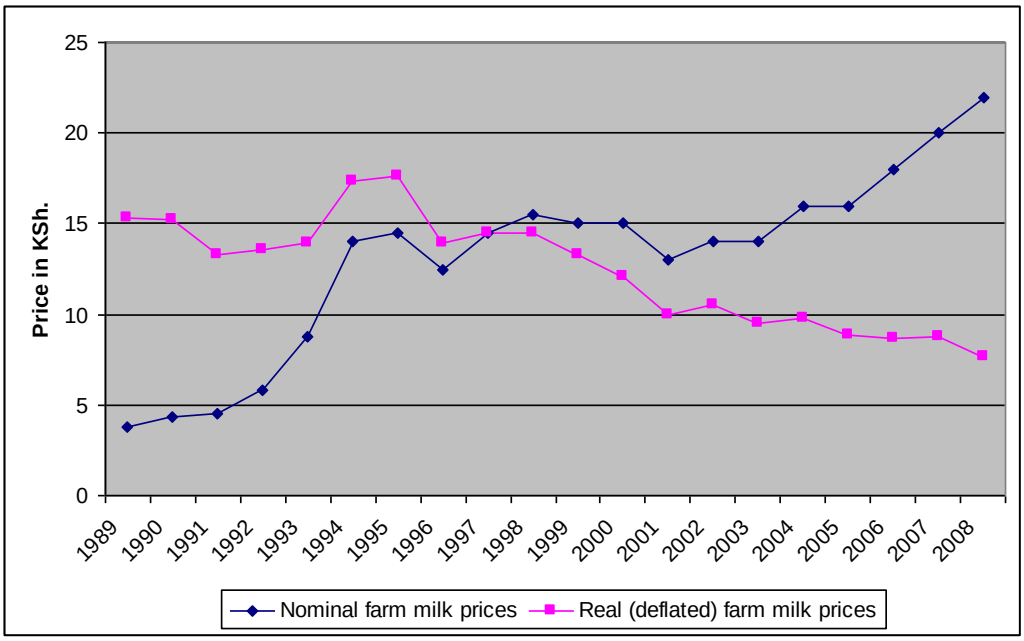


Figure 9: Dairy producer prices (nominal and deflated) 1989 - 2008

The recent last 3 years have had improved farm-gate milk prices (Figure 9) because of increased local competition and improved international prices. A comparative milk prices summary in Table 19 show Kenyan milk prices to be more competitive over those of the major world milk producing regions – New Zealand, USA and Europe, but not over those of regional neighbouring markets (Tanzania and Uganda).

Table 19: Comparison of international prices in Kenya shillings Equivalent per kilogram of milk

Country	July 05	February 07	2008
	Rolling price average last 12 months	Rolling price average last 12 months	Price
Europe average milk price	27.0	26.27	37.7
New Zealand	17.1	15.23	25.2
United States of America	26.9	21.80	32
Kenya	17	17	22
Uganda		13	
Tanzania		14.85	

Exchange Rate used – Kush. 93 =1 Euro for 2005 and 2007 and Kush. 109 = 1 Euro

Source: LTO-International Milk Price Comparison (www.milkprices.nl: accessed on 30th June 2010) and personal communication

Though Kenyan milk price are competitive over those of industrialised countries, they are not potential export markets because market penetrate would be difficult given the stringent quality and safety requirements. The potential milk export market is in the regional neighbouring markets where milk deficits are experienced, but will require strategic actions of producing local milk more competitively to penetrate.

4.7.2. Seasonal fluctuation in milk supply

Milk production in Kenya is rainfed pasture based system with marked seasonal fluctuations. The drop in milk supply in dry season reaches 50 to 70% of the wet season supply when quantity and quality of pastures are high and support high productivity. The formal milk intake illustrated in Figure 10 captures this seasonal milk supply prominently, showing marked intake decline from February through May and from July through October.

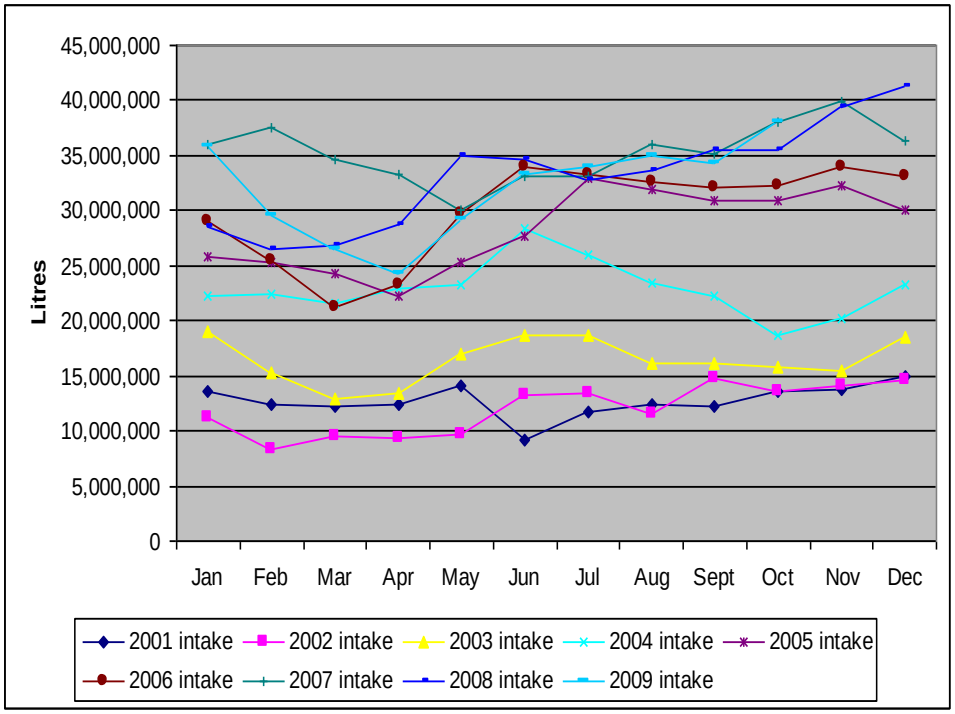


Figure 10: Monthly milk intake in the formal (2001 – 2009)

Fluctuations in milk production presents losses to producers but also processors as recently experienced with oversupply of milk during normally dry seasons of December and January when off season (El Nino) rains were received. Demand remains almost the same while the supply is in excess production without matching processing capacity for production of long lasting products such as milk powders and UHT. Fluctuating milk supply increase operational costs to processors

in maintaining processing equipments for long lasting products because active use is only for a fraction of the year.

While the existing milk processing are generally under operating below their capacities, what is needed in terms of strategy are expansion of conversion of liquid milk to powdered milk processing and storage capacities so that during excess production excess milk that can't get to the regional export markets can be powdered and later reconstituted as and when needed.

4.7.3. Models for projection of milk supply

Milk supply projections for Kenya have applied several models in form of market supply function, production extrapolation or trend variables regression. The models fit diverse variables to explain milk supply, reflecting data availability and the objective of estimation. Using the model outputs, differences are computed in the projected estimates from the reported estimates or actual supply as summarised in Table 20 and 21. This reveals large variation in estimates with under estimation evident, except for estimations of the ministry which have smaller deviations relative to the others.

Table 20: The projected milk supply from 1995 to 2009 by different authors and their differences with the reported estimates or actual supply

Year	Projected milk supply (000 litters)		Actual /reported estimate (000 litters)	Difference between estimated and projected (%)	Reference model
	Trend	*Trend +price change*			
2000	360.4	533.3	137.0	-163 to -289.3	Muruiki, 1991
2010	423.0	595.9	400.0	-5.7 to -49	
	Projected Supply				
1978	346.7		269.8	-28.5	Ruigu,1978
1980	381.3		186.9	-104.0	
1982	418.8		260.3	-60.9	
1985	482.4		321.4	-108.5	
1997	2457		2449	-0.33	MoLD, 1997
2000	2608		2639	+1.17	
2005	2951		3400	+13.20	
2009	3321		4200	+20.9	

The large deviations of projected estimates from the reported estimates or actual supply can be attributed to several reasons, but largely to lack of quality data. The available data is highly

inconsistent, and does require strategic actions to ensure regular capturing and reporting on livestock performance to stakeholders for decision making, particularly for investment plan.

Increased use of imported semen which contributes to improved animal productivity is captured in trend variables regression. However, the models ignore the contribution from zebu cattle, dairy goats and camels, which combined have substantial domestic milk supply. Though the rate of herd growth is unlikely to be at an increasing rate since 1960s, none of the projection models adjusted for this in the national milking herd size. The projections also take conservative growth rates, lower than the dynamics that follow thereafter in the dairy industry, suggesting need to project with higher rates of growth.

Table 21: The 1991 Dairy Master Plan projected milk supply from 1995 to 2005 under low, medium and high growth rate scenarios

Year	Projected milk supply (000) under assumed annual growth rate scenario			Reported estimate intakes	Difference between estimated and projected (%)
	Low (4.65%)	Medium (5.41%)	High (7.17%)		
1995	1,130	1,195	3,400	2,448	-51 to +39
2000	1,365	1,495	1,768	2,639	-43 to -33
2005	1,641	1,799	2,232	3,400	-47 to -34

The model of Muriuki (1991) gives importance to price in influencing formal milk market supply response, because increase in real milk price would result in increase in milk supply to the formal market. However, many studies indicate an inelastic short run supply response and a wide range of long run elasticity, suggesting inelastic to elastic long run response, probably associated with the biological nature of milk production and probably the asset fixity. Though the most immediate response to change in milk price is likely altering the proportion of milk produced that is marketed, the proportion of milk produced not marketed remains a function of socio economic circumstances that temporary price change will have little or no influence on.

The alternative would be to change production of the present milking herd by changing the quality or quantity of feeding. This would be reflected in more or less attention to grazing of the animals and increased or reduced feed supplementation with the adoption of such practices. Such actions are for the immediate short run. In the long run, the farmer will change the area available for forage or arrange for alternative source of forage, change replacement policy through breeding programs and culling using imported semen.

The input prices of importance to dairy enterprise in Kenya are for feed supplementation, health and breeding services. Commercial feed supplementation remains minimal (2 kg/day) and restricted to

milking times, serving more as stimulus for milk let-down. Health and breeding services before 1990 were relatively cheap because of high government subsidies. If the real (deflated) price of inputs goes up, milk production would be expected to go down. Real price of inputs will also be negatively related to profitability of the dairy enterprise.

Rainfall inclusion in the model is a proxy to feed availability because milk production in Kenyan is predominantly rainfed pasture-based system with limited supplementary feeding. Irrigated forages remain negligible though envisaged to expand with the vision 2030 implementation. Rainfall influences animal productivity (per animal milk production) and hence available milk for home consumption and the market. Change in milk supply is assumed positively related with the amount of rainfall, extension and market access. Poor rainfall will therefore result in low milk production and the amount available for the market supply.

Ruigu (1978) identified maize, wheat, pyrethrum, tea and coffee commodities to compete with milk production in Kenya, but production circumstances have changed since then. Horticultural crops would be competing with milk production under large scale dairy commercial systems but such farms are fewer, so should be considered as complementary rather than competing.

In Kenya, beef herd does not compete with dairy herd for milk market. Beef herd is more important for home milk consumption in the marginal areas of the country where market oriented dairying is economically unfeasible. Prices of dairy animals have remained higher than those for beef animals. Therefore price of beef animals can be excluded from model projection milk supply and demand.

The time trend variable captures growth of inventory in the dairy industry and changes in technical know-how. The technical know-how assumed include improvement on feeding, health and breeding management as a result of improved delivery of extension services and marketing infrastructures. It captures the effects of AI services positive impacts on milk supply through change in animal milk productivity after about three years from service when resulting female progeny calve down. Included in the growth of inventory are expansion of processing capacity and marketing facilities by the processors, cooperative societies and other related agencies and the growth of the dairy herd.

Comparing all the model projection approaches, regression with trend variables provides a better basis for projection. However, due to limitations of data quality it is difficult to use regression models to estimate relevant parameters for the functions. The past estimates used past growth trends to project future supply under different scenario to account for data quality problem. Table 22 present proposed models for Kenyan situation in estimating total milk supply and formal milk marketed.

Table 22: Models proposed for Kenyan situation in estimating total milk supply and formal milk marketed.

Model	Explanatory variables fitted	Model application
Q_{tp} = f (N, P_{pp}, P_{ip}, RF, BI_p, T, PE, *u*) Q_{tp} = total milk production;	N = population of dairy animals (cattle, camels, goats, sheep) P_{pp} = present and past prices of milk per litre; P_{ip} = the prices of inputs; RF = the annual rainfall/precipitation representing general feed availability BI_p = Breed improvement programmes; T = time trend variable representing general change in dairy production, inventory and technical know-how; PE = policy environment *U* = disturbance/error term.	total milk supply from all milk producing livestock
Q_{fs} = f (P_{pp}, P_{ip}, $P_{c,}$ CF, RF, BI_p, T, PE, *u*) Q_{fs} = milk deliveries/supply to the formal market	P_{pp} = present and past prices of milk per litre; P_{ip} = the prices of inputs; P_c = prices of competing products CF = price of and availability commercial feed; RF = the annual rainfall/precipitation representing general feed availability BI_p = Breed improvement programmes; T = time trend variable representing general change in dairy production, Inventory and technical know-how; PE = the policy environment *U* = disturbance/error term.	formal market milk supply

Informed with all the arguments preceding, projections apply trend regression growth in projecting milk demand and supply for 2020 and 2030 using: $S_t = S_o * N_t (1+P_g * P_s)^t$ where S_t is production in the year t ; S_o is the productivity in the base year; P_g is the growth in nominal prices, P_S is the price elasticity of supply for the milk; and N_t is the projected livestock population in the year t. The milk supply projections at increasing rates of medium and high growth rates are presented in Table 23.

Table 23: Milk supply projections at increasing rates of medium and high growth rates

Year	Milk projection (000) at varying moderate growth rates		Milk projection (000) at varying high growth rates	
	Milk (000)	Growth rate (%/y)	Milk (000)	Growth rate (%/y)
2005	2650	2	2782	3
2010	3071	3	3385	4
2015	3736	4	4320	5
2020	4769	5	5781	6
2025	6382	6	8108	7
2030	8092	7	10621	8

4.7.4. Domestic milk demand and supply balance

Using the 2010 to 2030 projected milk demand presented in Table 18 and supply in Table 23, the balance in milk demand and supply for 2010 to 2030 is illustrated in Figure 11. At these growth rates in milk supply, projections show a deficit of 31.8 to 43.5% for medium growth rate in supply and a deficit of 16.8 to 32.8% for a high growth rate in milk supply. Therefore satisfying the targeted 220 litres per capita milk consumption by 2030 requires sustained higher growth rates above 3%.

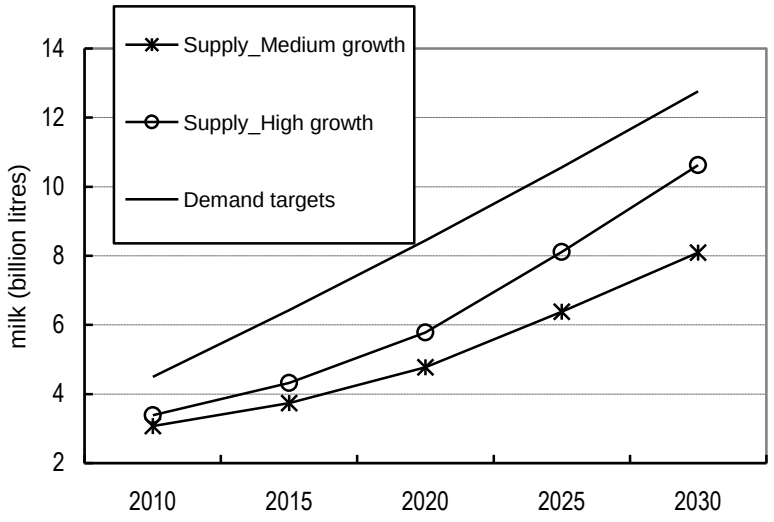


Figure 11: The demand and supply milk balance projections from 2010 to 2030

4.8. Animal Productivity Targets

Past increases in domestic milk supply have come through increases in dairy cattle population and not much from improved productivity per animal. This development approach is

unsustainable with the environmental issues currently attracting high level societal concerns. The recommended option is to increase animal productivity and thus decrease the number of dairy cattle over time, in real terms. Ample evidence show that strong growths in dairy development in the developed world have been achieved with technical change in yield per animal through better feeding, health care and genetic improvement complemented with managerial skills.

The 0.25 billion litres of milk production from 1.4765 million milking herd estimated in the DMP 1991 could have been obtained with a 60% smaller herd of 300,000 cows producing 4167 litres of milk per year or 11.4 litres per day. This productivity level and even better is achievable and would substantially reduce pressure on pastures and the environment, while ensuring adequate milk supply locally and for export.

Present quoted milk productivity per milking animal is low and has remained stagnant for dairy cattle at 1800 litres/yr or 4.9 litres/day. A low milk productivity level is also true for zebu cattle, camels and dairy goats. If the present dairy cattle productivity levels persist to 2030, and with dairy herd accounting for 80% of the milk produced, producing the needed 12.76 billion litres of milk will require building national milking herd to 5.671 million cows. Milking cows is about half the herd, meaning building a herd of 11.342 million heads, which is unsustainable with the growing land and environmental pressure. Current estimates of the national total dairy herd are inconsistent, giving wide range of 3.5 to 6.7 million heads of dairy and dairy crosses, producing 3.4 to 5.1 billion litres of milk worth about K.shs. 100 billion.

Benchmarked on satisfying domestic demand of 12.76 billion litres of milk by 2030, productivity levels needed in dairy and zebu cattle, camels and dairy goats projected are presented in Table 24. The milk productivity increases projected correspond to an average annual growth rate of 4.71% in dairy cattle, 3.83% in dairy goats, 2.50% in zebu cattle and 1.32% in camels, summarised in Table 25. The summarised value show that high productivity increases will be required in all milking livestock, but greatest increase will be needed in dairy cattle by 150% and in dairy goats by 115.5% relative to 64% in the zebu cattle and 29.9% in camels.

Potential to achieving these productivity levels can be benchmarked to productivity levels in dairy cattle achieved with low cost rain fed pasture system of dairy production in Australia (Tables 2 and 25). Locally, better managed herds utilizing innovations adequately, appropriately and efficiently in feeding, health and breeding are able to achieve an annual productivity of 5,285 litres with Friesian, 4,617 litres with Ayrshire, 3402 litres with Guernsey and 3159 litres with Jersey (DFID, 2001). A wide range in individual animal productivity of 7 to 45 litres for dairy cows, 4 to 12 litres for camels and 0.35 to 4 litres for dairy goats indicate room for improvement. Therefore

strategic actions to improving the individual animal productivity are a recommendation of this master plan.

Table 24: Projected milk productivity in the milking herds for meeting 220 litres per capita milk consumption by 2030

Year	Total population	Lactating animals	Animal Productivity	
			Litres/year	Litres/day
		Dairy cattle		
2010	3,403,000	1,531,350	1800	4.9
2015	3,750,234	1,687,605	2630	7.2
2020	4,201,644	1,890.740	3350	9.2
2025	4,925,486	2,216,469	3970	10.9
2030	5,551,387	2,498,124	4500	12.3
		Zebu cattle		
2010	10,119,000	2,023,800	250	0.7
2015	11,389,984	2,277,997	279	0.8
2020	12,151,750	2,430,350	315	0.9
2025	12,608,316	2,521,663	358	1.0
2030	12,881,960	2,576,392	410	1.1
		Camels		
2010	1,132,000	277,340	1440	4.0
2015	1,356,231	332,277	1636	4.5
2020	1,552,163	380,280	1755	4.8
2025	1,723,369	422,225	1830	5.0
2030	1,872,967	458,877	1870	5.1
		Dairy goats		
2010	178,571	43,750	225	0.6
2015	334,921	82,056	299	0.8
2020	514,184	125,975	365	1.0
2025	719,719	176,331	425	1.2
2030	955,376	234,067	476	1.3

Table 25: The projected growths needed between 2010 and 2030 in animal milk productivity (litres/year) for attaining per capita milk consumption of 220 litres by 2030

Year and growth rate	Dairy cattle	Zebu cattle	Camels	Dairy goats
2010	1800	250	1440	225
2030	4500	410	1870	476
Growth rate (%/year)	4.71	2.50	1.32	3.83
Percentage change (%)	150.0	64.0	29.9	111.5
Australia 1990 to 2009	2,850 to 5,750			
Percentage change (%)	101.7			

References Cited

Agricultural Sector Development Strategy 2009 – 2014: An agricultural public and private sectors partnership

AU NEPAD, 2003. Comprehensive Africa Agriculture Development Programme (CAADP).

Dairy policy Draft, 2008. Towards a Competitive and Sustainable Dairy Industry for Economic Growth in the 21^{s} Century and Beyond. Ministry of Livestock Development and Fisheries.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, E., and Courbois, C. 2001, *Livestock to 2020. The Next Food Revolution*, International Food Policy Research Institute, Washington, DC.

Githinji, V., Olala M and Maritim W. (2009). Feed Millers Industry Survey Report 2009. Ministry of Livestock Development

ILRI, 2008. Annual Report 2007: Markets that work: making a living from livestock. International Livestock Research Institute, Nairobi, Kenya

IPCC (Intergovermental Panel on Climate Change), 2007. Climate change: Impacts, Adaptation and Vulnerability. Summary for policy makers. Online at http://www.ipcc.cg/SPM13ap07.pdf.: accessed on June 30, 2010.

Kibaara, B. (2008) Trends-in-Kenyan-Agricultural-Productivity Tegemeo Institute www.aec.msu.edu/.../kenya/Trends_in_Kenyan_Agricultural_Productivity_September_5_2008.doc

Karanja, A. M. (2003). The dairy industry in Kenya: the post-liberalization agenda. Tegemeo Institute. www.tegemeo.org/documents/other/dairy.pdf

Kenya Vision 2030. Ministry of Planning. Nairobi.

National Livestock Policy, 2008. Sessional Paper No. 2 of 2008. Ministry of Livestock Development, Nairobi.

NALEP, 2006. The Internal impact assessment of national agriculture and livestock extension programme phase 1. Ministry of Agriculture ministry of agriculture and ministry of livestock and fisheries development, Nairobi.

Okeyo, A. M., Kajume, J. K., Mosi, R. O., Okila, E. V. A., Gathuma, J. M., Kiere, S. M. N., Agumbah, G., Kuria, J. N., and Chema, S., 2000. Artificial Insemination a bio-technological

tool for genetic improvement of Kenyan dairy cattle herds: Historical perspective, Current status, Challenges and Way forward in the next Millenium. A Kenya Country Paper. *In* "Symposium on Dairy Cattle Breeding in East Africa: Sustainable Artificial Insemination Service", Kenya Agricultural Research Institute (KARI), Headquarters, Kaptagat Road, Nairobi, 20-21, March, 2000.

Omore, A., Muriuki, H., Kenyanjui, M., Owango, M., Staal, S., 1999. The Kenyan dairy subsector. A rapid appraisal report by the MoA-KARI-ILRI smallholder dairy (Research and Development) Project. International Livestock Research Institute. Nairobi, 50 pp.

Peeler, E. J., Omore, A. O. 1997. Manual of livestock production systems in Kenya KARI/DFID. National Agriculture Research Project II. Nairobi Kenya.

Republic of Kenya (Rok)., 2005. *Strategy for Revitalising Agriculture* SRA 2004-2014, Government PRESS, Nairobi, Kenya.

Republic of Kenya (Rok)., 2007. *Economic Recovery for Wealth and Employment Creation*. Ministry of planning and National Development , Government Printers. Nairobi, Kenya

Tegemeo, 2006. Draft Report on Revitilisation of the dairy sector in Kenya. Tegemeo Institute of Agricltural Policy and Development, Nairobi.

Thornton P.K; Jones P.G; Owiyo T; Kruska R.L; Herrero M; Krisjtjanson P; Notenbaert A; Bekele N; Omollo A; with contributions from Orindi V; Ochieng A; Otiende B; Bhadwal S; Anantram K; Nair S; Kumar V; Kelkar U, 2006. Mapping climate vulnerability and poverty in Africa. Report to the Department of International Development, ILRI, Nairobi, Kenya. 200pp. Online at http://www.dfid.gov.uk/reserach/mapping-climate.pdf