IGAD Livestock Policy Initiative

A Living from Livestock

The Contribution of Livestock to the Kenyan Economy

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DISCLAIMER

This report on Kenya is part of a series of Working Papers on The Contribution of Livestock to GDP in the IGAD Member States. These papers were planned and commissioned by the Inter-Governmental Authority on Development's Livestock Policy Initiative (IGAD LPI). The purpose of these papers is to provide support to Livestock Policy Hubs in the IGAD Member States in their engagement with PRSP processes in their respective countries to advocate that the representation of livestock in national strategy documents is commensurate with its contribution to economic growth, poverty reduction and food.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of either the Food and Agriculture Organization of the United Nations or the Inter-Governmental Authority on Development concerning the legal status of any country, territory, city or area or its authorities concerning the delimitations of its frontiers or boundaries.

The opinions expressed in this paper are solely those of the authors and do not constitute in any way the position of the FAO, IGAD, the Livestock Policy Initiative nor the governments studied.

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ABBREVIATIONS

ASAL	Arid and semi-arid lands
DVS	Department of Veterinary Services
Ksh	Kenya shilling
GDP	Gross domestic product
IGAD	Intergovernmental Authority on Development
ILCA	International Livestock Centre for Africa
ILRI	International Livestock Research Institute
LPI	Livestock Policy Initiative
KIHBS	Kenya Integrated Household Budget Survey 2005/06
KNBS	Kenya National Bureau of Statistics
MOLD	Ministry of Livestock Development
NHIF	National Hospital Insurance Fund
ISIC	International Standard Industrial Classification of All Economic Activities
SNA	System of National Accounts
TLU	Tropical Livestock Unit

EXECUTIVE SUMMARY

This report on Kenya is the third in a series of studies on the contribution of livestock to the economies of the IGAD member states. Livestock specialists frequently argue that livestock production is underrepresented in the GDP estimates of African nations. With respect to Kenya this argument is confirmed.

The Kenya National Bureau of Statistics, which is responsible for estimating Kenya's GDP, uses a commodity flow approach to estimating agricultural GDP. According to this method, calculations of the value of marketed agricultural production are based on the recorded value, quantities and prices for officially marketed agricultural commodities. Non-marketed agriculture production directly consumed by farmers or pastoralists or traded informally is estimated through periodic household budget surveys, and – in the intervals between surveys – is assumed to grow at the same rate as recorded marketed production. In short, the level of overall production is inferred from that portion of the total that is traded through official channels.

The opportunity to cross-check this method of GDP estimation was provided by the Kenya human population census of 2009 which contained questions about the animals that people kept. With more reliable livestock figures from the 2009 census, it is now possible to estimate the amount of physical product generated on average by a given population of animals, and to value this output according to prevailing producer prices. In contrast to the commodity flow approach, these techniques do not base production estimates on assumptions about how total output is partitioned between various uses - for commercial sale, consumption by producers themselves, export, etc.

These alternative estimation procedures support the following conclusions:

1. When compared to KNBS's commodity flow approach, the procedures followed in this report generate a significantly higher estimate of the contribution of ruminant livestock to agricultural GDP – 318.971 billion Ksh versus the official estimate of 127.723 billion Ksh in 2009, an increase of 150%. In the course of arriving at these different results, the two estimation procedures also provide substantially different pictures of the level of livestock product output and the amount of livestock-derived food that is domestically available.

2. According to the revised estimates, milk is far and away Kenya's most economically important livestock product, with a value of 257.811 billion Ksh in 2009, or about 70% of the total gross value of livestock's contribution to the agricultural sector. Officially recorded milk production was only about one twentieth of total re-estimated milk production in 2009.

3. Cattle are Kenya's most important source of red meat, supplying by value about 80% of the nation's ruminant offtake for slaughter. According to re-estimated levels of offtake in this report, official recorded slaughter constituted 94% of total domestic offtake for small stock and 72% of all domestic offtake for cattle in 2009. It would therefore appear that official meat offtake records do a better job than official milk production figures in depicting total output levels.

4. The estimates presented in this report on the availability of livestock food items agree roughly with current official estimates of domestic meat and offal supplies per capita. The official Food Balance Sheet for 2009 estimates that 15.3 kg of beef, sheep and goat meat is available on average for every Kenyan; this report estimates 15.25 Kg per person for the same meat products.

On the other hand, our estimates of the amount of milk available for consumption (either as fluid milk or converted into other dairy products) diverge significantly from official figures. We estimate that 198 litres of fluid milk are available on average per person, either for consumption or for processing. On the other hand, the official Food Balance Sheet estimates for 2009 give per caput fluid milk supply at 17.3 kg plus 0.1 kg of butter or ghee. In sum, our estimates of domestic meat availability broadly agree with official figures, but our estimates for the availability of milk and dairy products are much higher than official figures.

In comparison to official assessments, our estimates of livestock production follow a similar pattern: The estimates in this report roughly agree with official small stock slaughter figures, exceed official estimates of cattle slaughters, but are about twenty times larger than official milk production figures. In terms of its contribution to agricultural GDP, milk is about four times more important than meat. Any inaccuracies in the calculation of milk output therefore have a proportionately large impact on the estimated performance of the entire livestock sector. Without better documentation of the value and volume of milk production and consumption, official statistics on the livestock sector lack authority and credibility.

5. Unlike neighbouring countries such as Ethiopia, Sudan and Somalia, Kenya is a livestock importer rather than an exporter, and an estimated 22% of the nation's beef is supplied by cattle walked across Kenya's borders. More than 80% of the beef consumed in Kenya is produced by pastoralists, either domestically or in neighbouring countries.

6. At about 2% of the total, livestock products make a modest contribution to national exports, primarily in the form of hides and skins, leather and leather products. There is an apparent trend in recent years for the increased export of higher value added products such as leather and shoes rather than raw hides and skins. This is tentative evidence of the increasing maturity and competitiveness of this sector of Kenyan manufacturing.

7. Rural Kenyans derive a range of financial benefits from livestock keeping, including the provision of credit, insurance, and as a means of sharing risk. The credit benefits of livestock derive from the ability of livestock owners to 'cash in' their animals for particular purposes at a time that they choose. This flexibility gives livestock owners access to money without the need to borrow, and confers an additional financial benefit beyond the sale, slaughter or transfer value of their livestock. This additional financial benefit can be estimated as the opportunity cost of rural credit – what it would otherwise cost a livestock owner in rural areas to obtain funds comparable to those produced by liquidating a part of the herd. Employing this estimation, the additional finance value of a livestock holding is equivalent to the interest that the owners would be required to pay to obtain loans equal to the value of their livestock offtake. Interest rates in rural Kenya are currently running at about 25% per annum in institutionalized channels, but about half of lending in rural Kenya is done privately by neighbours, friends and kin, resulting in low rural interest rates averaging 6.3% per annum. In this case the financial value of livestock offtake is about 4.230 billion Ksh.

8. Part of the insurance value of livestock comes from the ability of owners to liquidate their own herds in an emergency. In this instance, the level of security provided to a particular individual depends on the value of that individual's assets, so livestock ownership functions as a kind of self-insurance. The value of this form of asset-based insurance can be calculated as the annual cost that herd owners would need to pay to purchase insurance coverage equal to the capital value of their herd. Health insurance provided by a government-supported national scheme, the National

Hospital Insurance Fund, annually costs 0.0048% of the coverage provided. Valued at a comparable insurance premium, livestock in Kenya provide 2.247 billion Ksh of insurance value to their owners.

9. For pastoralists in Kenya, the insurance value of livestock derives not only from their ability to liquidate their individual herds, but also from their ability to call upon assistance from fellow pastoralists in time of need. These collective schemes for sharing risk are based on the gifting and loaning of livestock within pastoral communities, with large herd owners donating some of their animals and less well-off pastoralists drawing support in the form of livestock received as gifts or on loan. Recent research suggests that about 10.5% of pastoral animals in Kenya are involved in livestock sharing networks of this kind. Assuming that the total capital value of pastoral livestock in Kenya is 295.270 billion Ksh, the collective insurance value of pastoral herds can be estimated at 31.003 billion Ksh in 2009.

10. There is insufficient evidence to assign a monetary value to the benefits derived from animal power. These benefits include the use of animal draught power (principally oxen) for cultivation, and the use of equines and camels for transport and haulage. Descriptive studies document the economic and practical value of working animals, but it is not possible to extrapolate from isolated studies of particular communities to an estimate of the national significance of their services, and there is no current information on the commercial rates charged for renting various forms of animal power, information which is needed to establish the imputed monetary value of work animals that are kept by households for their own use.

11. The direct use value of livestock to the national economy in 2009 is estimated at 356.217 billion Ksh, of which 318.971 billion Ksh represents the value of the goods produced by livestock, and constitutes the livestock contribution to agricultural sector GDP. An additional 37.246 billion Ksh in direct use benefits is derived from the value of financial services – credit, insurance and risk pooling – that are provided by livestock for their owners, and are excluded from conventional GDP calculations. In comparative terms, in Ethiopia livestock-based financial services were equivalent to more than half of the value of the livestock contribution to agricultural GDP. In Kenya these same services are equivalent to a little over 11% of agricultural sector GDP from livestock. The decline in the relative importance of livestock-based financial services can be attributed to the better penetration of rural areas by formal financial services in Kenya as compared to Ethiopia. Improved financial services have lowered the costs of obtaining credit and insurance in Kenya, and thereby diminished the imputed value of comparable services provided by livestock. A major shortcoming of the present analysis is our inability to assign a national monetary value to any form of animal power usage in Kenya.

These conclusions support the following recommendations:

1. Despite the data limitations discussed in this report, KNBS should consider adopting as standard practice the production approach to estimating livestock GDP that is presented in this report.

2. Ministry of Livestock Development (MOLD) currently has little authoritative, quantified, national-level data on Kenya's most valuable livestock product – milk – and the Ministry should seek to remedy this deficiency. Dairy production and marketing are topics on which numerous Kenyans have conducted sophisticated and precise scientific research, and there is a large pool of national talent to engage in improving the Ministry's field monitoring, data analysis, and reporting skills. Until remedial action has been taken, the Ministry's lack of authoritative and

comprehensive data impairs its ability to contribute to evidence-based discussions of national dairy policy.

3. With technical support from interested research institutes and Kenyan universities, MOLD and KNBS should undertake a national survey of the value of animal power to the Kenyan economy and of the role of animal power in sustaining both rural and urban livelihoods. This survey should include all forms of animal traction, transport and haulage by all species of working animals – cattle, equines and camels – in rural and urban areas and in all economic sectors – agriculture, manufacturing and services. As well as the commercial provision of animal power, the survey should assess the monetary value of the services that working animals directly provide for their owners.

Ignorance about the economic importance of animal power is not unique to Kenya; it is a regional phenomenon, and our recommendation regarding research on animal power applies equally to Ethiopia and Sudan, two other countries where IGAD is currently conducting studies on the economics of livestock and livelihoods. IGAD should consider introducing a region-wide programme of work on the economics of animal power, a subject that is chronically neglected by both academic research and government agricultural monitoring systems.

4. The information on livestock numbers provided by the 2009 census revealed the limitations of the procedures used by MOLD to estimate livestock populations, a weakness that scientific researchers had recognized but could not conclusively demonstrate. A report by Wanyoike et al. (2005) speaks of the 'need for better estimation methods' for enumerating livestock populations. We agree. The next human population census may not contain questions on livestock. It is essential that MOLD develop affordable survey techniques to reliably estimate the country's livestock numbers, or subcontract this responsibility to a qualified national research institute or university.

INTRODUCTION – METHODS AND SCOPE OF THE PRESENT STUDY

The overall objective of the IGAD Livestock Policy Initiative (LPI) is to enhance the contribution of the livestock sector to sustainable food security and poverty reduction in the IGAD region. The LPI project covers IGAD member states Djibouti, Ethiopia, Kenya, Somalia, Sudan and Uganda. This is the third in a series of reports on the contribution of livestock to the economies of the IGAD member states. The objective of this report is to assess the extent to which livestock's contribution to the Kenyan national economy is reflected in national accounts, if necessary by assigning monetary values to the non-marketed services that livestock provide. The first report in this series examined the contribution of livestock to Ethiopia's agricultural sector GDP (IGAD LPI Working Paper No. 02 – 10, 2010). A second report, also on Ethiopia (IGAD LPI Working Paper No. 02-11), expands the scope of the original investigation to examine livestock-related economic benefits that are not conventionally considered to be part of official GDP estimates.

Building on methodologies developed in Ethiopia, the present study undertakes an assessment of the contribution of livestock to Kenya's national economy. Conventional GDP accounting may ignore some of the benefits that people derive from livestock in subsistence-oriented economies, when households directly provision themselves, when economic exchanges are not calculated in monetary terms or when these exchanges go unrecorded. The present study assigns monetary values to the non-marketed goods and services provided by livestock, and estimates the contribution of livestock to the wider national economy – as exports, as inputs into manufacturing industries, and as a component of household consumption.

1.1 Estimation of agricultural GDP in Kenya

The Kenya National Bureau of Statistics (KNBS) is responsible for compiling national accounts, and publishing its estimates in annual Economic Survey reports, with the most recent covering five years up to 2010. KNBS uses a commodity flow approach to calculate agricultural GDP. According to this estimation method, the value of agricultural output is derived by adding together the value of all the uses that are made of agricultural products – as consumer goods, as inputs into other products or processes, as exports, or as contributions to fixed capital and inventories. Calculations of the value of marketed agricultural production are based on the recorded value, quantities and prices for agricultural commodities. Non-market agricultural production is principally estimated through periodic household budget surveys, and – in the intervals between surveys – is assumed to grow at the same rate as recorded marketed production. Formulae are therefore used to project forward the estimated value and volume of unrecorded output, based on a combination of past survey data and current marketing statistics.

This approach may work well in a commercialized agricultural economy, such as that of Kenya, in which industrial crops – e.g. pyrethrum, sisal, and sugar cane – or heavily exported crops – such as coffee, tea, or cut flowers – are an important component of agricultural output. These crops are unlikely to be sold or consumed in large quantities outside of formal channels and marketed output will probably reflect fluctuations in total product output.

While the commodity flow approach may be justified for Kenya's agricultural sector as a whole, it has limitations when applied to livestock and livestock products, which in Kenya have important subsistence uses for large numbers of rural producers. With the commodity flow approach, non-

marketed agriculture production is principally estimated through household budget surveys. Despite an attempt to update Kenya's benchmark household income/expenditure data in 2005/06 (Kenya Integrated Household Budget Survey 2005/06), the current benchmark used by KNBS to calculate the subsistence portion of agricultural GDP is fourteen years old (Welfare Monitoring Survey, 1997, unpublished). Because of the problems involved in sampling nomadic households, the 1997 benchmark survey also did not include pastoralists, and consequently pastoral consumption patterns are assumed for national accounting purposes to be identical to those of poor rural farming households, which is almost certainly not the case. The accuracy of both projected home consumption levels and estimates of the total value of livestock output also depend on the reliability of annual statistics on livestock and livestock product sales. If these are incomplete, estimates of both home consumption and marketed output will be fundamentally flawed. There is good reason to think that the official livestock sales and slaughter statistics currently provided by the Department of Veterinary Services (DVS) are incomplete since the DVS does not cover some small markets and has no coverage in North Eastern Province.

These considerations suggest that it would be useful to cross-check current estimates of the contribution of livestock to agricultural GDP using analytical techniques that do not rely entirely on official sales figures or on projections of un-marketed production based on an old benchmark that does not include pastoral producers. Now is a good time to undertake such a review. In 2008 new international guidelines for national accounting were published (SNA 2008), and Kenya will respond to these new guidelines with a revised system of national accounting beginning in 2012. In the meantime, KNBS is examining its analytical procedures and methods, and is in a position to adopt new methods if these are needed. There is also available, for the first time in several decades, a comprehensive enumeration of Kenya's livestock population, based on questions attached to the human population census of 2009 on the number of livestock kept by households. The new census data reveals that estimations of ruminant livestock populations for the last decade were roughly half of the census estimate for camel, sheep and goat populations, and about three quarters of the census estimate for cattle (Table 1). Any attempt to directly estimate livestock output requires reliable livestock population estimates. With the new livestock population figures from the census, a production-based approach to estimating livestock output is now a practical possibility.

Table 1: Kenyan livestock populations: head in 2009 and proportion in % of 2009 census figure

	National MLD 2008 estimates	National 2009 population census	ASAL[1]	Arid	Semi-arid	Highlands
Cattle	13,522,500 77%	17,467,774 100%	12,155,974 70%	6,281,354 36%	5,874,620 34%	5,311,800 30%
Sheep	9,907,300 58%	17,129,606 100%	14,954,925 87%	10,246,527 60%	4,708,398 27%	2,174,681 13%
Goats	14,478,300 52%	27,740,153 100%	25,250,865 91%	18,230,633 66%	7,020,232 25%	2,489,288 9%
Camels	1,132,500 38%	2,971,111 100%	2,968,670 100%	2,924,742 98%	43,928 1%	2,441 0%
Donkeys	786,800 43%	1,832,519 100%	1,616,522 88%	1,126,103 61%	490,419 27%	215,997 12%
pigs	330,020 98.6%	334,689 100%	82,500 25%	1,438 1%	81,062 24%	252,189 75%
Bee hives		1,842,496 100%	1,371,101 74%	286,564 16%	1,084,537 59%	471,395 26%
Chicken indigenous	29,615,000 93%	25,756,487[2] 81%	10,258,066 32%	1,063,276 3%	9,194,790 29%	15,498,421 49%
Chicken commercial		6,071,042 19%	1,523,983 5%	131,811 0%	1,392,172 4%	4,547,059 14%

Source: KNBS, Kenya Population and Housing Census, Vol. II, Table 11; unpublished records, Animal Production Division, MLD

Notes: [1]ASAL combines arid and semi-arid; see Annex IV for lists of arid, semi-arid and highland districts.

[2]There are 31,827,529 chickens in Kenya according to the 2009 census; all estimates of the importance of different components of the national chicken flock are expressed in the table as a proportion of this total.

1.2 A production-based method for estimating agricultural output

The estimation techniques that we will use in this study were piloted previously in an investigation into Ethiopian livestock production (IGAD 2010). Analysis proceeds in four stages, beginning with national livestock population estimates, in this case figures from the 2009 human population census. In the second stage, production coefficients (estimates of the amount of physical product that will on average be produced by known number of animals) are applied to the livestock population estimates to generate estimates of the total output of goods such as meat, milk, dung for fuel or fertilizer, etc. Third, based on available information on producer or 'farm gate' prices, a monetary value expressed in Kenya shillings – the gross value of output – is ascribed to the total output of each kind of livestock product. Finally, input costs (based in this case on information currently available in the national accounts) are deducted from the gross value of output to derive value added. Using these methods, the value added by livestock to the agricultural sector is based on an estimation of the amount of physical product generated on average by a given number of animals. In contrast to the commodity flow approach, there is no need to distinguish initially between production destined for commercial sale, consumption by producers themselves, or export.

The first advantage of this approach for estimating Kenya livestock output has already been mentioned: the existence of recent, reliable livestock population figures broken down by species to the district level. A second advantage is the wealth of scientific research that has been carried

out on livestock production in this country. Finally, Kenya can be broken down into relatively distinct geographical zones in terms of livestock production (e.g. Arid, Semi-arid and Highlands) and in terms of scale and husbandry techniques (small producers versus large establishments such as private commercial ranches and dairy farms). Time and resources permitting, it should be possible to build an estimate of national livestock production by constructing formulae to characterize the different levels and kinds of output from different geographical sub-sectors and livestock husbandry systems.

The results of our calculations will not examine or comment in detail on the methods currently used by KNBS to estimate the contribution of livestock to the agricultural GDP. When it is suitable to our needs, we will use information that is produced by and for national accounts, but the purpose of this report is to undertake a fresh examination of the value of livestock output, from a new perspective, using different methods.

1.3 Organization of the report

This report is divided into two parts.

Part I examines what some economists have termed the 'direct use values' of livestock in Kenya. Direct use values, which will be defined in greater detail in the introduction to Part I, include the kinds of agricultural outputs that are enumerated in conventional GDP estimates. The calculations undertaken in Part I will therefore provide a means to cross-check current Kenyan GDP estimates for livestock production against a new set of estimates generated by using a fundamentally different methodology. Part I also examines two kinds of economic contributions made by livestock – to financial services and to transport, traction and haulage – that are imperfectly represented in standard GDP calculations organized according to international conventions. Though not exclusively, both of these kinds of economic activity tend to directly support the livelihoods of livestock owners.

Part II of the report examines some of the non-agricultural contributions livestock make to the wider Kenyan economy. Agricultural GDP is based on the value of unprocessed or lightly processed agricultural produce at point of first sale. Some agricultural produce is consumed at this stage, but much is taken up by other sectors of the economy that use it, modify it, and add value to it. As these livestock goods and services transit through the wider economy they continue to contribute to national GDP, not in the form of agricultural output but classified now as services or manufactured products. The GDP benefits derived from livestock in this way appear under a variety of accounting headings and are not readily attributed to livestock, which makes it difficult to assess the full extent of livestock's influence on the national economy. To remedy this situation and to gain a clearer understanding of the size of the livestock sector and the economic linkages between livestock production and the wider economy, Part II of the report examines three different ways Kenyans make use of livestock outputs – for private consumption, as exports, or as inputs into other domestic industries.

PART I: DIRECT USE BENEFITS OF LIVESTOCK

2.1 Introduction

Direct use values refer to livestock outputs in the form of goods and services, both marketed and for non-commercial or subsistence use. The concept of direct use value was developed by economists attempting to quantify the economic benefits derived from the natural environment (Barbier 1993) and has subsequently been applied to livestock (Hesse and McGregor 2006).

Direct use values include but are broader than conventional definitions of Agricultural GDP. Agricultural GDP expresses in monetary terms the value of the goods that livestock produce – items such as live animals for slaughter and dairy products, manure, fibres, hides and skins. As long as enough of these products are traded to establish a producer price, home-produced goods that are directly consumed by livestock owners are routinely included in agricultural GDP, though there may be practical difficulties in estimating the volume and value of these subsistence goods. Estimates of agricultural GDP therefore include, or should include, the value of both marketed and un-marketed or informally marketed goods produced by livestock. The same cannot be said for the un-marketed services that livestock provide for their owners. For reasons discussed later in this report, the financial services provided by livestock – as credit, insurance or savings – are excluded entirely from GDP calculations, and only a part of the benefits derived from animal power are recognized, usually as contributions to transport rather than agricultural sector GDP.

The concept of direct use value pulls together under one heading all the various economic benefits derived from livestock – from both goods and services, whether they are marketed or for subsistence, both in the agricultural and other sectors of the economy. This is useful for an analysis, like the present one, that attempts to construct a comprehensive estimate of the economic benefits derived from livestock. The concept of direct use also includes a broad range of livelihood benefits that livestock owners depend upon in practice, but which cannot for technical reasons be incorporated into national accounts. The concept of direct use therefore provides a more balanced expression than GDP accounting of the economic reasons why livestock owners keep and value their animals. Since agricultural GDP is one component of direct use value, it is nonetheless possible to compare the results of this more inclusive assessment with those based on national accounting guidelines.

The following sections of Part I estimate the value of the goods and financial services provided by livestock to the Kenyan economy. The economic contribution of animal power is briefly discussed but there is insufficient evidence to quantify the value of these services.

2.2 Live animal offtake and milk output

The monetary values of meat and milk output are the main components of official estimates of the contribution of livestock to agricultural GDP. We therefore begin our appraisal with an estimation of these values.

2.2.1 Cattle milk

Dairy production by cattle is one of the best researched aspects of Kenyan livestock productivity. Annex II provides an overview of published research that quantifies dairy output. The large

number of studies reviewed in Annex II makes it possible to estimate levels of dairy output for each of Kenya's main agro-ecological regions – the highlands, arid and semi-arid zones.

Dairy output is a complex result of the interaction of multiple variables – the percentage of cows in the herd, the proportion of those cows that lactate per year, output per lactation, the level of extraction for human use, etc. For comparative purposes, the interplay of these factors is summarized in a single measure in Annex II: litres of milk offtake for human consumption per 100 head of cattle. This report uses 900 litres per annum as the estimated milk output for human consumption per head of highland cattle (Ngigi 2005). This estimate is high relative to many of the studies reviewed in Annex II, but it is the result of a recent random survey of highland milk production, and we judge it to be authoritative for that reason. Annex V Livestock Population 2009 lists the highland districts used to estimate highland cattle numbers, 5,311,800 head based on the 2009 census data. The formula for highland milk production in 2009 is:

> **5,311,800 head * 900 lit/head = 4,780,620,000 litres of milk production or 4.780 billion lit** (based on Ngigi (2005) at 1733 lit/cow with 52% of herd consisting of adult females, or 90,000 lit per 100 head of cattle – see Annex II *Cattle Milk* for citations and literature review).

Rege et al. (2001) provide the most recent and comprehensive data on cattle milk production in the semi-arid zone. The unweighted mean of milk production at the four research sites in this study is 108.67 lit/head of cattle per year for human consumption. Annex V Livestock Populations 2009 gives the semi-arid districts used to estimate semi-arid cattle numbers, 5,874,620 head based on the 2009 census data. The formula for semi-arid milk production in 2009 is:

> **5,874,620 head * 108 lit/head = 637,102,539 litres of milk production or 0.637 billion lit** (based on Rege et al. 2001 at 378 lit/cow and 28.75% of herd lactating or 108.67 lit per head/yr or 10,845 lit/100 head of cattle - see Annex II *Cattle Milk* for citations and literature review).

Milk production by cattle in the arid zone is poorly documented, with only two output per head estimates, at 59 lit (McPeak and Doss 2004) and 81 lit (McCabe 1987) per annum. We will use the lower estimate from McPeak and Doss in this report. Annex V Livestock Populations 2009 gives the arid districts used to estimate arid cattle numbers, 6,281,354 head based on the 2009 census data. The formula for arid milk production in 2009 is:

> **6,281,354 head * 59 lit/head = 370,599,886 lit of milk production or 0.371 billion lit** (based on McPeak and Doss 2004 in Marasabit District - see Annex II Cattle Milk for citations and literature review).

Total cattle milk production:

Highland:	4,780,620,000 litres
Semi-arid:	637,102,539 litres
Arid:	370,599,886 litres
NATIONAL COW MILK PRODUCTION:	**5,788,322,425 litres**

There is no official data on the mean national producer price for cow milk in 2009. Producer prices vary according to season, location and whether the milk is sold through formal or informal channels. Available evidence on these issues is summarized below:

- Between Dec 2004 and March 2005 Mburu et al. (n.d.) documented informal milk prices of 20.1 Ksh/litre and cooperative milk prices of 16.8 Ksh/litre, or informal prices were a multiple of 1.2 of formal prices, 2004-05.
- Apparently reporting prices in 2000, close to Nairobi in Karen and Kiambu Districts producers were receiving 24 Ksh/lit and in Muranga further from Nairobi they were receiving 22 Ksh/lit. Producers were receiving from dairy cooperatives 16-19 Ksh/lit delivered to the cooperative and were able to obtain 20-22 Ksh/lit from other sources for some of their production (Ebony Consulting 2001). Informal prices were a multiple of 1.24 of formal prices in 2000.
- Omore et al. (1999) provide a map of fresh raw milk prices in 1997. Average prices paid by small milk traders to producers were 19.71 Ksh/lit across 7 locations including Nairobi and Mombasa. Prices paid by milk processors and cooperatives at the same date across 5 locations were 14.8 Ksh/lit. Informal prices were a multiple of 1.33 of formal prices.
- In 2000 the mean price over seven locations in western Kenya was 16 Ksh/lit at parastatal collection points and 14 Ksh/lit at cooperative collection points, and all other buyers combined averaged a price of 20 Ksh/lit. (Waithaka et al 2002). Informal prices were a multiple of 1.33 of formal prices.
- Pastoral milk in Gabra pastoral system sold for 20 Ksh/lit from 1993-97 (McPeak and Doss 2005).

For purposes of our calculations we will assume that informal producer prices are an unweighted mean of the four studies cited above, or a multiple of 1.275 of the formal price in any year. Pastoral milk prices are high relative to highland prices, so there is no reason to discount the price of pastoral milk. Formal milk prices are based on KNBS figures for 2009 in the Economic Survey 2010.

Formal cattle milk price in 2009	28.28 Ksh/litre (KNBS 2010)
Informal cattle milk price in 2009	28.28 Ksh/litre * 1.275 = 36.06 Ksh/litre

According to Muriuki et al. (2003) 74% of milk is sold outside formal channels consisting of Dairy Cooperative Societies or processors (Muriuki et al. 2003). In this study we will value 74% of all milk – both that which is sold and not sold – at informal prices, and value the remaining 26% of all milk at formal prices, to reflect the relative importance of the different marketing channels.

The value of cattle milk:

Volume and value of milk production valued at formal sale price (A): 5,788,322,425 litres national production * .26 = 1,504,963,830 litres @ 28.28/litre = 42,560,377,110 Ksh in 2009 or 42.560 billion Ksh

Volume and value of milk production valued at informal sale price (B): 5,788,322,425 litres national production * .74 = 4,283,358,594 litre @ 36.06/litre = 154,457,910,800 Ksh in 2009 or 154.458 billion Ksh

NATIONAL VALUE OF CATTLE MILK: A + B = 197.018 billion Ksh in 2009

2.2.2 Camel milk

Musinga et al. (2008) measured annual camel milk offtake for human consumption in Isiolo at 186 lit per head, and McCabe (1987) measured Turkana camel milk at 241 lit per head. In these

calculations we will follow the lower output estimate of Musinga et al. (2008), which is in line with other research for Kenya (see Annex III Camel Milk). The national camel population was 2,971,111 head in 2009 according to the 2009 census (Table 1).

The formula for camel milk production in 2009 is: 2,971,111 head * 186 lit/head = 552,567,224 litres of milk production or .553 billion lit (based on Musinga et al. 2008 with 34% of herd lactating and 547 lts/lactating camel/year – see Annex III Camel Milk for citations and literature review). Musinga et al. give a producer price of 29.3 Ksh/lit for camel milk in Isiolo in October 2008, and we will use this price to value camel milk production in 2009.

> **NATIONAL VALUE CAMEL MILK: 552,567,224 * 29.3 = 16,190,219,660 Ksh or 16.190 billion Ksh in 2009**

2.2.3 Sheep and Goat Milk

It is unclear what proportion of Kenya's goats and sheep are milked. Government and donor projects have promoted dual purpose meat and milk goats on highland farms. These animals are generally milked and exist in small numbers. Sheep are milked in ASAL areas, but the practice is not common. Goats are routinely milked in the arid and semi-arid regions of the country, but the exact proportion is undocumented. For purposes of this analysis we will assume that no highland goats and no sheep in any part of the country are milked, and that all goats in arid and semi-arid regions are milked. According the 2009 census, there are 25,250,865 head of goats in ASAL regions of Kenya (Table 1).

The formula for the production of sheep and goat milk for human consumption is:

> **25,250,865 head of ASAL goats * 51.2 lit/head = 1,292,844,288 litres of milk production or 1.292 billion lit** (based on Field n.d. assuming 0.351 lit/day/doe or 5120 lit per 100 head of goats, 40% of flock adult female – see Annex IV *Sheep and Goat Milk* for citations and literature review).

There is little documentation on the producer price for goat milk. One study (Ogola et al 2010) reports goat milk selling at Ksh 28/lit when cow milk in the same area was selling at Ksh 23/lit, i.e., goat milk producer prices were a multiple of 1.22 of the producer price of cow milk. The estimated value of goat milk in 2009 is therefore assumed to be 28.28 Ksh/litre (the formal price cow milk) * 1.22 = 34.50 Ksh/litre.

In sum, based on available information, the national estimate of the value of goat milk undertaken here assumes that no highland goats are milked, that all ASAL goats are milked, and that the value of ASAL goat milk is equivalent to a multiple of the formal (and hence lower) producer price for cow milk.[1]

> **NATIONAL VALUE OF GOAT MILK: 1,292,844,288 litres (ASAL production) @ 34.50/ litre = 44,603,127,930 Ksh or 44.603 billion Ksh in 2009**

[1] Should it become possible at some point to identify the proportion of the highland goat herd that is milked, then the milk production coefficient is estimated at 19.2 lit/head for human consumption, based on Onim n.d. assuming 60 lit/lactation, 50% of flock adult female and 65% kidding rate or 5120 lit per 100 head of goats – see Annex IV *Sheep and Goat Milk* for citations and literature review. Peacock (2008) states that arid and semi-arid goats are generally twice as productive as those in more humid areas, and the estimated milk outputs ascribed here to highland and ASAL goats conform to this pattern.

2.2.4 Cattle offtake

In this report, estimations of national cattle offtake for sale and slaughter are based on two offtake rates – one for the arid and semi-arid zones (ASAL) and a second for the highlands.

Fratkin et al. (1999) documented a wide range of offtake rates - from 26% to 8% in one arid pastoral area - depending both on Kenyan macro-economic policy and when herds were sampled relative to droughts. McCabe documented offtake rates ranging from 3.6% to 12.2% in the course of a drought in Turkana (1987). There is, in other words, no single 'correct' offtake rate for ASAL herds subjected to unpredictable weather. Because offtake rates also respond to market prices, we will in this report use for ASAL cattle an offtake estimate of 15% based on recent research (McPeak et al. 2011 in press). Net offtake of ASAL cattle for sale and slaughter is estimated as:

> **12,155,974 ASAL cattle * 0.15 net offtake rate = 1,823,396 head of offtake from ASAL cattle in 2009.**

In the highlands 90% of small holders obtain their replacement animals from other smallholders, so circulation of breeding stock within this sector is intense. All that would appear to exit are culls and male animals, depending on the extent to which the latter are used for draught. It is therefore important in the highlands to distinguish between gross offtake (all the animals leaving a herd) versus net offtake (herd exits less purchases and cattle received as gifts or loans), and to base calculations on the latter figure. On this basis net offtake from highland dairy areas is estimated at 7.9% per annum (Bebe n.d.), and the offtake of highland cattle for sale and slaughter in 2009 is estimated as:

> **5,311,800 head of cattle in highland areas * 0.079 = 419,632 net offtake from dairy sector in 2009.**

National smallholder and pastoral cattle offtake is estimated at:

> **419,632 highland cattle + 1,823,396 ASAL cattle = 2,243,028 total offtake in 2009, or a national cattle offtake rate of 12.8% per year**.[2]

The preceding calculations estimate the domestic supply of cattle for consumption, but Kenyans also consume significant amounts of imported beef. In 2003 Agriconsortium estimated that the cross border importation of live cattle contributed 22% of Kenya's domestic beef supplies. Holding constant the assumed proportion of imported animals, cross border live cattle imports into Kenya in 2009 can be estimated at 632,649 head.

63% Kenyan pastoral and ranch cattle:	1,823,396 head
22% imported pastoral cattle	632,649 head
15% dairy sector cull cows and males	419,632
Total:	**2,875,677 head of cattle**

[2] Livestock held in commercial ranches were included in the 2009 census and offtake from these sources is part of the national estimate of 2,243,028 head of cattle produced for slaughter in 2009. Agriconsortium (2003) estimated ranch offtake of 36,000 head per annum from 360,000 head of commercial cattle, an assumed offtake rate of 10% per year. If commercial offtake remained roughly constant between 2003 and 2009, cattle sourced from ranches constituted about 1.6% of national offtake in 2009.

Total beef supply in 2009 is estimated at 2,875,677 head of cattle, 63% from domestic pastoralists/ranchers, 22% pastoral imports, and 15% from the dairy sector. Over 80% of the beef consumed in Kenya is produced by pastoralists, either domestically or in neighbouring countries.

Average producer prices for livestock in Kenya from 2004- 2010 are given in table 2.

Table 2: National average livestock sale prices, 2004-2010

Year	Cattle	Goats	Sheep	Camels
2004			2,015	
2005	17,011	2,500	1,653	
2006	16,431	1,727	1,308	
2007	17,251	1,711	1,884	
2008	22,834	1,844	1,888	22,987
2009	24,057	1,984	1,636	38,570
2010	26,823	2,549	2,967	42,634

Source: National Livestock Information System, Ministry of Livestock Development

Notes: Estimated average sale prices exclude dairy cows and immature animals. Producers directly sell their animals in primary, secondary and tertiary markets, and the estimates quoted here are an average of prices prevailing at all market levels.

Valued at average producer prices, domestic live cattle offtake and imported cattle in 2009 were worth the following amounts (Ksh):

Value of pastoral offtake 1,823,396 * 24,057 = 43,865,437,570 Ksh or 43.865 billion Ksh

Value of dairy offtake 419,632* 24,057 = 10,095,087,020 Ksh or 10.095 billion Ksh

Value of imports 632,649 * 24,057 = 15,219,636,990 Ksh or 15.220 billion Ksh

TOTAL VALUE OF DOMESTIC OFFTAKE: 53.960 billion Ksh

TOTAL VALUE OF DOMESTIC SUPPLY: 69.180 billion Ksh (includes imports)

2.2.5 Camel offtake

McCabe documented camel offtake rates ranging from 5.1% to 7.5% through a Turkana drought cycle, which is a higher offtake rate than that routinely reported. **Agriconsortium (2003) estimated an offtake of .9 million head of camels in 2003, or an annual offtake rate of 1.7% per annum. If we adopt this lower offtake rate, camel offtake in 2009 was: 2,971,111 head of camels * 0.017 = 50,509 head of offtake * 38,570 Ksh/head (Table 2) = 1,948,132,130 Ksh or 1.948 billion Ksh in 2009**

2.2.6 Sheep and goat offtake

Agriconsortium estimated 4.2 million head of offtake for shoats in 2003, at an offtake rate 13.2%/year for sheep and 13.7%/year for goats. These offtake rates are low relative to other parts of Africa, but this could be explained by high rates of mortality in Kenyan flocks. During a drought in Turkana, McCabe (1987) documented offtake rates for small stock of about 9.5% with many deaths. We have thus far been unable to find additional research studies that give offtake rates for small stock in Kenya, and Agriconsortium does not provide evidence for its offtake estimates. Nonetheless, applying Agriconsortium's offtake rates to 2009 sheep and goat populations gives us the following estimated offtake:

17,129,606 sheep * 0.132 = 2,261,108 head of offtake * 1,636 = 3,699,172,688 Ksh or 3.699 billion Ksh in 2009

27,740,153 goats * 0.137 = 3,800,401 head of offtake * 1,984 = 7,539,995,584 Ksh or 7.540 billion Ksh in 2009

2.3 Manure as fertilizer

Manure used as fertilizer is particularly important in intensive smallholder dairy operations on very small farms. Manure is used to fertilize crop fields by 95% of smallholders in the highlands, and on small dairy farms milk and manure were ranked almost equal in importance (Lekasi et al. 2001). Manure is important to smallholders because it:

- speeds the rate of nutrient turnover by accelerating biomass decomposition through digestion or through physical process like the trampling of bedding;
- manure is a major conduit for nutrient inputs into the system when animals are fed concentrated feeds and fodder (including hand-cut roadside grass and crop residues) and subsequently excrete the nutrients introduced through these feed supplements (Utiger et al.2000).

By purchasing concentrates and conserving and using manure, farmers realize an additional benefit from the money they spend on feed supplements for dairy cattle, which are recycled back into home-produced fertilizer for enhanced crop production. Livestock thereby generate soil fertility inputs, accelerate nutrient cycling, and pay through the sale of milk for external nutrient inputs (Staal et al 2003). The profitable sale of milk is essential for this spiral of intensification. Without profits from milk, farmers do not purchase feed concentrates, reducing the effectiveness of manure as a source of external nutrient inputs. A profitable market for the sale of milk is therefore an important factor in sustaining nutrient balances on small farms undergoing intensification. By the same token, manure has a clear economic as well as agronomic value on intensively managed smallholder dairy farms. At the commercial manure price in 1996 of Ksh 5.3/kg (Ksh 90 = £1.00) for dry manure, manure provided 2 to 6 times the equivalent nutrients that the same about of money would have purchased in the form of inorganic fertilizer: 'The organic fertiliser value of faeces is approximately five times that of its inorganic fertiliser … equivalents' (Lekasi et al.2001).

Kimani et al. (2000) found that most manure came from within the farm (83%) and a very small proportion of farmers purchased manure – 6% of households in a survey conducted in 2000 (Waithaka et al 2002). By 1986 in Machakos District 87% of farmers used manure on crops and 3% were selling it (Tiffen et al. 1994).

On zero grazing one cow produces about 2.8 kg of manure per day (0.008 of live weight of 350 kg) and cattle were estimated to produce about 85% of the available manure on surveyed farms (Lekasi et al 2001); on the other hand, Kimani et al. (2000) (cited in Kimani and Lekasi n.d.) estimated that 65% of available manure came from cattle.) Using 1996 milk prices, Lekasi et al. (2001) estimated that the value of manure produced by a dairy herd was about 32% of the value of milk offtake. This is the potential value of manure; realized value depends on how much manure is retrieved and used as fertilizer, which is largely a function of the grazing system. Zero grazing and stall feeding capture a much larger proportion of manure production than free grazing.

Ngigi (2005, based on SDP survey data from 1999-2000) estimated that 25% of highland smallholders practiced free grazing, 38% practiced semi-zero grazing, and 37% practiced zero grazing. Based on a survey conducted in 2000, Waithaka et al. (2002) estimated the relative prevalence of different grazing systems in the highlands to be 22% free ranging, 56% mainly free with some stall feeding, 17% mainly stall and some free, 5% zero grazing. Bebe et al. (2003) in a random sample of smallholder farming in the Highlands documented free grazing on 23% of their sample in 1996-98.

The equivalent monetary value of recovered manure can be calculated as a proportion of the value of milk offtake, based on Lekasi's finding that the potential value of manure (at 100% recovery) is roughly 32% of the value of milk offtake. For purposes of this calculation, we will assume that 37% of highland farms practice zero grazing – a figure based on a random survey of highland farms (Ngigi 2005). We will further assume that 100% of the potential value of manure is recovered on these farms, equivalent in monetary value to 32% of milk offtake from these farms, but that no manure is used in any of the other highland grazing system. Mean annual milk offtake per head of cattle in the highlands is approximately 900 lit/head, but with zero grazing rises to about 1300 lit/head according to recent research (Ngigi 2005; Muia et al. 2011; Musalia et al. 2007). Assuming that 37% of highland cattle are kept under zero grazing, then the volume of milk output from these systems is: 5,311,800 (highland cattle in 2009) * 0.37 (proportion under zero grazing) * 1300 (litres of milk output per year) = 2,554,975,800 litres or 2.555 billion litres of milk per annum.

Seventy-four percent of this output is valued at the informal milk price and 26% at the formal producer price, or 2.555 billion lit * 0.74 * 36.06 Ksh/lit = 68.179 billion Ksh. and 2.555 billion lit * 0.26 * 28.28 = 18.786 billion Ksh. The total value of highland milk from zero grazing systems can in this way be estimated to be worth 86.965 billion Ksh in 2009. If the manure on these farms is worth 32% of the value of their milk production, then **manure output used as fertilizer was worth 27.829 billion Ksh in 2009.**

2.4 Animal draught power

Relative to the information on other kinds of livestock products and services, the use of animal draught power in Kenya agriculture is poorly documented. In the early 1990s Tiffen et al. observed that 'In Kenya … there was no definite policy on ox-ploughing before 1975. This is reflected in a sparse research literature, which even now is dominated by technical issues, rather than those of economics or management' (1994: 239).

The literature is still dominated by discussions of improved implements and harnesses, and a dearth of information on the economic benefits derived from existing systems for using animal

power. The exception is Ouema et al. (2004), who base their estimates of the value of animal draught on the prices paid to rent ploughing services. They documented a value for ploughing services in extensive smallholder farming at $251.90 per farm and at $31.50 per semi-intensive farm. This made ploughing 2.42 times as valuable as milk revenue for extensive small holder farmers and about 9% of milk revenue for semi-intensive producers. Average farm size for extensive holdings was 5-6 zebu cattle on about 2.2 ha of land; intensive farms averaged 3-4 upgraded dairy cattle on 0.2 to 1.8 ha.

The monetary value of draught power could be estimated as a proportion of the value of milk offtake, based on Ouema's results (2004). However, to complete these calculations we need estimates of the relative balance of extensive versus semi-intensive producers in the highlands and information on the prevalence of draught power usage among semi-arid small holders, as in Machakos and Makueni (Ndathi et al n.d.). We have been unable to locate this information and therefore have concluded that there is at present insufficient evidence to undertake these calculations.

There is material in Dennis (1998) and Leyland (n.d.) on working equines, but there is not enough information in these sources to quantify the economic benefits of donkey usage.

2.5 Livestock-based financial services

2.5.1 Livestock as credit

The credit or financing benefits of livestock derive from the ability of livestock owners to dispose of their animals for particular purposes at a time that they choose – their ability to 'cash in' on the value of their animals as needed. This flexibility gives livestock owners access to money without the need to borrow and confers an additional financial benefit beyond the sale, slaughter or transfer value of their livestock. This additional financial benefit can be estimated as the opportunity cost of rural credit – what it would otherwise cost a livestock owner to obtain funds comparable to those produced by liquidating a part of the herd (Bosman et al. 1997). Employing this method of estimation, the additional finance value of a livestock holding is equivalent to the interest that the owners would be required to pay to obtain loans equal to the value of their livestock offtake. The total estimated value of national livestock offtake in 2009 is given in Table 3:

Table 3: Value of ruminant livestock offtake in 2009, billion Ksh

Livestock species	Offtake value in billion Ksh
Cattle	53.960
Camel	1.948
Sheep	3.699
Goat	7.540
Total	**67.147**

Table 4 summarizes information on the interest rates charged by different institutional channels providing agricultural credit in Kenya.

Table 4: Sources of agricultural credit and annual interest rates

Source of credit	Percent 2000	Percent 2004	Annual interest
Commodity based credit providers	53.5	62.7	Not known
Cooperatives/Saccos	26	20.6	24
Informal money lenders	12.1	9.9	20-34
Local trader/input stocklists	6.8	3.9	24 for donor guaranteed stocklists
AFC	0.4	1.3	10
Commercial bank	0.6	1.0	12-18
MFI/NGO	0.6	0.5	35 (Dondo pp 9)
	100%	100%	-
Hire-purchase interest rates 1997-2003 (Ngugi and Wambua 2004)	-	-	40 % 1996 to 15-20% in 2005

Source: Kibaara 2006, Dondo n.d. and Ngugi and Wambua 2004 where noted.

Notes: Informal money lenders include shylocks (professional money lenders), self help groups, merry-go-rounds and community associations. Commodity based credit providers include tea, tobacco, French bean and sugar companies. AFC = Agricultural Finance Corporation, a government institution. FSA = financial services association; MFI = micro finance institution; ROSCAs = rotating savings and credit associations; SACCO = savings and credit cooperative societies

Institutionalized credit sources in rural Kenya (see Table 4) can be characterized as follows:

- Only 2.5% of all agricultural households had obtained long-term credit for use in their farms and over half of these used it to purchase improved dairy cattle (Waithaka et al 2002). The kinds of lending institutions that are likely to provide long-term credit – AFC and commercial banks – provide only 1% of all loans and are not a relevant standard for determining rural credit interest rates. 'AFC and commercial banks gave the largest amount of credit per household but to only to a few households, while the cooperatives/Saccos and commodity based credit providers … disbursed low amount of credit to a larger clientele base' (Kibaara 2006: 8).
- Loans for agricultural inputs supplied to farmers on contract to agricultural processing companies are the most common form of credit in rural Kenya, but the interest charged on these loans is not documented.
- 79% of households had at least one member in a cooperative or savings and credit group, which were highly concentrated (over 70%) in low income zones which are generally less attractive to non bank and bank financial institutions (Owen 2007).

The interest rates charged by cooperatives and informal money lenders provide one indication of the prevailing cost of credit for smallholders. These rates range from 20 to 34 percent per annum. If we assume that interest rates on rural credit in Kenya are currently running at about 25% per annum (the prevailing rate in institutionalized channels), then the financial value of livestock

offtake is a quarter of the annual value of offtake – in 2009, for example, 67.147 * 0.25 = 16.787 billion Ksh financial benefit on top of 67.147 billion Ksh in direct offtake value.

However, 47.9% of lending in rural Kenya is not conducted through institutions, but is done privately by neighbours, friends, and kin, apparently at very low interest rates, resulting in an average rural interest rate of 6.3% per annum according to national survey data (KNBS 2006). In this case the financial value of livestock offtake is 67.147 * 0.063 = 4.230 billion Ksh. **In this report we will use the lower interest rate of 6.3% and the lower estimated national credit value of Kenyan livestock at 4.230 billion Ksh.**

2.5.2 Self-insurance

Part of the insurance or security value of livestock comes from the ability of owners to liquidate their own herds in an emergency. The insurance value of livestock is a practical benefit for rural Kenyans. In 2005/06 the KIHBS inquired how households responded to shocks. Nationally, the most common response was to spend cash savings and to work more and longer hours. In rural Kenya the third most prevalent response was to sell animals (KNBS 2007).

In this instance, the level of security provided to a particular individual depends on the value of that individual's assets, and livestock ownership functions as self-insurance. The value of this form of asset-based insurance can be calculated as the annual cost that herd owners would need to pay to purchase insurance coverage equal to the capital value of their herd (Bosman et al. 1997). On a national basis, estimates of the insurance value of the Kenyan national herd are based on an assessment of the capital value of that herd, which is undertaken in Table 5. We have no data on the relationship between the average producer prices that owners receive for livestock when they sell them relative to the average value of the animals that remain behind in their herds. For the purposes of this calculation, we have assumed that the mean value of livestock as capital is 75% of their mean sale value.

Table 5: The capital value of ruminant livestock in 2009

Livestock species	2009 population	Mean Producer sale price/head	Assumed mean value/head at 75% of sale price	Capital value of stocks – billion Ksh
Cattle	17,467,774	24,057	18,043	315.171
Sheep	17,129,606	1,636	1,227	21.018
Goats	27,740,153	1,984	1,488	41.277
Camels	2,971,111	38,570	28,927	85.945
Total				**463.411**

If the capital value of the Kenyan national herd in 2009 was roughly 463.411 billion Ksh, the estimated value of these assets as self-insurance is equivalent to the insurance premiums that rural Kenyans would need to pay to provide themselves with 463.411 billion Ksh of insurance coverage, i.e. the opportunity cost of comparable levels of coverage.

Private health care expenditure per capita in 2005 amounted to Ksh 330/month or 3960 Ksh/year for an average family of five, which added up to around 12% of total household non-food expenditure for the poor (Mathauer et al 2008). According to the KIHBS survey of 2005/06, medical costs were the third most common reasons for households to borrow money, following subsistence needs and school fees (KIHBS 2006). The average cost of health care for a Kenyan household is considerable and the cost of health insurance therefore provides a reasonable indication of the costs of insurance more generally for Kenyans of modest means.

The Kenyan National Hospital Insurance Fund is a nation-wide government-backed health insurance scheme to which all civil servants and formal sector employees are obliged to contribute. Self-employed and informal sector workers can join on a voluntary basis, paying a flat rate of Ksh 1920/year/family, which provides health coverage limited to 396,000 Ksh/year. The premium to coverage ratio in this case is 1920/396,000 or 0.48%.

If voluntary health insurance in Kenya costs 0.4848% of the value of the cover provided, then the self-insurance value of Kenyan livestock in 2009 can be estimated as the capital value of the national herd or 463.411 billion Ksh * 0.004848 = 2.013 billion Ksh.

2.5.3 Risk pooling

For pastoralists in Kenya, the insurance value of livestock derives not only from their ability to liquidate their individual herds, but also from their ability to call upon assistance from fellow pastoralists in time of need. These collective insurance schemes are based on the gifting and loaning of livestock within pastoral communities, with large herd owners donating some of their animals and less well-off pastoralists drawing support in the form of livestock received as gifts or on loan. Since transfers are in-kind – meat, milk, live animals and traction/transport services – contributions into these systems are roughly comparable to withdrawals from them. The value of the system from the perspective of resource givers and receivers is therefore approximately equal: poorer pastoralists extract a level of support from the system that equals what richer pastoralists are willing to invest in order to maintain their reputation for generosity and thereby retain their right to call upon community support if they require future assistance. The value of this communal system of livestock insurance is therefore equal to the level of livestock loaning and gifting within a pastoral community.

Like farmer-managed livestock, pastoral animals will have the self-insurance value that can be ascribed to all Kenyan livestock, as discussed in the previous section. Some pastoral animals will also have an additional collective insurance value depending on how many animals are involved in livestock sharing schemes designed to pool risk.

Table 6 summarizes the results of recent work on rates of livestock sharing among pastoralists in southern Ethiopia and northern Kenya.

Table 6: Rates of animal sharing in southern Ethiopian and northern Kenyan rangelands

Country	Site	Ethnic majority	Gifted animals as % of herd	Borrowed animals as % of herd	Total shared animals as % of herd
Kenya	Dirib Gumbo	Boran	13	5	18
	Kargi	Rendille	3	10	13
	Logologo	Ariaal	6	2	8
	Ng'ambo	Il Chamus	8	0	8
	North Horr	Gabra	9	2	11
	Sugata Marmar	Samburu	10	2	12
Ethiopia	Dida Hara	Boran	10	5	15
	Dillo	Boran	4	3	7
	Finchawa	Guji/Gabra	1	9	10
	Qortate	Boran	1	0	1
	Wachille	Boran	9	3	12
Unweighted mean					10.5

Source: Barrett et al. 2006; McPeak et al. forthcoming 2011

For purposes of this calculation, we assume that all livestock in the arid districts and all livestock in twelve semi-arid districts of Kenya are kept by pastoralists and potentially subject to these lending/borrowing arrangements. Annex V lists the semi-arid districts assumed to be pastoral. Table 7 estimates the populations of pastoral livestock in Kenya and their monetary value.

If 10.5% of all pastoral ruminants in Kenya are involved in livestock sharing networks and if the total capital value of pastoral livestock in Kenya is 295.270 billion Ksh, the collective insurance value of pastoral herds can be estimated at 295.270 * 0.105 = 31.003 billion Ksh 2009.

Table 7: Pastoral livestock populations in 2009

	Cattle	Sheep	Goats	Camels	TOTAL
Arid (head)	6,281,354	10,246,527	18,230,633	2,924,742	
Semi-arid pastoral districts[1] (head)	2,704,786	3,170,220	2,627,347	35,625	
Kenya pastoral total (head)	8,986,140	13,416,747	20,857,980	2,960,367	
Assumed mean value Ksh/head at 75% of sale price	18,043	1,227	1,488	28,927	
Capital value of pastoral livestock – billion Ksh	162.136	16.462	31.037	85.635	295.270

Note: [1]See Annex V for a list of semi-arid pastoral districts

2.6 Poultry production

Indigenous egg production can be estimated as follows: 25,756,487 indigenous chickens in 2009 (Table 1) of which half were mature birds and 87.5% of the mature birds were laying females, each of which produces 60 eggs per year at a producer price of 8 Ksh/egg (MOLD Animal Production Division Annual Report for 2006, unpublished).

25,756,487 * .5 * .875 * 60 * 8 = 5,408,862,057 Ksh or 5.409 billion Ksh in 2009.

Commercial egg production can be estimated as follows: 6,071,042 commercial chickens in 2009 (Table 1) of which 36% are assumed to be laying hens (based on the ratio of hens to broilers in the MOLD Animal Production Division Annual Report for 2006, unpublished) each of which produces 280 eggs per year at a producer price of 8 Ksh/ egg.

6,071,041 * .36 * 280 * 8 = 4,895,688,268 Ksh or 4.896 billion Ksh in 2009

TOTAL VALUE OF DOMESTIC EGG PRODUCTION: 10.305 billion Ksh

Indigenous chicken meat production can be estimated as 25,756,487 indigenous chickens (Table 1) yielding 10,302,595 chickens for slaughter at 40% offtake per year, with an average of 1.3 kg dressed weight per chicken (MOLD Animal Production Division Annual Report for 2006, unpublished). Assuming a 30% replacement rate, 2,285,575 commercial laying hens produced 655,672 culled layers at 1.3 kg per bird in 2009; in 2009 3,885,467 broilers (64% of commercial flock based on the ratio of hens to broilers, MOLD Animal Production Division Annual Report for 2006, unpublished), produced 4,429,432 broilers (114% offtake) with a dressed weight of 1.5 kg per bird.

TOTAL SLAUGHTER CHICKEN OUTPUT IN 2009	10,302,585 indigenous birds
	655,672 culled commercial layers
	4,429,432 commercial broilers
	15,387,699 head total offtake in 2009

At an average producer price of 300 Ksh per bird, chicken meat production had a gross value of 4,616,309,700 Ksh or 4.616 billion Ksh for 20,889 tons of meat.

2.7 Pig production

The 334,689 pigs recorded in the 2009 census produced an estimated 167,344 head for slaughter at a 50% annual offtake rate (MOLD Animal Production Division Annual Report for 2006, unpublished). MOLD further assumes a 60 kg. dressed weight per pig. For purposes of this report, we will use an average producer price of 150 Ksh/kg dressed weight or 9000 Ksh/slaughter pig:

334,689 * .5 * 9000 Ksh/head = 1,506,096,000 Ksh or 1.506 billion Ksh as the gross value of pig offtake in 2009.

2.8 Summary of Part I

Table 8 summarizes the gross value of the goods derived from livestock in Kenya in 2009. Livestock gross value added – i.e., the estimated value of livestock production – is 369.214 billion Ksh (Table 8). According the KNBS (unpublished) the costs of the inputs used in livestock production totalled 50.243 billion Ksh in 2009. Deducting these intermediate costs from the gross value of production give a figure of 318.971 billion Ksh, the value added by livestock to the agricultural sector of the Kenyan economy in 2009.

When compared to KNBS's commodity flow approach, the procedures followed in this report generate a significantly higher estimate of the contribution of livestock to agricultural GDP – 318.971 billion Ksh versus the official estimate of 127.723 billion Ksh in 2009, an increase of 150%. According to the revised estimates, milk is far and away Kenya's most economically important livestock product, with a value of 257.811 billion Ksh in 2009, or about 70% of the total gross value of livestock's contribution to the agricultural sector. Cattle are Kenya's most important source of red meat, supplying by value about 80% of the nation's offtake for slaughter.

Table 8: Estimated Gross Value of Livestock Production in 2009

Product	billion Ksh
Cattle milk	197.018
Camel milk	16.190
Goat milk	44.603
Subtotal estimated milk offtake	**257.811**
Cattle offtake	53.960
Camel offtake	1.948
Sheep offtake	3.699
Goat offtake	7.540
Subtotal estimated ruminant offtake	**67.147**
Egg production	10.305
Chicken offtake	4.616
Pig offtake	1.506
Subtotal non-ruminant production	**16.427**
Manure for fertilizer	27.829
Change in stocks	No estimate
TOTAL PRODUCT OUTPUT	**369.214**

Table 9 estimates the gross value of both goods and services derived from livestock in Kenya in 2009. In 2009 the total estimated value of goods and services provided by livestock – i.e. the direct use value of livestock to the Kenyan economy – was 356.217 billion Ksh (Table 9). Of this total, about 90% is supplied by goods normally included in estimates of agricultural GDP, and 10% is derived from financial services provided by livestock and excluded from conventional national accounts. The contribution of services to the total direct use value of Kenya livestock would undoubtedly have been much greater if it were possible to quantify the economic importance of animal power, which is omitted from these calculations for lack of sufficient data.

For 2005-09, Table 10 assembles a number of official indicators of the economic performance of Kenya's livestock sector, and Table 11 does the same for official estimates of the volume of livestock product output and sales. With the exception of GDP estimates that are adjusted to include subsistence production, the figures in Tables 10 and 11 refer exclusively to the value and quantity of recorded marketed production and reflect the dependence in official Kenyan agricultural statistics on data collected by and from large commercial operations.

Table 9: Direct use benefits derived from ruminants and equines, 2009 in billion Ksh

Type of benefit	Agricultural GDP	Services not in current GDP estimates
Value added livestock products (slaughter animals, milk, eggs, manure for fertilizer)	318.971	
Traction power for ploughing		No estimate
Benefit from financing		4.230
Benefit from self-insurance		2.013
Benefit from risk pooling/stock sharing		31.003
Transport and haulage by equines and camels		No estimate
Sub-totals	318.971	37.246
Total economic benefits		356.217

Table 10: Official indicators of economic performance in the livestock sector

	2005	2006	2007	2008	2009
Livestock and products recorded marketed production at current prices, Ksh million					
Cattle and calves	13,063.5	13,403.2	13,451.6	13,494.1	14,627.2
Dairy produce	5,313.2	6,494.4	8,462.2	8,368.7	11,496.7
Chicken and eggs	1,901.5	2,186.7	2,575.5	2,788.8	4,344.6
Others	3,980.7	4,291.5	5,202.1	5,977.6	5,151.6
Total	**24,258.9**	**26,375.8**	**29,691.4**	**30,629.1**	**35,620.1**
Costs of the inputs used in livestock production, Ksh million					
Services	952	1,041	1,154	1,212	1,384
Livestock drugs	1,313	1,439	942	857	1,855
Manufactured feeds	2,638	2,242	2,038	4,849	5,544
Fresh fodder	5,868	6,725	8,385	9,663	7,960
Dipping and spraying	11,347	13,323	15,662	15,118	15,055
Artificial insemination	1,122	1,647	1,362	2,062	1,861
Other animal costs	12,225	14,463	16,939	17,895	16,584
Total intermediate consumption	**35,466**	**40,880**	**46,481**	**51,656**	**50,243**
Gross domestic product, farming of animals, Ksh million					
	73,549	**80,931**	**82,868**	**99,699**	**127,723**

Source: KNBS 2010; data on intermediate consumption from unpublished KNBS records.

Table 11: Official indicators of livestock and dairy product output and sale

Product	Unit	2005	2006	2007	2008	2009
Production and sale of livestock and dairy products						
Recorded milk production	Mn. litres	340	361	423	399	407
Milk processed						
Whole milk and cream	Mn. Litres	191	225	282	262	286
Butter and ghee	Tonnes	1,261	1,549	1752	1,218	1,074
Cheese	Tonnes	270	243	215	155	188
Livestock slaughtered						
Cattle and calves	'000 head	1,786	1,911	1,720	1,892	2,057
Sheep and goats	'000 head	4,220	4,775	5,014	5,425	5,716
Pigs	'000 head	180	176	167	198	221

Source: KNBS 2010

Table 12 compares the 'commodity flow' and 'production' approaches to estimating livestock sector performance. It is clear from this comparison that the results of the two estimation techniques are incomparable; by referring exclusively to formally marketed production, official statistics always represent a fraction of total estimated output using a production-based approach.

Table 12: A comparison of official and revised estimates of livestock sector performance

	Value of cattle and calves offtake, billion Ksh	Value of dairy offtake, billion Ksh	Milk production, Mn. litres	Bovines slaughtered '000 head	Sheep/ goats slaughtered '000 head	GDP livestock, billion Ksh
Official/ recorded	14.627	11.497	407	2,057	5,716	127.723
Production-based estimate	53.960	257.811	7634	2,875[1]	6,062	318.971
Official/ recorded as % of production-based estimate	27%	4%	5%	72%	94%	40%

[1]The estimate of the number of bovines slaughtered according to the production-based method includes pastoral, dairy, ranch cattle offtake and imported cattle. It is likely that informally imported cattle supplied by the cross-border trade are included in official slaughter estimates.

This result is not surprising. What is notable is the small proportion of all livestock production that is apparently captured in official statistics – less than a third of the value of bovine offtake

and less than a twentieth of the value of national milk production. Within their limits, the official recorded estimates of the value of livestock production may be reasonably accurate, but because only a small portion of Kenya's livestock production is exchanged through official channels, official figures give a very partial impression of the size and organization of the livestock sector. These figures would also appear to provide an unreliable basis upon which to estimate the contribution of livestock to agricultural GDP. Unlike the other official estimates in Table 12, GDP estimates are obliged to include estimates of the value of un-marketed and informally marketed livestock production. At 40% of the production-based estimate of livestock's total contribution to agricultural production, it is doubtful that the commodity flow approach is fit to achieve this purpose.

PART II: CONTRIBUTION OF LIVESTOCK TO THE WIDER ECONOMY

3.1 Introduction

This final part of the report examines three different ways Kenyans make use of livestock products – for private consumption, as inputs into other domestic industries, and as exports. In large measure, the following discussion extracts and summarizes information contained in the Economic Survey 2010 (KNBS 2010).

3.2 The role of livestock in household consumption and expenditure

Nationally, 11.4% of household consumption expenditure (including purchased and the monetary value of own produce, own stock and gifts) is spent of livestock-derived food items, 13.1% in rural and 9.7 % in urban Kenya (KIHBS pp 40-41). In rural Kenya 53.9% of food is purchased, while in urban Kenya 79.9% is purchased (KIHBS pp 35).

Table 13: Ruminant, poultry and pig meat for consumption (includes live animal imports), 2009

Product	Calculations	Total consumption (mt)	Per Capita (kg/year)
Beef	Small holders/pastoral/imports 2,839,677 head * 125 kg/head	354,960	
	Ranches 36,000 * 240 kg/head	8,640	
Total beef		363,600	9.42
Beef Offal	25% of meat production	90,900	
Total beef and offal		**454,500**	**11.77**
Sheep and goat meat	6,061,509 * 15 kg/head	90,923	2.35
Sheep and goat offal	25% of meat production	22,731	
Total sheep and goat meat and offal		**113,654**	**2.94**
Camel meat	50,509 * 330 kg/head	16,670	.43
Camel offal	25% of meat production	4,167	
Total Camel meat and offal		**20,837**	**.54**
Ruminant total, meat and offal		**588,991**	**15.25**
Pig meat	167,344 head * 60 kg dressed weight	**10,041**	**.26**
Chicken meat	Indigenous and culled commercial layers 1.3 kg dressed weight; broilers 1.5 kg dressed weight	**20,889**	**.54**

Source: Estimated ruminant slaughter weights for meat and offal are taken from Agriconsortium 2003, Table 1; dressed weight of slaughtered pigs based on MOLD reports.

According to the national census, Kenya had a population of 38,610,097 people in 2009. Based on this population estimate, Table 13 uses the milk and meat production estimates developed in this report to calculate the red meat (including offal) available from ruminants (cattle, sheep, goats and camels) and pigs for consumption per capita in 2009.

According to Table 13, Kenyans on average have available meat and offal for consumption per person of 11.77 kg from beef, 2.94 kg from small stock, 0.54 from camels, 0.26 from pigs, and 0.54 from chickens. These figures are remarkably close to the estimates of meat supply in the 'Food Balance Sheet' for 2009 (Economic Survey 2010, page 175), at 13 kg of beef, 2.3 kg of mutton and goat meat, and 0.9 kg of 'other meat', per caput per year. This outcome is surprising given the discrepancies between current official estimates of livestock production and the higher estimates of livestock product output in this report (section 2.6).

The revised milk production estimates given in this report are:

Cattle	5.788 billion litres – 76% of national total
Camels	0.553 billion litres - 7% of national total
Sheep and goats	1.293 billion litres – 17% of national total
Total milk production	**7.634 billion litres**

Using the 2009 census population estimate of 38,610,097 people, per capita fluid milk available for consumption or for conversion into processed dairy products for consumption is 198 litres per person per year. This figure is approximately ten times higher than the food balance sheet estimate of milk supply at 17.3 kg and butter/ghee at 0.1 kg per caput per year.

In sum, the food balance sheet estimates of per capita milk supply are significantly lower than our estimates for milk and milk products, but roughly equal to our estimates for meat and offal.

3.3 Livestock products as inputs into manufacturing

In the six years between 2005 and 2010, manufacturing that relied on three animal product inputs – meat, milk and hides/skins – constituted about 12% of Kenya's total official manufacturing output (Table 14).

Table 14: Value of Livestock-related manufacturing, 2005-09 ('000 Ksh)

Industry	2005	2006	2007	2008	2009	2010
Meat and dairy products	41,733,259	43,627,399	49,718,245	46,691,670	65,294,571	63,904,472
Leather and footwear	1,432,292	1,279,841	1,627,101	1,663,465	2,266,619	2,885,897
Livestock total	43,165,551	44,907,240	51,345,346	48,355,135	67,561,190	66,790,369
Total manufacturing	342,994,299	374,829,654	408,138,714	503,607,108	488,471,951	604,737,504
% Livestock-related manufacturing	12.6%	12.0%	12.6%	9.6%	13.8%	11.0%

Source: KNBS unpublished data

Over this period food manufacturing was much more important than leather and footwear, but the production of leather shoes increased dramatically in 2009 by 46.5%, which supported overall growth in the output of leather and footwear production of 36.5% in that year (KNBS 2010).

3.4 The export of hides, skins and leather goods

Hides and skins, leather and leather products are Kenya's principal livestock-based exports. Livestock may also contribute the export of 'animal and vegetable oils' and 'articles of apparel and clothing accessories', but it is not possible to identify the extent of this contribution given the way data is aggregated in published reports. In any case, it is clear that livestock make a modest contribution to national exports.

Table 15 summarizes information on the quantities of livestock exports. Table 16 presents the value of livestock exports as a proportion of total national exports. Over the last five years livestock-related exports have contributed about 2% of total exports, with a tentative trend away from trade in raw hides and skins and towards the export of finished products such as leather and footwear.

Table 15: Quantities of livestock-related exports, 2005-09

Commodity	2005	2006	2007	2008	2009
Hides and skins (Undressed), tonnes	15,683	11,875	2,416	841	717
Leather, tonnes	10,083	16,062	20,049	19,529	13,957
Footwear, 1000 pairs	46,288	47,054	47,239	45,918	44,035

Table 16: Values of livestock-related exports as percentage of total exports, million Ksh, 2005-09

Commodity	**2005**	**2006**	**2007**	**2008**	**2009**
Hides and skins (Undressed)	866	622	143	40	30
Leather	1,611	1,971	3,036	3,313	2,237
Footwear	1,952	2,279	3,029	2,618	2,665
Total livestock product export	4,429	4,872	6,208	5,971	4,932
Total exports	209,918	228,181	261,685	322,660	323,571
Percentage of livestock contribution to total exports	2.11	2.14	2.37	1.85	1.52

3.5 Summary of Part II

1. The estimates presented in this report on the availability of livestock food items agree roughly with current official estimates of domestic meat and offal supplies per capita. On the other hand, our estimates of the amount of milk available for consumption (either as fluid milk or converted into other diary products) diverge significantly from official figures. Estimates of livestock

production follow a similar pattern (Table 12), with the estimates in this report agreeing with official small stock slaughter estimates, exceeding official estimates of cattle slaughters, but being about nineteen times larger than official milk production figures. In terms of its contribution to agricultural GDP, milk is about four times more important than meat. Without better documentation of the value and volume of milk production and consumption, official statistics on the livestock sector lack authority and credibility.

2. Unlike neighbouring countries such as Ethiopia, Sudan and Somalia, Kenya is a livestock importer rather than an exporter. At about 2% of the total, livestock products make a modest contribution to national exports. There is an apparent trend in recent years for the increased export of higher value added products such as leather and shoes rather than raw hides and skins, tentative evidence of the increasing maturity and competitiveness of this sector of Kenyan manufacturing.

CONCLUSIONS AND RECOMMENDATIONS

This report has explored an alternative to the methods currently used by the Kenyan National Bureau of Statistics to estimate the contribution of livestock to GDP. KNBS bases its estimates on information on marketed livestock output combined with survey data on household consumption patterns. In contrast, this report begins with livestock population data from the 2009 population census, and asks how much these livestock are, in all likelihood, producing.

Annex VI lists the production coefficients used to estimate product output, and Annexes II-IV summarizes the research studies that validate these production coefficients. The breakdown of the national livestock population by ecological zones is given in Annex V. Whenever distinctions are warranted and when sufficient data exists, estimates of product output have been tailored to different types of livestock production systems (e.g. pastoral, commercial ranching or intensive smallholder dairying systems) in different ecological zones (arid, semi-arid and highlands).

When compared to KNBS's commodity flow approach, the procedures followed in this report generate a higher estimate of the contribution of ruminant livestock to agricultural GDP – 318.971 billion Ksh versus the official estimate of 127.723 billion Ksh in 2009. In arriving at these different results, the two estimation procedures also provide substantially different pictures of the level of product output (section 2.6) and the amount of livestock-derived food (section 3.2) that is domestically available.

With cash or export crops, official marketing and recording channels most probably capture a large proportion of total production and provide a reliable indication of output. This does not appear to be true for livestock in Kenya, where informal exchanges and the immediate consumption of livestock products by smallholders and pastoralists absorb large amounts of production before it can be officially traded or enumerated. Because the size of the national herd was not known with any reliability, until the 2009 census it was difficult to establish how much livestock production was likely to have escaped official notice. It is, however, highly unlikely that national livestock populations in 2009 were smaller than the census estimates, and as a consequence, we now have a baseline against which we can evaluate the coverage of official livestock production data.

KNBS is currently reviewing its national accounting methods in response to new international guidelines (SNA 2008). In practice, KNBS will need to identify estimation procedures that make the most of the scarce data that is available on livestock production at the national level. The reliability of data varies for different livestock products – slaughter animals, milk and dairy production, and animal power. These are separately appraised in the following discussion.

Slaughter animals:

There are two possible sources of MOLD data on livestock offtake – slaughter figures kept by animal health inspectors and hides and skins marketing data. Table 17 summarizes the slaughter statistics, and Table 18 provides hides and skins production figures.

Table 17: Veterinary Public Health annual slaughter figures, 2005-09

	Cattle	Sheep	Goats	Camels
2005	483,533	341,319	484,066	1,962
2006	466,770	293,938	402,388	3,261
2007	493,170	347,657	413,542	3,426
2008	495,699	485,649	306,767	3,544
2009	534,210	509,879	485,789	1,155
Total	2,473,382	1,978,442	2,092,552	13,348
Five year average	494,676	395,688	418,510	2670
2009 population	17,467,774	17,129,606	27,740,153	2,971,111
Implied mean annual offtake rate based on slaughter figures	2.8%	2.3%	1.5%	0.1%
Offtake rate based on data in this report	12.8%	13.2%	13.7%	1.7%

Source: unpublished records Department of Veterinary Services, MOLD

The offtake rates in Table 17 implied by the Veterinary Public Health slaughter statistics are unrealistically low, given what we know about the size of the national herd and the preponderance of evidence on offtake rates provided by research studies. These figures therefore provide no indication of national offtake levels and cannot be used for that purpose.

The figures on marketed hides and skins in Table 18 are more promising, with implied offtake rates within the range of values suggested by independent research. However, these figures include hides from the estimated 633,000 head of cattle imported live from neighbouring countries and slaughtered in Kenya, about 22% of the national supply of slaughter cattle. Inflated by the addition of hides from imported animals, the sales statistics on hides inadvertently provide what appear to be reasonable estimates of domestic cattle offtake rates. In fact, because not all hides are marketed, the sales data on hides probably underestimates the number of cattle slaughtered by a considerable margin. In this report, total beef supply was estimated at 2,875,677 head in 2009. Five year mean hide production is 1,835,663 (Table 18) or 64% of estimated cattle offtake in 2009.

Table 18: Hides and skins production and marketing, 2006-10

	Cattle and calves	Sheep	Goats
2006	2,345,880	2,488,084	3,962,865
2007	2,028,068	2,963,414	3,752,375
2008	1,232,247	1,174,914	2,238,559
2009	2,300,739	2,276,788	3,962,334
2010	1,271,379	2,593,944	5,059,943
Five yr total	9,178,313	11,497,144	18,976,076
Five yr mean	1,835,663	2,299,429	3,793,415
2009 population	17,467,774	17,129,606	27,740,153
Implied mean annual offtake rate based on hides/skins data	10.5 %	13.4 %	13.7 %
Offtake rate based on data in this report	12.8%	13.2%	13.7%

Source: unpublished records Department of Veterinary Services, MOLD

Domestic sheep offtake in 2009 was estimated at 2,261,108 head in this report and the average number of marketed sheep skins per year over the five year period 2006-10 were virtually identical at 2,299,429, but probably included imported animals. Domestic goat offtake in 2009 was estimated at 3,800,401 in this report and the average number goat skins marketed per year 2006-10 was very similar at 3,793,415 according to DVS records, which again included imported goats.

In sum, further work needs to be carried out to determine the proportion of slaughtered animals that show up in official figures as marketed hides and skins, and to better understand the impact of live animal imports on inflating the hides and skins sales figures. Despite these limitations, marketed hides and skins statistics capture a significant proportion of slaughtered animals and are preferable to official slaughter statistics as a realistic estimation of national animal offtake for slaughter.

The National Livestock Information System, recently transferred from ILRI to MOLD, provides authoritative national average livestock sale prices based on the monitoring of a network of primary, secondary and tertiary markets. In sum, KNBS has authoritative producer price estimates for slaughter animals and, in the marketed hides and skins statistics, a flawed but valuable source of information on the number of animals slaughtered nationally. Taken in combination, these sources of data suggest the possibility in future of more accurate and larger estimates of the contribution of animal offtake to agricultural GDP.

Milk and dairy production:

The availability of current data of milk production and pricing is less promising. The bulk of Kenya's milk production probably never did flow through official channels, but the market share represented by these channels fell sharply after the sector was liberalized in 1992 (Ngigi 2005). According to estimates in this report, official recorded milk production now constitutes only about

5% of total national production. There is, furthermore, no systematic monitoring by MOLD of the prices producers receive for their milk, prices that vary by season, locality, livestock species, and marketing channel. The last MOLD Animal Production Division annual report, and hence the last national estimate of milk producer prices, refers to 2006, and this consultancy was unable to locate any further national annual reports or authoritative statements of milk producer prices after that date (although individual provincial Animal Production annual reports do exist current to 2010).

According to the estimates in this report, milk production constitutes about 73% of the value of livestock's contribution to agricultural GDP, and milk from cattle is Kenya's single most valuable livestock product. Because MOLD has at present no systematic method for estimating national production or national average producer prices, the information on milk production in this report comes overwhelmingly from research institutes like KARI and ILRI, from international researchers, and from work carried out by Kenya's universities, notably Egerton University. In compiling national accounts, the only workable option with respect to data on milk production is to rely on the broad range of detailed reports and research conducted by the scientific community in Kenya. This work is not organized so as to provide systematic national coverage, but the volume and quality of work conducted in recent years is sufficient to offset this deficiency.

Animal power:

Work on animal power in Kenya – either by government or by the research community – tends to be old, scarce, and difficult to use for making quantified economic estimates. It has, consequently, been impossible to hazard even a guess as to the contribution of animal traction to agricultural crop production, or to estimate the role of equines and camels in providing transport and haulage services, on a commercial basis or directly for their owners. The near total lack of information on animal traction is the single most limiting area of data availability on the livestock sector in Kenya.

These conclusions support the following recommendations:

1. Despite the data limitations discussed in this report, KNBS should consider adopting as standard practice the production approach to estimating livestock GDP that is presented in this report.

2. MOLD currently has little authoritative, quantified, national-level data on Kenya's most valuable livestock commodity – milk – and the Ministry should seek to remedy this deficiency. Dairy production and marketing are topics on which numerous Kenyans have conducted sophisticated and precise scientific research, and there is a large pool of national talent to engage in improving the Ministry's field monitoring, data analysis, and reporting skills. Until remedial action has been taken, the Ministry's lack of authoritative and comprehensive data impairs its ability to contribute to evidence-based discussions of national dairy policy.

3. With technical support from interested research institutes and Kenyan universities, MOLD and KNBS should undertake a national survey of the value of animal power to the Kenyan economy and of the role of animal power in sustaining both rural and urban livelihoods. This survey should include all forms of animal traction, transport and haulage by all species of working animals – cattle, equines and camels – in rural and urban areas and in all economic sectors – agriculture, manufacturing and services. As well as the commercial provision of animal power, the survey should assess the monetary value of the services that working animals directly provide for their owners.

Ignorance about the economic importance of animal power is not unique to Kenya; it is a regional phenomenon, and our recommendation regarding research on animal power applies equally to Ethiopia and Sudan, two other countries where IGAD is currently conducting studies on the economics of livestock and livelihoods. IGAD should consider introducing a region-wide programme of work on the economics of animal power, a subject that is chronically neglected by both academic research and government agricultural monitoring systems.

4. The information on livestock numbers provided by the 2009 census revealed the limitations of the procedures used by MOLD to estimate livestock populations, a weakness that scientific researchers had recognized but could not conclusively demonstrate. A report by Wanyoike et al. (2005) speaks of the 'need for better estimation methods' for enumerating livestock populations. We agree. The next human population census may not contain questions on livestock. It is essential that MOLD develop affordable survey techniques to reliably estimate the country's livestock numbers, or subcontract this responsibility to a qualified national research institute or university.

ANNEXES

Annex 1: Consultancy terms of reference

The study has the following objectives

1. To assess and capture all contributions of livestock to the national economy, irrespective of whether on not current methodologies of GDP calculation cover them. This will involve satellite accounting by looking at the contribution of livestock to other sectors such as manufacturing and transport and add these values to the agricultural GDP estimates.
2. To provide a subsequent assessment of how far the contribution of livestock to Kenya's economy is reflected in national income accounting in Kenya. This will require assigning values to the non marketable services that livestock provides and familiarity with the System of National Accounts (SNA). Under this consultancy, the consultant is not required to provide an exhaustive overview of the KNBS's methodologies.

In order to address the objective of the study, the consultant(s) will:

1. Carry out a situational analysis (mainly through literature review and interviews) on how livestock is currently computed in GDP calculations within national income accounting and how and where livestock contributes to the overall economy in Kenya.
2. Propose a methodology for the internal computation of livestock in GDP that includes assigning values to the non marketable services that livestock provides.
3. Propose an approach for the assessment of the contributions of livestock to the overall economy (satellite accounting).
4. Report the situational analysis findings and the proposed methodology in an inception report to IGAD LPI which will be shared with the LPH for discussion and comments.
5. Apply the proposed methodology and the approach (ideally in collaboration with a national consultant drawn from the KNBS) in determining the contribution of the livestock sector to Ethiopia's GDP and to the overall economy.
6. (Ideally in collaboration with a national consultant drawn from the KNBS) report the findings of the study in a draft report to be presented to IGAD LPI and members of the LPH for comments.
7. Prepare a final report to IGAD LPI containing the findings of the study and a critical assessment of the application of the methodology and the approach in Kenya, together with any pertinent recommendations for how similar studies could be implemented the remaining IGAD Member States.
8. Present findings to members of the Kenya Livestock Policy Hub.

Expected Outputs:

1. Inception Report presenting the findings of the situational analysis and the proposed methodology and approach.
2. Draft report of findings and the application of the methodology and the approach in Kenya.
3. Final report containing the study findings, an assessment of the application of the methodology in Kenya and further recommendations for its application in the wider IGAD region.

Annex II Cattle milk

Kenya – cattle milk

Area	Production system; herd size	% cows in herd	% lactating in herd; ratio lactating to total cows ( )	Yield litres/cow/ lactation Yield/day (litres)	Litres offtake per 100 head of cattle	Source
DAIRY						
Natl survey 2000		**52**		**1733 litres per cow 8.83 litres/day**	**90,000 litres**	**Ngigi 2005**
Nyandarua	open grazing 2.6 head per milking herd per hh	52		1633 litres per milking cow	84,916	Ngigi 2005
Kiambu	Zero grazing 1.47 milking herd per hh	52		2515 litres per milking cow	130,780	Ngigi 2005
Nyandarua, Central Kenya	Smallholder dairy 5.29 head per herd		44%	8.2kg/cow/day 2993kg/cow/yr 365 day lactation	131,692 kg	Muia et al 2011
Western Kenya Butere/Mumias Kakamega	Smallholder dairy exotic cattle only		45 in dairy portion of herd	2920 kg/cow/yr	131,400	Musalia et al 2007
Vihiga, Kenya	Grade dairy cattle	45	36% (.8)	2004/yr 5.49/day	72,144	Ongadi et al. 2007
Nakuru	Small holder dairy 2-3 cows and followers	-	- (assume 45%)	11.37/day free: 3434/cow/yr 12.96/day semi: 3914/cow/yr 19.9/day zero: 6010/cow/yr	(302 average days per lactation) 154,530 free 176,130 semi 270,450 zero **200,370 mean**	Lanyasunya et al 2006
Western Kenya	Zebu, zubu exotic mixed, pure exotic dairy	26 exotic and zebu	19.5 all and zebu (.75) 22.1 (.85) breed cattle	5.1-4.4/day pure 3 -3.1/day cross 1.9-2.7/day zebu	4.75/day 1734/yr pure: 38,321 3.1/day 1131/yr cross: 24,995 2.3/day 839/yr zebu: 16,360	Waithaka et al 2002

Kenya	Exotic/crosses sm. Semi intensive 1-20	40	32 (.8)	1555	49,760	Omore AGRIPPA
Kenya	Exotic/crosses sm. Intensive 1-10	40	32 (.8)	2000	64,000	Omore AGRIPPA
Kiambu	Sm scale dairy		- (45 assumed)	2628kg/cow/yr	118,260	Omore et al 1999
Nairobi milk shed	Sm scale dairy		- (45 assumed)	1825kg/cow/yr	82,125	Omore et al 1999
National	Dairy herd				88,400	Omore et al 1999, pp 13
National	Large scale dairy			4000 kg/cow/yr		Peeler and Omore 1997 cited in Omore et al 1999
Kiambu Central Kenya				5.0/day		Gitau et al. 1994
National	Traditional herd				4900	Omore et al 1999, pp 13
National				1300 kg		MoA cited in Omore et al 1999
Kiambu and Murang'a	Smholder dairy	42%				Lekasi et al 2001
ZEBU						
Area	*Production system; herd size*	*% cows in herd*	*% lactating in herd; ratio lactating to total cows ( )*	*Yield litres/cow/ lactation Yield/day (litres)*	*Litres offtake per 100 head of cattle*	*Source*
Makueni	Zebu – sm. Scale	29	24 (.82)	465	11,160	Rege et al. 2001
Kitui	Zebu – sm. Scale	43	31 (.73)	410	12,710	Rege et al. 2001
Taita Tavitu	Zebu – lg. scale	40	26 (.66)	277	7,202	Rege et al. 2001
Kajiado	Zebu – lg. scale	39	34 (.87)	362	12,308	Rege et al. 2001
Kajiado	Zebu – lg. scale	36	21 (.58)	257	5,397	Bekure et al 1991
Kenya	Zebu lg. – extensive	35	26 (.75 assumed)	200	5,200	Omore AGRIPPA

	30+					
Kenya	Zebu lg. – semi intensive 1-30	35	26 (.75 assumed)	250	6,500	Omore AGRIPPA
Borana Eth.			31.5 (Coppock 1994)	312	9828	Nicholson 1984
Mali				235		Nicholson 1984, Diallo et al. 1981
Nigerian Fulani				416		Nicholson 1984
Maasai Kenya			34 (Rege et al 2001)	305 litres/lactation	10,370	Roderick et al. 1999
Maasai Kenya		39 (Rege et al. 2001	.6 calving rate * 39 = 23.4	.95 litres/day * 372 days (Roderick et al 1999) = 353.4/yr	8,270	Homewood 1995
Marsabit Kenya	Gabbra pastoral			59 per TLU (mean all species dry and milking)	5900 (assumes 59 litres/yr/head of cattle)	McPeak and Doss 2004
Turkana	Pastoral	53	12.72	635	8077	McCabe 1987

Ethiopia – cattle milk

Area	Production system; herd size	% cows in herd	% lactating in herd; ratio lactating to total cows ( )	Yield litres/cow/ lactation Yield/day (litres)	Litres offtake per 100 head of cattle	Source
Eth. Highland	Oxen ploughing		9.5	292	2774	Gryseels
Eth. National	National survey		20	238	4760	CSA 2009
Eth. Highland	Oxen ploughing zebu		15.5	447	6934	GRM 1994
Eth. Gondor	Transhumant		14.8	540	8004	Tegene et al. 2009
Eth. Borana	Pastoral		31.5	294	9261	Coppock 1994
Eth. Highlands	Oxen ploughing crossbreed		15.5	923	14317	GRM 1994
Eth. Afar	Pastoral		41	401	18464	Davies 2003
Eth. SNNPR	Urban dairy		50.7	1516	76863	Tigrem et al. 2008
Eth. Southern			-	555	-	Tolera and Abebe 2007
Mieso, Oromiya			-	271	-	Hussen et al. 2008

Annex III Camel milk

Area	*Production system; herd size*	*% she camels in herd*	*% lactating in herd; ratio lactating to total she camels ( )*	*Yield litres/camel/ lactation Yield/day (litres)*	*Litres offtake per 100 head of camels*	*Source*
Marsabit, Kenya	Rendille pastoralist		- 25% assumed	1.66 litres/day *365 608 litres/she camel/yr measured	15,200	Aloo et al. n.d.
Kenya	Gabra			.34-1.26/litres/day		Olukoye et al 2003
Marsabit, Kenya	Rendille		- 25% assumed	1.9 litres/day * 365 = 693 litres/lac./yr	17,325	Simpkin 1998
Ole Maisor Ranch, Kenya	Somali/Turkana camels		- 25% assumed	1.28 litres/day * 365 = 467 lts/yr	11,675	Hulsebusch et al 1994
Isiolo, Kenya			**34%** of herd lactating	1.5 lts/day pp 35 547lts/lac/yr	**18,598 measured**	Musinga et al. 2008
Pokot, Baringo Districts, Kenya	Pokot pastoralists	38-47% Mean 42.5	21 month calving interval 1 yr lactation 57% lactating **24.2%** of herd	- 600 litres assumed	14,520	Bollig 1992
Rendille, Kenya		62%	- Assume 21 mo. calving interval 1 yr lac or 57% lac = 35% of herd lac.	1.3 drought – 2.0 normal/lac/day 365 * 1.65 = 602	21,275	Sato 1997
National, Ethiopia			21 % of herd lactating	999	20,979	CSA 2009
Afar, Ethiopia	Afar pastoral		-	904		Gebre Mariam 1987
Borana,, Eth.	Pastoral			1045		Dessalegn 1985
Borana, Eth.	Pastoral		-	1746		Mehari 2007
Borana, Eth.	Borana/ Garri		-	2369		Tolera and Abebe 2007
Mieso, Oramiya Eth.			-	797		Hussen et al. 2008
Eastern Ethiopia			-	1422		Bekele et al. 2002
Turkana	Pastoral		22	1095	24,090	McCabe 1987

Annex IV Sheep and goat milk

Area	*Production system*	*Percent flock lactating/year*	*Litres offtake per lactation*	*Litres offtake per 100 head sheep/goats*	*Source*
Marsabit District,	Rendille - **goats**	40% of flock adult female	.351/day/adult female *365 = 128 litres/ adult female/year	**5120**	Field n.d.
Marsabit District,	Rendille - **sheep**	40% of flock adult female	.175/day/adult female * 365 = 64 litres/adult female/yr	**2555**	Field n.d.
Coast, Nyanza and Rift	Smallholder goat dairy project	55.4 % of flock female and 5 month lactation but **no kidding interval given**	1.9 lit/day or 285 per lactation		Ogola et al n.d.
Kenya	Dual purpose goats		.49 kg/day * 79 day lac = 39 lit/lactation		Semenye et al 1989
Kenya	Dual purpose goats	65% kidding * 50% adult female = 32% of flock in milk	60 kg per lactation	1920	Onim n.d.
Kenya	Smholder x-bred	29% breeding females			Ahuya et al n.d.
Kenya	Kajiado sheep and goats	46% breeding ewes 49% does			Bekure et al. 1991
Ethiopia	Afar goats	49.2% breeding ewes	224 ml/day * 1.5-6 month lactation, mean 3.75 = 113 days * 224 = 25 lit/lactation	1230	Getachew et al 2010
Ethiopia	Afar goats	73	54	3947	Davies 2003
Ethiopia	Somali goats	29	42	1218	Baars 2000
Ethiopia	Borana/Garri goats	-	43	-	Tolera and Abebe 2007
Ethiopia	Borana goats	-	47	-	Cossins and Upton 1987
Tanznia	Milk and mixed milk and meat goats semi arid Morogoro	42% milk adult female and 30%mixed adult female	223 milk system and 220 mixed annual milk yield/doe	9366 lit milk only 6600 mixed	Safari et al 2008

Annex V: Livestock populations by District, 2009 census results

Kenya Semi-arid pastoral districts and livestock populations, 2009 Census

	Cattle	Sheep	Goats	Camels	Donkeys	Pigs	Indigenous Chicken	Chicken Commercial	Bee Hives
KENYA	**17,467,774**	**17,129,606**	**27,740,153**	**2,971,111**	**1,832,519**	**334,689**	**25,756,487**	**6,071,042**	**1,842,496**
WEST POKOT	129,475	114,050	173,693	294	8,243	149	143,426	8,397	32,080
POKOT NORTH	377,688	199,977	377,903	29,273	21,671	93	121,380	8,705	69,469
POKOT CENTRAL	179,212	146,300	213,141	1,050	6,559	155	138,190	4,950	28,432
LAIKIPIA NORTH	39,417	86,452	120,416	2,064	3,990	17	13,513	614	14,818
LAIKIPIA EAST	55,695	105,048	46,454	22	2,374	1,209	125,100	22,197	3,972
LAIKIPIA WEST	94,573	149,414	115,864	717	7,111	1,481	179,512	19,036	6,843
NAROK NORTH	255,881	529,492	219,394	116	38,796	3,959	113,328	17,324	19,402
NAROK SOUTH	701,899	935,757	510,328	449	38,934	2,275	172,644	8,731	22,730
TRANS MARA	459,106	184,780	150,496	43	20,466	1,097	275,347	11,468	22,335
KAJIADO CENTRAL	95,534	218,961	270,148	472	31,564	355	39,657	7,453	2,680
LOITOKITOK	165,011	185,909	192,720	134	10,997	451	78,040	11,471	9,925
KAJIADO NORTH	151,295	314,080	236,790	991	21,419	5,321	150,216	257,367	3,486
SEMI-ARID PASTORAL	**2,704,786**	**3,170,220**	**2,627,347**	**35625**	**212,124**	**16562**	**1,550,353**	**377,713**	**236,172**

Livestock Population by Type and District, Semi-arid Districts, 2009 census

	Cattle	Sheep	Goats	Camels	Donkeys	Pigs	Indigenous Chicken	Chicken Commercial	Bee Hives
KENYA	**17,467,774**	**17,129,606**	**27,740,153**	**2,971,111**	**1,832,519**	**334,689**	**25,756,487**	**6,071,042**	**1,842,496**
NAIROBI									
CENTRAL									
NYANDARUA NORTH	121,973	148,810	17,943	4	7,366	1,528	337,630	36,959	6,483
NYANDARUA SOUTH	110,110	116,856	5,697	1	3,863	597	239,240	16,385	5,804
NYERI NORTH	128,193	136,947	46,557	78	2,219	5,773	283,681	67,995	9,256
NYERI SOUTH	94,053	31,862	56,369	10	1,064	7,811	229,956	84,385	6,743
LARI	34,890	23,554	2,677	-	2,291	960	69,419	29,186	896
COAST									
KWALE	32,903	4,771	58,873	1	269	89	117,353	36,703	517
KINANGO	84,133	46,081	170,326	552	723	120	129,011	6,619	1,991
MSAMBWENI	138,107	32,281	120,556	60	1,540	320	187,463	54,898	1,974
KILIFI	66,502	17,440	193,040	6	1,029	1,435	276,720	115,548	1,746
KALOLENI	54,501	10,424	105,773	-	826	532	158,360	24,463	1,441
MALINDI	65,960	19,085	173,295	10	2,125	478	220,186	36,729	2,818
LAMU	81,200	15,626	68,178	47	2,572	55	87,951	7,636	1,219
TAITA	111,158	26,274	103,392	1,078	2,772	688	146,614	35,170	13,438
TAVETA	42,610	19,053	63,268	208	796	366	65,515	3,065	3,512
EASTERN									
IGEMBE	108,661	25,083	100,052	1,448	5,260	4,401	199,324	28,356	16,731
TIGANIA	97,740	29,995	94,750	2,529	5,325	8,053	227,334	18,812	28,225
THARAKA	63,444	31,961	142,813	12	5,444	980	135,417	5,692	77,383
EMBU	67,052	20,716	54,116	2	579	5,021	234,489	53,217	26,972
MBEERE	83,648	26,834	166,679	11	7,234	1,347	202,410	14,675	74,004
KITUI	138,576	17,395	381,149	24	48,647	574	370,942	31,868	105,781
MUTOMO	63,773	10,254	224,621	396	26,750	294	117,422	3,750	88,495
MWINGI	84,332	10,262	276,392	513	35,361	171	144,292	5,249	110,271
KYUSO	53,660	27,593	175,228	1,190	25,863	113	78,526	3,371	84,514
MWALA	52,251	10,735	133,335	7	6,587	206	154,782	9,466	9,345
YATTA	94,779	35,321	263,080	1	10,828	405	237,075	15,843	23,288

MAKUENI	84,465	23,111	192,329	3	14,326	463	233,209	15,639	27,180
KIBWEZI	64,791	29,657	253,037	2	4,826	444	180,986	12,114	32,905
NZAUI	70,595	33,734	169,009	12	6,195	351	187,146	8,684	13,900
NORTH EASTERN									
NYANZA									
SIAYA	167,154	55,755	79,573	8	1,552	9,905	616,660	34,332	11,734
BONDO	66,419	19,004	52,674	4	2,406	955	194,203	11,873	827
RARIEDA	60,060	19,807	44,300	4	3,573	559	183,384	6,563	722
MIGORI	145,339	33,958	79,625	1	5,848	1,021	428,046	28,729	672
RONGO	102,999	29,324	43,995	4	1,896	1,528	435,781	28,404	604
RIFT VALLEY									
WEST POKOT	129,475	114,050	173,693	294	8,243	149	143,426	8,397	32,080
POKOT NORTH	377,688	199,977	377,903	29,273	21,671	93	121,380	8,705	69,469
POKOT CENTRAL	179,212	146,300	213,141	1,050	6,559	155	138,190	4,950	28,432
KOIBATEK	96,952	67,988	100,644	6	8,228	174	145,569	20,700	22,805
KEIYO	97,350	89,881	64,177	4	2,737	393	166,025	16,567	27,682
LAIKIPIA NORTH	39,417	86,452	120,416	2,064	3,990	17	13,513	614	14,818
LAIKIPIA EAST	55,695	105,048	46,454	22	2,374	1,209	125,100	22,197	3,972
LAIKIPIA WEST	94,573	149,414	115,864	717	7,111	1,481	179,512	19,036	6,843
NAIVASHA	139,501	240,746	115,363	67	19,375	6,390	222,316	84,814	6,487
NAROK NORTH	255,881	529,492	219,394	116	38,796	3,959	113,328	17,324	19,402
NAROK SOUTH	701,899	935,757	510,328	449	38,934	2,275	172,644	8,731	22,730
TRANS MARA	459,106	184,780	150,496	43	20,466	1,097	275,347	11,468	22,335
KAJIADO CENTRAL	95,534	218,961	270,148	472	31,564	355	39,657	7,453	2,680
LOITOKITOK	165,011	185,909	192,720	134	10,997	451	78,040	11,471	9,925
KAJIADO NORTH	151,295	314,080	236,790	991	21,419	5,321	150,216	257,367	3,486
WESTERN									
SEMI-ARID DISTRICTS	5,874,620	4,708,398	7,020,232	43,928	490,419	81062	9,194,790	1,392,172	1,084,537

Livestock Population by Type and District, Highland Districts, 2009 census

	Cattle	Sheep	Goats	Camels	Donkeys	Pigs	Indigenous Chicken	Chicken Commercial	Bee Hives
KENYA	**17,467,774**	**17,129,606**	**27,740,153**	**2,971,111**	**1,832,519**	**334,689**	**25,756,487**	**6,071,042**	**1,842,496**
NAIROBI									
NAIROBI WEST	18,292	14,352	12,253	-	2,211	7,005	75,353	71,847	2,946
NAIROBI EAST	13,263	11,529	16,714	3	3,068	8,477	111,809	129,718	2,789
NAIROBI NORTH	12,838	5,371	14,204	17	6,894	12,981	77,544	110,746	1,243
WESTLANDS	10,153	3,465	3,666	-	651	1,513	14,691	30,477	607
CENTRAL									
KIRINYAGA	144,112	27,642	101,596	7	3,990	10,606	465,455	82,458	10,227
MURANGA NORTH	102,573	21,865	86,808	-	930	3,843	246,041	89,409	6,019
MURANGA SOUTH	112,181	25,974	82,937	4	2,066	14,336	365,272	280,819	25,643
KIAMBU EAST(KIAMBAA)	28,767	11,057	10,459	110	1,028	9,885	91,032	185,126	2,909
KIKUYU	32,758	17,304	9,499	-	3,381	18,820	110,976	399,043	1,379
KIAMBU WEST	22,484	19,745	5,765	-	3,444	1,260	61,827	186,631	913
GITHUNGURI	57,008	9,111	6,513	-	697	2,455	101,259	110,202	1,217
THIKA EAST	21,164	8,000	26,083	-	356	990	53,662	49,439	12,224
THIKA WEST	17,323	14,716	17,838	-	725	2,884	80,174	191,810	562
RUIRU	16,458	16,745	16,904	2	1,117	3,660	89,749	168,294	585
GATANGA	28,494	6,480	17,402	-	302	4,105	71,439	144,862	1,832
GATUNDU	53,364	27,569	20,162	15	677	2,464	142,974	366,834	3,280
COAST									
MOMBASA	8,488	2,155	15,410	-	757	687	57,236	109,977	521
KILINDINI	4,509	1,397	14,397	1	917	438	44,182	79,450	535
EASTERN									
MERU CENTRAL	57,108	24,524	31,093	2	862	2,010	131,170	22,164	14,556
IMENTI NORTH	84,555	72,865	46,724	49	2,371	4,320	212,865	49,956	10,158
IMENTI SOUTH	54,240	15,755	40,921	4	409	1,822	123,687	35,025	17,377
MERU SOUTH	36,893	19,283	52,354	2	486	4,575	123,515	15,940	33,942
MAARA	32,522	10,418	36,423	6	188	4,030	99,410	16,724	18,638
MACHAKOS	121,693	46,665	148,309	9	2,665	2,595	282,312	127,965	9,489

KANGUNDO	71,168	33,887	85,250	3	1,256	820	188,423	29,678	4,248
MBOONI	51,188	13,010	119,010	5	6,737	245	161,437	9,590	11,320
NORTH EASTERN									
NYANZA									
KISUMU EAST	79,369	36,552	58,628	5	953	2,559	285,087	81,850	954
KISUMU WEST	50,329	16,670	35,594	2	813	529	176,289	12,245	291
NYANDO	143,085	97,179	100,744	6	14,174	1,172	391,119	33,369	11,143
HOMABAY	158,259	48,665	67,488	7	4,285	3,239	445,540	22,404	1,030
SUBA	83,238	17,364	86,412	10	8,625	962	215,674	9,592	893
RACHUONYO	132,046	52,918	105,275	6	5,879	965	433,562	23,805	1,482
KURIA WEST	84,830	15,060	43,929	-	839	808	283,475	19,365	2,031
KURIA EAST	48,004	15,322	31,684	-	1,256	228	138,434	11,684	2,446
KISII CENTRAL	77,353	5,427	28,433	-	931	670	270,754	47,631	1,386
KISII SOUTH	25,627	788	7,930	-	118	140	93,509	12,192	185
MASABA	63,945	6,651	19,094	2	1,845	425	189,884	20,822	1,130
GUCHA	98,487	9,178	21,941	-	2,644	757	320,792	32,086	6,314
GUCHA SOUTH	40,625	2,719	10,449	-	909	310	151,492	11,029	488
NYAMIRA	76,127	6,309	27,671	-	1,376	379	215,897	29,564	1,509
MANGA	22,548	1,989	7,054	-	218	84	65,849	12,267	1,105
BORABU	22,827	4,416	8,776	-	653	417	70,047	11,250	1,178
RIFT VALLEY									
TRANS NZOIA WEST	68,170	42,618	10,811	6	2,778	2,366	265,443	77,417	3,997
TRANS NZOIA EAST	57,887	49,074	6,136	12	2,474	426	183,284	71,188	3,802
KWANZA	53,090	48,151	15,006	29	3,462	1,316	181,888	12,850	2,484
ELDORET WEST	109,909	75,332	14,856	6	1,441	1,777	288,777	68,423	5,601
ELDORET EAST	99,774	95,778	22,796	-	2,053	652	206,589	46,301	11,120
WARENG	85,421	55,837	6,514	-	2,105	6,374	168,639	44,609	6,312
MARAKWET	99,969	202,260	108,093	17	10,636	218	143,608	12,207	33,422
NANDI NORTH	86,242	43,588	7,166	6	1,278	244	147,802	11,820	4,586
NANDI CENTRAL	85,198	34,680	5,220	13	675	476	171,878	15,077	6,652
NANDI EAST	35,420	10,971	5,294	6	963	181	72,246	5,060	2,130
NANDI SOUTH	68,155	22,280	14,340	11	2,040	268	146,613	7,013	5,652
TINDERET	34,023	9,942	14,649	-	4,205	58	62,074	2,876	3,718
NAKURU	83,787	70,632	62,188	2	3,938	3,803	244,309	151,941	3,610

NAKURU NORTH	34,463	43,751	11,762	-	2,273	1,912	196,487	151,864	1,446
MOLO	182,243	149,906	37,724	2	20,208	1,789	439,209	39,865	64,052
KERICHO	130,712	16,000	46,176	2	9,070	490	237,377	33,681	2,720
KIPKELION	88,104	35,276	26,783	-	10,503	250	172,350	10,129	10,020
BURET	112,087	33,629	14,250	6	4,008	349	161,569	17,601	16,109
SOTIK	102,484	30,100	13,387	4	3,592	328	168,386	7,840	3,666
BOMET	210,855	53,060	82,395	5	18,363	604	364,644	13,981	14,807
WESTERN									
KAKAMEGA CENTRAL	65,044	12,219	12,864	2,004	785	2,705	277,667	23,486	1,479
KAKAMEGA SOUTH	29,661	4,793	1,814	2	193	6,123	117,054	4,551	639
KAKAMEGA NORTH	63,536	10,644	11,670	4	991	567	214,560	9,276	2,634
KAKAMEGA EAST	43,994	7,662	3,450	-	458	6,198	154,080	11,131	2,799
LUGARI	78,650	35,159	12,124	2	817	2,831	275,758	31,316	2,223
VIHIGA	59,588	3,747	14,323	1	298	486	199,210	15,368	598
EMUHAYA	49,665	4,646	10,156	-	309	892	157,082	9,521	585
HAMISI	38,990	3,685	7,894	-	220	358	121,759	8,883	651
MUMIAS	73,060	15,498	8,443	4	1,202	3,579	338,298	20,479	1,415
BUTERE	64,007	14,963	12,378	-	859	3,204	226,742	19,773	1,986
BUNGOMA SOUTH	85,978	13,374	28,068	8	920	7,167	392,459	24,900	3,335
BUNGOMA NORTH	77,907	29,975	8,612	4	688	1,810	273,318	14,230	4,371
BUNGOMA EAST	59,883	12,384	9,186	-	346	1,113	180,014	12,446	1,750
BUNGOMA WEST	63,813	12,876	22,523	6	797	1,292	238,929	8,774	1,445
MT. ELGON	45,941	20,359	14,668	2	6,347	725	107,726	3,044	7,537
BUSIA	71,386	15,269	19,050	-	590	21,315	362,069	13,515	1,337
TESO NORTH	26,693	3,308	20,267	-	131	4,457	158,383	12,677	888
SAMIA	17,079	4,548	16,690	-	132	7,386	93,144	5,649	502
BUNYALA	13,912	2,632	10,577	-	102	2,884	57,163	1,625	152
TESO SOUTH	34,725	5,984	19,189	-	44	12,746	198,936	9,333	439
		2,174,681	2,489,288	2441	215,997	252,189	15,498,421	4,547,059	471,395

Livestock Population by Type and District, Arid Districts, 2009 census

	Cattle	Sheep	Goats	Camels	Donkeys	Pigs	Indigenous Chicken	Chicken Commercial	Bee Hives
KENYA	**17,467,774**	**17,129,606**	**27,740,153**	**2,971,111**	**1,832,519**	**334,689**	**25,756,487**	**6,071,042**	**1,842,496**
NAIROBI									
CENTRAL									
COAST									
TANA RIVER	58,056	141,698	365,544	48,586	12,688	23	43,208	6,734	11,058
TANA DELTA	211,838	131,154	118,676	496	4,902	12	65,897	4,872	4,469
EASTERN									
MARSABIT*	25,906	13,306	28,162	915	2,800	14	8,286	1,560	440
CHALBI	220,979	682,991	698,582	69,411	37,713	66	5,204	411	308
LAISAMIS	61,462	187,959	270,213	46,680	11,843	45	5,049	633	1,584
MOYALE	116,256	75,748	146,523	86,314	11,505	-	27,769	1,778	359
ISIOLO	101,525	152,164	166,549	9,957	11,874	115	20,261	5,696	1,012
GARBATULLA	96,899	209,672	232,354	29,127	10,315	-	14,876	956	432
NORTH EASTERN									
GARISSA	266,878	312,601	1,000,856	101,548	25,820	40	31,134	12,329	3,035
LAGDERA**	197,846	489,282	561,883	104,992	33,568	16	19,710	4,020	439
FAFI	86,337	98,889	179,226	28,143	7,694	2	5,844	2,540	519
IJARA	352,617	323,676	348,648	1,740	8,096	1	25,439	3,279	422
WAJIR SOUTH	331,458	389,482	464,512	97,111	29,113	-	27,298	3,650	414
WAJIR NORTH *	189,707	192,787	300,079	161,958	23,681	1	41,780	3,549	327
WAJIR EAST*	159,846	460,690	720,936	167,764	32,192	2	35,265	10,145	390
WAJIR WEST	113,541	363,924	380,699	106,818	30,517	-	35,767	4,793	141

MANDERA CENTRAL*	467,713	745,295	1,767,102	385,085	83,649	-	85,687	10,415	1,806
MANDERA EAST*	306,791	542,948	1,506,203	179,713	64,985	6	42,516	6,579	1,333
MANDERA WEST*	302,474	344,581	656,442	366,021	43,030	-	72,459	10,014	50,363
NYANZA									
RIFT VALLEY									
TURKANA CENTRAL*	196,492	560,671	1,273,445	150,700	90,067	220	27,405	3,773	1,985
TURKANA NORTH*	652,288	1,274,062	1,874,668	269,185	194,434	132	23,876	3,441	307
TURKANA SOUTH*	685,832	1,682,418	2,846,748	412,577	273,686	218	114,068	8,230	30,289
SAMBURU CENTRAL	78,123	175,415	148,368	3,544	4,281	60	25,076	3,679	5,014
SAMBURU EAST	37,350	69,422	131,840	7,212	10,363	95	7,754	906	3,413
SAMBURU NORTH	69,193	142,861	270,542	22,068	12,178	32	4,919	377	12,630
BARINGO	68,595	72,260	168,852	13	3,047	243	119,715	11,032	42,416
BARINGO NORTH	38,143	30,446	128,364	28	299	58	73,037	3,537	31,570
EAST POKOT	787,209	380,125	1,474,617	67,036	51,763	37	53,977	2,883	80,089
WESTERN									
ARID DISTRICTS	6,281,354	10,246,527	18,230,633	2,924,742	1,126,103	1438	1,063,276	131,811	286,564

Annex VI: Summary of recommended formula to estimate the contribution of ruminant livestock to agricultural GDP

1. cattle milk

A. head of highland cattle * 900 lit/head
B. head of semi-arid cattle * 108 lit/head
C. head of arid cattle * 58 lit/head
D. A + B + C = litres national milk production
E. D * .26 * formal milk price = value in Ksh of milk at formal price
F. D * .74 * (formal milk price * 1.275) = value in Ksh of milk at informal price
G E + F = value in Ksh of national milk production

2. **camel milk**: head of camels * 186 lits/head * formal cattle milk price

3. **sheep and goat milk**: head of ASAL goats * 51.2lit/ head * (formal cattle milk price * 1.22)

4. **cattle, domestic offtake and supply**

A. head of ASAL cattle * .15 net offtake rate
B. head of highland cattle * .079 offtake rate
C. 36,000 ranch cattle (adjusted to accommodate more up-to-date estimates)
D. A + B + C = total head of offtake
E. D * National Livestock Information System average price = **value in Ksh of national offtake**
F. [D + (D * .2836)] * National Livestock Information System average price = **value in Ksh of national beef supply, producer prices**

5. **camel offtake**: head of camels *.017 offtake rate * National Livestock Information System average price

6. **sheep offtake**: head of sheep * .132 * National Livestock Information System average price

7. **goat offtake**: head of goats *.137 * National Livestock Information System average price

8. **manure as fertilizer**

A. head of highland cattle * .37 * 1300 lits/head = litres milk production under zero grazing
B. A * .26 * formal milk price = value in Ksh of milk at formal price
C. A * .74 * (formal milk price * 1.275) = value in Ksh of milk at informal price
D. (B + C) * .32 = value in Ksh of manure used for fertilizer

9. **egg production**

A. head of indigenous chickens * .5 * .875 (proportion of hens in flock) * 60 eggs/hen/year * producer price for eggs
B. head of commercial chickens * .36 (proportion of hens in flock) * 280 eggs/hen/year * producer price for eggs
C. A + B = total value of egg production

10. **chicken offtake**

A. head of indigenous chickens * .4 (annual offtake rate) * producer price
B. head of commercial chickens * .36 (proportion of hens in flock) * .30 (replacement rate for layers) * producer price
C. head of commercial chickens * .64 (proportion of broilers in flock) * 1.14 (annual offtake rate * producer price
d. A + B = C = total value of chicken meat production

11. **pig offtake**

A. head of pigs * .5 (annual offtake rate) * producer price

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