MINISTRY OF FINANCE AND ECONOMIC DEVELOPMENT
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A REVIEW TO IMPROVE ESTIMATION OF LIVESTOCK CONTRIBUTION TO THE NATIONAL GDP

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The Inter-Governmental Authority on Development's Livestock Policy Initiative (IGAD LPI) has produced a series of working papers on the contribution of livestock to the national economy in IGAD member states, including Ethiopia. The purpose of these papers is to support Livestock Policy Hubs to advocate for representation of livestock in national strategy documents to be commensurate with its contribution to economic growth, poverty reduction and food security. In Ethiopia, the findings of the studies led to the establishment of a taskforce with a view to recommending changes, where appropriate, in the calculation of livestock's contribution to GDP.

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ACRONYMS

COFOG	Classification of Functions of Government
COICOP	Classification of Individual Consumption according to Purpose)
CSA	Central Statistics Agency
EIAR	Ethiopian Institute of Agricultural Research
ESNA	Ethiopian System of National Accounts
EVA	Ethiopian Veterinary Association
GDP	Gross domestic product
GVA	Gross Value Added
GVO	Gross Value of Output
GVP	Gross Value of Production
IC	Intermediate consumption+
IGAD	Inter Governmental Authority on Development
ILCA	International Livestock Centre for Africa
ILRI	International Livestock Research Institute
ISIC	International Standard Industrial Classification
LDMPS	Livestock Development Master Plan Study
LPI	Livestock Policy Initiative
MOA	Ministry of Agriculture
MOFED	Ministry of Finance and Economic Development
NAIC	National Artificial Insemination Centre
NAD	National Accounts Directorate
NAS	National Accounts Statistics
PADS	Pastoral Areas Development Study
PFA	Pastoralist Forum Ethiopia
SNA	System of National Accounts
TDMI	Total Dry Matter Intake
TLU	Tropical Livestock Unit
VA	Value Added

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1. INTRODUCTION

This report is prepared by a taskforce established from experts in different government and non-governmental organisations in Ethiopia to examine findings of a consultancy report produced for the Livestock Policy Initiative of the Intergovernmental Authority for Development (IGAD-LPI). The consultancy report was commissioned to study and suggest improvements to existing method of estimating contribution of the livestock sector to the national GDP of Ethiopia. The consultancy report was produced in two separate volumes (Behnke 2010 and Behnke 2011).

The consultancy report recommended that a range of livestock related economic accounts would need to be revised and update to improve the accuracy in measuring the contribution of the livestock sector in the Ethiopian economy. This required adjustments to a number of livestock productivity coefficients and derived variables that the Ministry of Finance and Economic Development has been applying in estimating sectoral and national GDP of Ethiopia. Therefore, IGAD-LPI initiated the process of forming a taskforce to gain consensus among stakeholders to institutionally adopt such a change to the system of economic accounts. Therefore, the main objective of the taskforce was to scrutinize the validity and accuracy of the consultancy report before adopting its recommendations. In order to fulfil this objective, the taskforce set out to accomplish three interrelated activities.

First, it was essential to have a yardstick against which to evaluate the finding of the consultancy report. This involved establishing a concise but comprehensive conceptual framework which is consistent with the UN system of national accounts (SNA) - a standard method of systems of national economic accounts and its specific application to the livestock sector in most countries in the world. Additionally, it was necessary to set the framework by taking into account Ethiopia's livestock production systems.

Second, since the consultancy report necessarily involved computations of a number of sub-sets of economic accounts for different livestock types and their products, establishing the conceptual framework was only one of the initial pre-requisite for accomplishing the mission of

the taskforce – it was important to go beyond this and redo the actual task of collecting the necessary data and then computing the estimates. In doing so, the taskforce has followed a pragmatic approach for good reasons. To begin with, the envisaged revisions to the livestock sector economic accounts should not be at odds with international practices. The main purpose of revising the figures is to improve the system of economic accounts and the existing coefficients which capture productivity of the countries assets, the livestock, in a realistic and practical way. If the revisions were conducted by arbitrarily imposing strong assumptions rooted in untested theoretical viewpoints, then the countries system of economic accounts can easily get rendered incomparable with those for other countries. Similarly, the livestock sector accounts can easily get out of line with the system of accounts for the rest of the sectors in the economy.

Third, the findings of the taskforce study were then compared with key findings and recommendations identified in the consultancy report. This enabled the taskforce to come up with robust sets of recommendations by making further improvements to the insights gained in through the consultancy study. Accordingly, this report is prepared providing detailed account by account comparisons of the findings in the consultancy report and those identified through this study.

Needless to say this study has its own shortcomings. The main source of its limitation lies in the paucity of livestock statistics, which is still at its rudimentary stage. In spite of the fact that a significant share of Ethiopia's livestock are located in lowland and pastoral areas, the Central Statistical Authority of the county has so far been confined to sedentary farming regions in conducting censuses and sample surveys. As a result, both the consultancy study and the taskforce study were obliged to start with incomplete data and then relying on finding of ad hoc studies to fill the existing gaps in the data. There are challenges inherent in the existing practices of measuring economic benefits from the livestock sector. The capital nature of livestock has always given rise to challenges in appropriately accounting for the services the livestock provide although this various from country to country. Some of these challenges are very specific to Ethiopia's condition of production. For instance, farmers in Ethiopia rely heavily

on animal draft power to plough the land for crop production. However, there is a wide gap in our knowledge to fully capture the value of services the livestock sector provide to the cropping sector both in terms of animal traction and through manure. Similarly, this study has not fully captured the costs of crop residue that provides a good proportion of livestock feed.

The remaining part of this report is divided into three sections. Section 2 presents a conceptual developed in this study. Section 3 provides detailed discussions of livestock statistics; computation methods for estimating values of gross outputs of different livestock products; costs of livestock production; and then finally the livestock sector GDP as well as livestock related GDP generated by services of livestock capital in other sectors of the economy. Section 4 provides concluding remarks focussing on broad sets methodological issues.

2. CONCEPTUAL FRAMEWORK FOR ESTIMATING LIVESTOCK SECTOR GDP

2.1 OVERVIEW

We devote this section of the report to discussing the conceptual basis of estimating the livestock sector GDP and related system of accounts linking the sector to the wider economy. A conceptual framework developed for this study is based on the United Nations System of National Accounts (UN-SNA); an international standard which provide guidance for the development of national and sectoral GDP estimations. In any effort to undertake estimations or revisions of GDP at sectoral or national levels, it is good practice to start to discussing and clarifying the basic concepts, definitions, and compilation techniques in the UN-SNA.

Basically, GDP derives from the concept of value added. Gross value added is the difference between output and intermediate consumption. GDP is the sum of gross value added of all resident producer units plus that part (possibly the total) of taxes on products, less subsidies on products, that is not included in the valuation of output. GDP is also equal to the sum of the final uses of goods and services (all uses except intermediate consumption) measured at purchasers' prices, less the value of imports of goods and services. Finally, GDP is also equal to the sum of primary incomes distributed by resident producer units. (SNA, 2008, 2.138 - 2.140)

The economic role of the livestock sector can be classified into two:

(a) Intra-sectoral activities – including wealth created due to economic activities that occurred within the livestock sector

b) Inter-sectoral activities - linkages of the livestock sector to other industries and domestic institutions

GDP generated in the livestock sector covers payments for services of different factor payments in the process of producing livestock product and these transactions fall in category (a). However, the process of livestock production involves interactions between the livestock sector and the rest of the economy through sales to other industries (e.g, live animals to slaughter houses, milk to dairy processing plants, manure to crop producers), or purchases of intermediate inputs (e.g., feed, hays, crop residues, vaccines, AI services), sales to households for final consumption (e.g., live animals, milk, eggs). These fall in category (b) which captures the *multiplier effects* of the livestock sector on the wider economy.

The empirical challenge in estimating GDP of the livestock sector lies in ensuring that both the sizes of intra-sectoral and inter-sectoral activities would not be underestimated or overestimated. There is an additional complexity in estimating livestock sector GDP – the capital nature of livestock.

2.2 THE ONE INDUSTRY CASE

It proves useful to start illustrating the concept of GDP by using a highly simplifying assumption – that Ethiopia has only one industry. In this case, Ethiopia's system of national accounts can then be represented by a very simple matrix of 2 x 2 dimension (shown on the below). The matrix representation displays information in a highly efficient and concise manner, showing key relationships between different parts of the economy.

Table 1 – A One Industry Matrix Representation For Value Added Estimation In An Economy

A	E
V	

Where, A = total value of intermediate, goods used to produce other goods

V = total payments for services of primary factors of production (land, labour, capital)

E = total value of goods consumed by institutions that can be categorised into: households, government, organisation for gross fixed capital formation, net export (exports less imports).

Focusing on the 2x2 matrix (Table 1) and reading down column, we collect value of different inputs in the process of production (origins of goods). The total cost of production equals gross value of production or output (GVO). Therefore, GVO = A + V. Now reading across the row, again we obtain total value of output as sum of sales by destinations – total value of goods consumed (used) in the process of production and total value of goods consumed by institutions. Therefore, GVO = A + E. It follows that V = E.

GDP is measured by following either the production approach (denoted by V in table 1) or using expenditure approach (denoted by E in table 1). The identity that states that V equals E implies that total payments for factor income in the process of production equals total expenditure by recipients of factor payments. In other words, at aggregate economy-wide level, total income equal total expenditure, one of the most important identities in macroeconomic theory which underlie the system of national accounts. Therefore, the simple 2x2 matrix presented above encapsulates the most essential relationships involved in estimating GDP. Estimating sectoral GDP involves simply disaggregating the cells in this matrix (column 1 and row 1) by the number of sectors. A three industries case is presented and discussed in the following section.

2.3 THE THREE INDUSTRIES CASE

A three industries case is suitable for the purpose of illustrating the conceptual framework for estimating the livestock sector GDP. Table 2 below displays a system of accounts with three sectors - livestock, cropping, and the other industries. The aggregate intermediate consumption represented by a single variable A in table 1 above is now disaggregated into a sub-matrix of 3 x 3 (the intersections between rows 1 to 3 with the corresponding columns 1 to 3). The first and second subscripts refer to receiving sector and paying sector, respectively. For instance, A31 denotes payment by the livestock sector for intermediate inputs (e.g. processed feed) supplied by feed processors in the manufacturing sector, which is categorised under "other industries".

Table 2 – A Three Sector Inter-Sectoral Matrix Representation For GVA In Agriculture

	1. Livestock	**2. Cropping**	**3. Other industries**	**4. Consumers**	**5. Total receipts**
1. Livestock	A_{11}	A_{12}	A_{13}	E_1	GVO_1
2. Cropping	A_{21}	A_{22}	A_{23}	E_2	GVO_2
3. Other industries	A_{31}	A_{32}	A_{33}	E_3	GVO_3
4. Factors	V_1	V_2	V_3		V
5. Total payments	GVO_1	GVO_2	GVO_3	E	

At first glance, the three sector matrix (Table 2) may look different from the highly simplified small matrix (table 1). However, the two matrices show essentially the same set of information except for sectoral dimensions and the explicit display of the Gross value of output (GVO) row and column table 2. Each account is given a number with a description (e.g. 1. Livestock) and the value-added row has become a vector with three entries, i.e., gross value-added by sectoral origin; and the aggregate expenditure column has now three elements, i.e., expenditure by commodity origins.

In this study, we employ the three industries matrix as a conceptual framework on the ground that details of the remits of this study is expected to revise a range of estimates related to the

livestock sector (entries in row 1 and column 1 of table 2). In this context, it is important to guard against the perception that the whole exercise would be to estimate just "livestock GDP" which would deal only with the contribution of the livestock sector to Ethiopia's GDP. This would essentially mean focusing on only one entry in that matrix – V1. This is a rather narrow perspective so it would prove useful to explicitly recognize that the wider role of the livestock sector or - the contribution of the livestock sector to the Ethiopian Economy.

Table 2 provides a framework and details of separate entries that we have targeted to revise. It is useful to bear in mind that the system of national accounts (SNA) approach, sections related to the measurement of production pages 127 to 156 and particularly section 6.41(a) – (f)). In this regard, the key point is that marketed as well as non-marketed outputs need to be accounted for in estimating sectoral GDP and GVO. Therefore, we set out to accomplish its duties by resolving this conceptual issue. In the next few paragraphs, entries in row 1 and column 1 are discussed in detail:

Gross Value of Output (GVO_1): The primary task to accomplish was to gather data on livestock statistics; apply suitable rates and coefficients; and obtain total output of livestock products. The rates and coefficients are related to direct and indirect methods of measuring livestock productivity. For instance, in order to estimate total value of milk output it was necessary to gather the following facts: total number of cattle, proportion of cows in total herd, proportion of cows giving milk from total cows, and milk yield per cow per year. If we apply these ratios, then we obtain total volume of milk produced from the cows. Since milk is also obtained from goats and camels, it is necessary to apply similar methods to obtain milk from the other livestock categories as well as other livestock products (e.g. cattle sales through off-take rates, etc). Since GDP is a "flow concept" which involves aggregation of values of different products produced during a particular year, then it is necessary to select a base year for which the livestock GDP and related variables would be estimated.

Gross Domestic Product or GDP (V_1): This is the livestock sector GDP per se and it is related to value added in the process of livestock production. This consists of actual or imputed estimates of labour time and hence compensation for labour devoted to the livestock sector; capital

rental values (e.g. housing services for livestock, fencing, etc); and land rent. Given data paucity, it is important to triangulate the estimation of this figure, an extremely important figure of all elements. For instance, it is relatively more straightforward to estimate the GVO. It is then possible apply ratio estimates for technical coefficients of intermediate elements (A_{11}, A_{21}, A_{31}) and then finally obtain V_1 as a difference ($V_1 = GVO_1 – (A_{11}+A_{21}+A_{31})$.

Intermediate inputs purchases (A_{31}): These are intermediate inputs purchased by the livestock sectors from non-agricultural sectors. Since these inputs are mostly purchased at market prices, reasonable estimates can be obtained from different sources.

Imputed Value of Crop Residue (A_{21}): This entry denotes actual or imputed values of intermediate inputs for livestock production that are supplied by the cropping sector (e.g. crop residue). It is necessary to account for this, even if that would mean replying mostly on other country experiences.

Livestock Products used in the Livestock Sector as Intermediate Inputs (A_{11}): This is highly relevant estimate but rarely accounted for in livestock production in the context of developing countries. For instance, total milk produced includes milk used by calves which is relevant since economics of livestock production involves calculation of energy intake, milk yield, etc.

Livestock Products used in the Cropping Sector as Intermediate Inputs (A_{12}): This consists of important estimates such as actual or imputed sales value of manure used to improve fertility of soil for the crop production sector.

Livestock Products used in the non-agricultural sector as Intermediate Inputs (A_{13}): A range of estimates are included in this variable - value of live livestock (cattle, small ruminants, poultry) sold to slaughtering houses or directly to hotels; dairy products sold to dairy processing enterprises; value of honey sold to food processing industries.

Livestock Products Sold To Institutions (E_1): This incorporates sales of livestock products to domestic and non-domestic institutions – sales for final consumption to households and the government sector (e.g. raw milk directly sold to households or live animals sold to household

for informal slaughtering); sales to domestic industries for gross fixed capital formation (e.g. breeding stocks); and exports of livestock products, including live animals (e.g., exports of live cattle or small ruminants to the middle east).

The Controversial Case of Hides and Skins: The sources of supply for hides and skins can be classified into the following four categories –

- slaughter houses - farmers sell live animal to traders who ultimately sell to slaughter houses located in towns or cities (A_{13})
- rural households - slaughter animals on farm for own consumption either slaughtering own livestock or livestock purchased by rural households from other rural households or traders (E_1)
- urban households - live animals sold to traders who ultimately sell to households located in towns or cities (E_1)

The sale of hides and skins by slaughter houses (case (a)) is clearly non-livestock. The reason is that the international standard industrial classification slaughtering is classified in the 10^{th} division of manufacturing (A_{13}). This sub-division sells the by-product to tanneries, leather, or sales to exporters, etc. Which means this is a clear case where the livestock industry will be out of the picture as soon as the sale takes place and the live animal changes hand. Even in all other cases, (b) and (c), it is extremely difficult both conceptually and empirically to attribute hides and skins to the livestock sector. The livestock sector is a primary activity, so post-processing livestock products cannot be classified as primary Hides and skins are partially processed products. So, hides and skins are inevitably and legitimately belong to manufacturing, by virtue of being partially processed in the (i) formal sector, when animals are slaughtered in known abattoirs; (ii) informal sector, when households and their compounds are used as some temporary slaughter houses. In the later case, the household sector would act as producers of outputs, which are sold to tanneries, leather industries, and exporters pretty much like sales by abattoirs. We can safely leave aside pursuing hides and skins because this represents interactions within the manufacturing sector or the manufacturing sector and the final demand sectors.

Rental value of livestock capital (V_1,V_2): In table A1.2, entries in the value added row (V_1,V_2, V_3) are sum of payments for services of all factors of production - compensation for labour (own or employed); property rents (buildings, land); non-livestock capital (rents of machineries or interest payments); and livestock capital. However, there are substantial variations in the proportions in which the factors are combined in different sectors. Oxen draft power, which is included in V_2, are relevant to only the cropping sector and it remains as part of crop sector GDP but it should be estimated separately to recognise the services of the livestock sector to other sectors in the economy (inter-sectoral linkage effect). Similarly, services of dairy cows, included in V_1, are as important as oxen draft power. While oxen draft power is inter-sectoral role of livestock capital, services of cows in producing milk is an intra-sectoral role of the capital value of livestock. Oxen are used to produce crops, but cows are used to produce milk. These two capital services need to be explicitly estimated.

3. ECONOMIC ACCOUNTS FOR LIVESTOCK SECTOR

3.1 ESTIMATION OF GROSS OUTPUT OF LIVESTOCK SECTOR

It is essential to obtain data on livestock numbers by type of livestock to estimate gross value of livestock production and then gross value addition that is likely to have taken place in the livestock subsector of agriculture. In other words, establishing the herd size, “stocks or assets” is a prerequisite for estimating the economic size of the sector, “flows”, from the livestock sector. The relationship between stocks and flows is mediated by estimates on the current level of productivity in the sector.

In this study, the estimates of economic accounts for the livestock sector covers cattle; sheep; goats; camels; poultry; equines (horses, mules and donkeys); and bee colonies (beehives). In this section, we start by examining herd sizes and logically progress to estimating economic activities associated with the livestock sector.

3.2 LIVESTOCK STATISTICS

Table 3 below displays Ethiopia's livestock statistics from 2004 to 2010. The table is divided into two subsections, the upper part showing livestock numbers in thousands for eight livestock types while the lower part shows annual growth rates of the corresponding categories of livestock types during the period. The cattle population have grown from 38 million in 2004 to 51 million in 2010.

Table 3 – Livestock Population Statistics (2004-2010)

Numbers ('000)	2004	2005	2006	2007	2008	2009	2010
Cattle	38,103	38,749	40,380	43,125	47,571	49,298	50,884
Sheep	16,575	18,075	20,734	23,633	26,117	25,017	25,980
Goat	13,835	14,859	16,364	18,560	21,709	21,884	21,961
Camel	471	459	438	616	1,009	760	808
Poultry	35,656	22,605	32,222	34,199	39,564	38,128	42,053
Horse	1,447	1,518	1,569	1,655	1,776	1,787	1,995
Donkey	3,770	3,930	4,289	4,498	5,573	5,422	5,715
Mule	321	318	341	326	377	374	366
Beehives		4,546	4,020	4,884	4,800	4,600	4,598
%Annual changes							
Cattle		1.7	4.2	6.8	10.3	3.6	3.2
Sheep		9.0	14.7	14.0	10.5	-4.2	3.8
Goat		7.4	10.1	13.4	17.0	0.8	0.3
Camel		-2.7	-4.6	40.9	63.7	-24.7	6.3
Poultry		-36.6	42.5	6.1	15.7	-3.6	10.3
Horse		4.9	3.4	5.5	7.3	0.6	11.6
Donkey		4.3	9.1	4.9	23.9	-2.7	5.4
Mule		-1.1	7.2	-4.4	15.7	-0.8	-2.1
Beehives		-11.6	21.5	-1.7	-4.2	0.0	na

Source: Central Statistical Authority

Similarly, the total number of shoats (sheep plus goats) has increased from 29 million to 47 million during the period. While the number of camels nearly doubled, the size of poultry population increased only by a relatively smaller amount – a rise from 36 million to 42 million. Similarly, the increase in the number of equines have followed similar pattern of growth as that

of camels. The number of bee colonies or beehives has increased only marginally during the period.

Although table 3 shows livestock statistics for seven years, it is important to focus on one year to estimate the interconnected economic accounts for the livestock sector (shown in Table 2, in the preceding section). In order to choose the baseline year, it was necessary to examine the patterns of changes over the seven years period. The annual growth rate of the livestock populations is shown in the lower part of Table 3. There are considerably large differences in annual growth rates for each livestock category across the years as well as between different livestock categories. The substantially large variations in annual growth rates could partly be explained by destructions in the livestock population due to recurrent droughts in some years and recoveries during the subsequent years.

For the purpose of this study, it is useful to avoid a baseline year with sharp falls or rises in figures for one or more livestock category. Choosing such a year as a baseline would jeopardise the accuracy of the estimates in the current estimates as well as future revisions, because the baseline estimates will be used as a yardstick in the subsequent years. For this purpose, we have opted for taking an average of three recent year figures (2008-2010) to represent the baseline livestock number for all livestock categories. Table 4 below shows such a weighted average figure which will be utilised for deriving economic accounts for the sector by applying appropriate productivity estimates.

Although we have smoothen the data by averaging over large annual variations, it was necessary to explore further and see if the weighted average figures were good enough to considered as baseline data for establishing the foundation for aggregate economic accounts on the livestock sector of the country. To this effect, we have compared the figures under weighted averages (2008-2010) were compared with other data sources. Adjusted figures which are used for further computations are presented in the column labelled “adjusted figures 2009”, and the percentage deviation of this column from the CSA data is presented in the last column of table 4. For this adjustment, we have relied on FAO database, Behnke (2010), and

Demeke (2008). The adjusted figure for cattle population was obtained from FAO statistical database, it is 3.2% greater than CSA data.

Table 4 – Average Herd Size For Years 2008 To 2010 (In Thousands)

	2008	2009	2010	Weighted Average (2008-2010)	Adjusted figures 2009	% adjustment
Cattle	47,571	49,298	50,884	49,288	50,884	3.2
Sheep	26,117	25,017	25,980	25,714	35,866	39.5
Goat	21,709	21,884	21,961	21,852	34,684	58.7
Camel	1,009	760	808	873	2,400	174.9
Chicken	39,564	38,128	42,053	39,981	42,100	5.3
Horse	1,776	1,787	1,995	1,858	1,858	0.0
Donkey	5,573	5,422	5,715	5,573	5,573	0.0
Mule	377	374	366	372	372	0.0
Beehives		4,600	4,598	4,599	4,599	0.0

Behnke (2010) have undertaken a thorough review of the literature to establish the fact that the CSA data hugely underestimates the small ruminant population. Accordingly, we have opted to use Behnke's estimates on sheep and goat population, which is 40% and 59% higher than the CSA estimates. The FAO statistical database and Behnke's estimate provide a considerably larger camel population, 175% higher than the CSA data. The main reason for which the CSA data consistently underestimates the livestock population figures is that CSA surveys have been confined to sedentary farming zones, excluding pastoral areas. This is clear, for instance, from the huge underestimations of camel and small ruminants. Demeke (2008) provided poultry population which is slightly higher than the estimates obtained from the CSA data.

3.3 TYPES OF LIVESTOCK PRODUCTS

In the conceptual framework discussed in section 2, gross output of livestock activities (GVO) was presented as a highly aggregated variable, consisting of a range of livestock products. These are displayed in Table 5, which shows a matrix of nine livestock types by six livestock product.

Table 5 – Livestock Type By Product Matrix

	Off-takes or live sales	Milk	Egg	Rental incomes	Honey	manure
Cattle	L	L		O		L
Sheep	L					
Goat	L	L				
Camel	L	L		O		
Poultry	L		L			
Horse				O		
Donkey						
Mule				O		
Beehives					L	

In the matrix, the intersections between row and column headings indicate whether or not the livestock type produces that type of livestock product, with letters representing existence and empty cells denoting non-existence of a product for that combination. For instance, there are only one relevant product for sheep - "off-takes" or live sales or slaughtering. However, cattle is a multi-purpose livestock type that supports livelihoods of farmers by generating income from live animal sales, milk sales or consumption, rental incomes from draft power and manure use or sales.

In section 2 of this report we have discussed that it is not appropriate to classify all outputs generated by the "different livestock types" as "livestock sector output". In Table 2, the letter "L" denotes livestock products that can be classified under the gross output value in the livestock sector while "O" represents livestock services that enabled generation of gross output of other agricultural sectors or non-agricultural sectors.

For instance, milk produced by different livestock types constitutes part of total gross output of livestock economic activity. However, while "O" under "rental income" and against "cattle" denotes oxen draft power service which constitutes gross value of output in the cropping subsector of agriculture, but "O" against camels, horses, mule and donkeys denotes gross value of output in the transport sector, a non-agricultural sector which partly relies on animal power to provide transportation services. In the context of draft power, it should be noted that

owners of the draft animals receive payments for the rental services of their assets which is utilised in other sectors. In most cases, the services could be provided within a farm, but it is essential to make these distinctions in estimating economic accounts since different economic activities of a mixed farmer is accounted for in different agricultural subsectors – e.g. livestock and cropping subsectors of agriculture.

In principle there should be some output of manure from all livestock types but the Ethiopian national economic accounts have traditionally considered only dung or baked and dried cattle manure which is mostly used for fuel. Accordingly, due to paucity of information on manure use and sales we take into account only estimated value of cattle manure used for preparing dung.

The most important point to bear in mind is that a typical livestock type produces multiple outputs. For instance, the cattle "off-takes" represents the proportion of animals sold in that year, either slaughtered by households (e.g. during festive seasons), at slaughterhouses on daily basis to be distributed to butchers or hotels, or exported as live animals to foreign markets. In the mean time, depending on conception and calving rates, the mature female cattle yield milk and this represents total milk production which multiplied by milk price per litre gives total value of milk during that year. Similarly, some proportion of mature males is used as oxen to plough crop fields, providing services to the crop sector. This rental value of oxen generates income for livestock keeping households (as institutions) but this figure is registered as value added in the cropping sector since it is generated in that economic activity.

3.4 ESTIMATES OF GROSS OUTPUT BY CATEGORIES OF LIVESTOCK PRODUCTS

In the sub-sections below, we discuss estimates of different livestock products – the six different categories presented as column headings in Table 5: live sales, milk output, egg output, rental services, honey output, and dung. We take each of the livestock outputs in turn and present the estimates. It should be noted that the sum of all entries labelled as "L" in table 5 above yield gross output of livestock production which is denoted by GVO1 in the conceptual framework discussed earlier in the context of Table 1. On the other hand, entries labelled as "O" represent gross value added in "other sectors". Specifically, rental services of oxen draft

power (entry "O" at the intersection between "cattle" and "rental services" in table 5), constitutes "V2", or gross value added in the cropping subsector. Similarly, rental services of transportation or draft power of equines (entry "O" at the intersection between row headings of "horses", "donkey", "mule", "camels", and column headings "rental services" in table 5), constitutes "V3", or gross value added in the transportation sector (non-agricultural sector).

3.4.1 OFF-TAKE OF LIVE ANIMALS

Table 6 shows details of methods for calculating value of gross output from sale of live animals - camels, cattle, goats and sheep. The summary of livestock statistics for each livestock type is taken from table 4 above. The other variables involved in this computation are obtained from FAO statistical database. In addition to livestock numbers, gross output is also affected by the off-take coefficients – camel (0.04), cattle (0.07), goats (0.35) and sheep (0.33). The cattle off-take coefficient applied here is equal to the rate MOFED has traditionally applied but lower than the 0.09 rate used by Behnke. However, the off-take coefficients for the other livestock categories in this study are consistently higher than those applied by MOFED and Behnke. While MOFED and Behnke have used average prices of live animals for all livestock categories, we found it useful to consistently measure "yield in carcass weight", as applied by FAO for most countries.

Table 6 – Estimates Of Gross Value Of Live Animals (2009)

Livestock off-take variables	Values and coefficients
a. Livestock population ('000)	
Camel	2,400.0
Cattle	50,884.0
Goats	34,684.4
Sheep	35,866.3
b. Off-take ratios	
Camel	**0.04**
Cattle	**0.07**
Goat	**0.35**
Sheep	**0.33**
c. Yield/Carcass Weight (Hectogram/Animal)	
Camel	1,200
Cattle	1,083

Goat	85
Sheep	100
d. Production (tonnes) = (a*b*100*c)/1000	
Camel	12,000
Cattle	389,880
Goat	103,371
Sheep	117,346
e. Producer Price (birr/tonne)	
Camel	33,360
Cattle	36,079
Goat	25,218
Sheep	26,962
f. Total value of production by animal type (million birr) = (d *e)/1000,000	
Camel	400
Cattle	14,066
Goat	2,607
Sheep	3,164
g. Total value of production - all animals (million birr)	**20,237**

Source: livestock number is obtained from Table 4 above, and the other coefficients are obtained from FAO statistical database. The computations involved are shown as necessary.

This yield is converted to meat equivalents which were multiplied by price per tonnes of meat to arrive at gross value of sales of animals. The aggregate figure obtained this way is displayed in the last row of table 6. Accordingly, estimate for gross value of sales of live animals is given as birr 20,237 million. Clearly, gross value of livestock production through off-takes is much higher than the corresponding figure estimated by Behnke and MOFED, which were birr 12,757 million and birr 9,653 million respectively. The main explanation for such large difference lies in the differences in the way the off-takes are valued. Pricing livestock units by averaging over all age and sex groups can lead to considerably large divergence from the realistic prices of cattle. However, “carcass weights” or even “live weight” based pricing follows standard conversion factors which reduce the livestock units to common denominator. Clearly, we know a lot more about the price a kg or a tonne of beef than, for example, the price of cattle in general.

3.4.2 MILK OUTPUT

The procedure employed in this study to obtain gross value of milk output from different livestock types (camel, cattle, and goats) is displayed in Table 7 below.

As we have done with off-takes, we start with total livestock population. We then obtain lactation ratios or proportion of the corresponding livestock type that give milk during the year. The FAO statistical database provides lactation ratios of 0.21 for camels (which is about the same as the ratios used by MOPED and Behnke) but it gives unrealistically low lactation ratios for cattle (0.13) and goats (0.03). In this study, we opted for using lactation ratios used by Behnke. On the other hand, Behnke applied an extra-ordinarily large lactation ratio of 0.6235 for goats, which cannot be realistic for the Ethiopian condition. As a result, we have opted for the combinations of lactation ratios MOFED has applied to different livestock categories – camel (0.20), cattle (0.22) and goats (0.25).

Table 7 – Estimates Of Gross Value Milk Production (2009)

Milk off-take variables	Values and coefficients
Livestock population ('000)	
Camels	2,400.0
Cattle	50,884.0
Goats	34,684.4
Milk animals (ratio of stocks)	
Camel	0.20
Cow	0.22
Goat	0.25
Yield (Hectogram/Animal)	
Camel	3,860
Cow	2,154
Goat	500
Milk production (tonnes)	
Camel	185,280
Cow	2,411,291
Goat	435,289
Milk producer price (Eth birr)	
Camel	13,435
Cow	5,845
Goat	9,132

Gross value of milk produced - by animal type (million birr)	
Camel	2,489
Cow	14,094
Goat	3,975
Gross value of milk produced - all animals (million birr)	**20,558**

MOFED and Behnke have then gone into classifying milk output into liquid milk and butter by applying conversion factors. For two reasons, we did not follow this approach. First, there is no compelling evidence to guide the division of the volume of milk into the liquid milk and butter categories. Second, even if there is enough data to guide this allocation, converting milk to butter involves some processing – essentially, butter is not a primary product, it is a derived product. The fact that the processing happened on farm does not make it any less important. Suppose liquid milk was sold to dairy processors, who would perform the same task of converting milk into butter, among other things. Then we would not classify this processed product as "primary" livestock output. For the purpose of economic accounting, it would suffice to appropriately value the primary output – liquid milk produced at farm level.

Although we have valued only liquid milk equivalent (without classifying the total milk volume into butter and liquid milk), the gross value of milk output obtained in this study (birr 20,558 million) is still higher than the corresponding figure obtained by MOFED (birr 19,471 million). However, Behnke's estimate of gross value of milk output is considerably higher than our estimates for two reasons. First, Behnke applied unrealistically high lactation ratio for goats. Second, and most importantly, Behnke implicitly assumed that a lactation period is 12 months, but this is not the case in traditional farming systems, where it is common to have 15 to 18 months lactation period. This means, the milk yield per lactation which Behnke used in the report would need to be scaled down to bring it in line with yield per animal per year (not per lactation). In other words, what is relevant for the purpose of GDP estimation is yield per annum, not yield per lactation.

As noted earlier, the bulk of production and producer price data used in this study was obtained from the FAO statistical database. For Ethiopia, milk producer price per tonne is

available only for cow milk. However, we explored if this was the case for other neighbouring countries and we found out that actually the FAO database has milk producer prices for all livestock type (camel milk, cow milk, and goat milk) for Kenya. There are substantial producer price differences between these milk categories – in Kenya, producer prices for camel milk and goat milk being 2.3 and 1.6 times cow milk prices respectively. We have applied similar price differentials to the Ethiopian data.

To begin with, the cow milk producer price for Ethiopia, given in the FAO database and applied in this study, is 1.2 times higher than the figures used by MOFED and Behnke. Similarly, the camel milk and goat milk producer price used in this study are 2.4 and 1.4 times higher than the corresponding producer prices used by MOFED and Behnke.

3.4.3 POULTRY PRODUCTION

Table 8 below displays summary statistics for estimating poultry related production. The FAO statistical database indicates that about 57.8 million chicken were slaughtered in Ethiopia during 2009. At 881 gram average carcass weight per chicken, total chicken meat amounting to 50.9 million tonnes was produced. In the FAO statistical database, the producer price of chicken meat was given as birr 39,103 per tonne (or about birr 34 per chicken). The estimated gross value of chicken meat during 2009 was estimated at about birr 1,990 million. Similarly, the estimated gross value of total egg production was about birr 498 million. Thus, estimated gross value of poultry production was birr 2,488 million. Poultry production was not taken into account in Behnke's estimates of gross value of livestock output.

Table 8 – Estimates Of Gross Value Of Poultry And Egg Production

Chicken meat production	
Producing animals/slaughtered (1000 head)	57,800
Yield/Carcass Weight (gram/Animal)	880.5
Production (tonnes)	50,893
Price of chicken meat (birr/tonne)	39,103
Total value of chicken meat produced (million birr)	**1,990**
Eggs production	
Laying (1000 Head)	8,600
Yield (gram/chicken)	3,589
Production (tonnes)	30,865
Producer Price (birr/tonne)	16,124
Total value of egg produced (million birr)	498
Total value of chicken meat and egg production (million birr)	**2,488**

3.4.4 HONEY PRODUCTION

Information obtained from CSA (2009/10) indicated there were about 4.6 million beehives in Ethiopian during 2009. This is the same as the figure reported in the FAO statistical database. The bulk of the beehives (97%) are traditional, with a yield of 7.0 kg of honey per year. Modern beehives constitute only 3% of the total beehives but their yield per year is 25 kg per hive, more than 3 times the yield of traditional beehives. The semi-modern or transitional beehives are a mere one percent of total beehives but they are just over twice the level of productivity of traditional beehives. Producer price of honey per kg was 22.0 birr according to the information obtained from the producer price database of CSA. Thus, the gross value of total honey produced in Ethiopia during 2009 was estimated at birr 760.7 million. In addition to poultry, honey production was not included in Behnke's estimates of gross value of livestock outputs. With regard to bee-wax production, no significant bee-wax is produced from modern beehive- as one of the indications of the quality of modern beehive that enables beekeepers to produce quality honey. Transitional (intermediate) and traditional bee keeping practices, the proportion of crude wax that can be produced accounts for 20% of the total honey production, respectively.

Table 9 – Estimates Of Gross Value Of Honey Production

	No. of Beehives (000)*	Honey yield (kg/hive/year) **	Production (000, kg)	Total value (million birr)x	% of crude bee wax	Crude bee wax produced/ annum (Million kg)	Average farm gate price of (Birr/kg)	Annual income (Million Birr)
Modern	118.0	25	2,951.6	64.93	0	0	25	0
Transitional	33.1	15	497.2	10.94	20	9.94	25	248.6
Traditional	4,447.0	7	31,129.1	684.84	20	6.23	25	155.6
Totals	**4,598.2**	**7.5**	**34,577.9**	**760.71**		**16.2**	**25**	**404.3**

Source: * CSA (2009/10)

**National Bee Research Institute (2011). Note: x @ 22 birr Producer price of honey per kg, which was obtained from producer price database of CSA.

3.4.5 OXEN DRAFT POWER

In the Ethiopian agricultural systems, oxen play a major role as source of animal traction for preparation of crop lands. According to 2009/10 CSA data, there were a total of 12.8 million (or 6.4 million pairs) of oxen providing draft power. ILCA (1986) estimated that oxen work for about 60 days per year on average in Ethiopia. Azage (1998) agrees that oxen work for about 2 months per year. The rental value of a pair of oxen in Ethiopia without farmer was Birr 40.00 per day on average.

Table 10 – Estimates Of Gross Values Of Oxen Traction Power

Descriptions	Values
Total number of a pair of oxen (million)	6.4
Average number of days spent by oxen in land preparation	60.0
National average rental value of a pair of oxen per day (birr)	40.0
Total value of oxen draught power in Birr (Million)	**15,419.1**

Behnke's reported that animal draft power (although it is not clear whether or not this includes equines used in ploughing crop lands) generate gross value added worth birr 21,500 million. This is greater than our estimate by 40%. The main source of such an inflated estimate lies in the method Behnke applied in obtaining the figure. Instead of starting with draft animal population, their employment rate per year, and the payment for their services, Behnke opted for starting with cultivated agricultural land, proportion of farmers who use draft animals and

rough estimates of the share of draft animals in gross value added in crop production. Surely, there are plenty of compounding errors involved in such series of strong assumptions and extremely indirect methods.

3.4.6 TRANSPORTATION AND DRAFT SERVICES OF EQUINES

Equines render considerable services to the national economy mainly in delivering services for transportation and as source of draught power. According to CSA (2009/10) agricultural sample survey report, draught animal refers to animals that are engaged in activities such as ploughing, threshing, etc. Estimation of services of equines was done by using census data of 2009/10 (CSA 2010). Census data disaggregated (horses, donkeys and mules) aged 3 years and above, and camels aged 4 years and above according to their services, mainly transportation and draught, as displayed in table 11 below.

Table 11 – Estimates Of Gross Value Of Services Of Equines

	Number	Service Days/year	Rental services (Birr/day)	Value (Million Birr/year)
Horses				
Transportation	1,208,433	46	25	1,390
Draft	143,955	42	35	212
Donkeys				
Transportation	3,478,579	80	15	4,174
Draft	813,845	48	15	586
Mules				
Transportation	292,492	46	30	404
Draft	15,062	42	40	25
Camel				
Transportation	169,962	36	40	245
Gross value of services				7,035

Source: livestock census (CSA 2010)

While horses, donkeys and mule provide both transportation services and draft power to plough crop lands, camels (which are also included in this analysis) provide only transportation services.

The number of average service days and average daily rental values were obtained from case studies and key-informant interviews with agriculture professionals and farmers of different regions. The study made by Mengistu et al. (2008) in northern Ethiopia, South Gonder zone of Amhara Region reported the average service days of equines (horses, mules and donkeys) in a year for transportation and draft power. This finding was confirmed with information collected from key-informant telephone interviews with agriculture experts of Awi zone in western parts of Amhara Region, which is a dominant area in the utilization of horses and mules as draught power source and transportation. Similarly, the annual average service years of donkeys in the central rift valley of the country was obtained from Adami Tulu Jido Kombolcha district of Oromiya Region. Camel renting is also a common practice in North Eastern part of the country in Bati district of Amhara Region. The study made by Agajie and Takele (2008) in Bati District of Amhara Region reported average service days of camel in a year and daily rental values.

Accordingly, gross value of equines transportation and draft services were estimated at birr 7,035 million. It is important to stress that estimates reported here are based on extremely rudimentary set of information, simply because the economic role of equines are not yet studied systematically covering different agro-ecological zones of Ethiopia. This is a very important area for future research.

Benke's estimate of value added by equines was birr 18,959 million, nearly 3 times the corresponding gross output estimated in this study. The methodology he employed for arriving at this particular figure is very unclear, but he relied on a study which was cited in the body of the report but not listed in the references. In any event, the cited study covered only a specific district in the Southern Nations and Nationalities Region (SNNR). Additionally, the way the reference was made (see Behnke 2011, p.19), is not possible to make any judgement whether the particular study was referring to gross value of equines services, sales value of the equines, or gross value added. There was a reference to birr 5323 per annum per household, which was then grossed over to all households in Ethiopia, but in our view this is a very unrealistic estimate and an extremely exaggerated figure.

3.4.7 DUNG PRODUCTION

Table 12 below provides a summary of dung production. We have followed Behnke's approach but it was necessary to revise the estimated values. Behnke's estimate was confined to dung for fuel, which was influenced by a previous study by the Ethiopian Energy Authority (EEA). Since dung production has traditionally been limited to using cattle manure, the EEA study did not go beyond estimating biomass of manure from cattle. However, Behnke have gone further and explored other research findings which estimated total manure production from all other livestock categories, by converting this to cattle equivalents using tropical livestock unit conversion method. In the end, the estimated manure yield was applied to the cattle population, except that the coefficient was changed from the EEA estimate of 0.182 tonne per cattle per year to 0.237 per cattle per year. As far as the role of manure of dung production is concerned, it is important to retain the EEA approach simply because it is not common to produce dung from manures of equines and small ruminants. Therefore, we opted for using the EEA coefficient and then applied to only the cattle population, without taking into account the other livestock categories.

Table 12 – Estimates Of Gross Value Of Dung Produced

Descriptions	**values**
Cattle number	**50,884,000**
Dung production per cattle per year (tones)	0.182
Price of dung (birr/ton)	306
Gross value of dung produced (million birr)	**2,834**

Accordingly, the gross value of dung production was estimated at birr 2,834 million, which is slightly higher than the average of MOFED and Behinke estimates. At this point, it is important to stress that the role of livestock manure in the Ethiopian economy is likely to have been grossly underestimated. Perhaps EEA's study seems to have set a tradition of looking at manure only from fuel and energy perspective. Accordingly, both MOFED and Behnke's estimated have not gone from beyond manure use for dung production. However, the economic role of manure as fertilizer in agricultural production activities is by far the most important economic role of manure production. In this context, there is simply no need to consider only cattle manure, since manure from all livestock types are equally relevant. In

terms of methodological approaches, the key lies in converting manure to fertilizer equivalents and then compute how much it would cost if the same plot of land was farmed using fertilizer rather than manure. This is a very important area for further research.

3.5 ESTIMATES OF COSTS OF INTERMEDIATE INPUTS IN LIVESTOCK PRODUCTION

Estimate of total intermediate cost of livestock production is very rudimentary. The estimates reported here are very likely to grossly underestimate the actual costs because the bulk of livestock rely on natural resources which are not yet appropriately valued ecosystem services. Even for those that are valued, the information system in the Ethiopian context is extremely sketchy. Therefore, we stress that the estimates we provide in this regard need to be read with caution.

There are three different categories of intermediate inputs that are reported in this section. Table 13 provides summary of feed costs, taking into account the proportion of total livestock that depend on supplementary feed (roughages and concentrates) and estimated costs of these feed types. The total cost of feed was estimated at birr 10,152 million (the sum of costs estimated for different livestock types).

Table 14 reports total costs of health costs, which is basically obtained by summing together total costs of different types of health products distributed or sold during the year. These add up to birr 22.3 million. Additionally, there was a separately estimated total breeding cost which was obtained by estimating total costs of semen distributed or sold during the year, which comes to birr 2.0 million.

Therefore, the total cost of intermediate inputs was obtained by addition of the three categories discussed above, and this yield birr 10,176 million. It should be noted that Behnke's did not make any attempt at estimating costs of livestock production.

Table 13 – Estimates Of Total Feed Costs

	Cattle	Sheep	Goat	Poultry
Livestock population	50.9	35.9	34.7	42.1
% of livestock fed on supplementary feed	8.1	2.5	3.4	3.4
Number of livestock fed on supplementary feed (Million)	4.1	0.9	1.2	1.4
TLU Conversion factors	0.7	0.1	0.1	0.0
TLU fed on supplementary feed (Million)	2.9	0.1	0.1	0.0
Total dry matter intake per TLU (kg/day) (Million)	7.1	10.0	10.0	15.0
Total dry matter intake all livestock units (million kg/day)	20.5	0.9	1.2	0.2
Total dry matter intake all livestock units (million kg/annum)	7476.8	327.3	430.4	78.4
Share of roughage intake in total dry matter intake	0.7	0.7	0.7	0.7
Share of purchased roughage	0.3	0.3	0.3	0.3
cost per unit of purchased roughage (birr/kg)	1.3	1.3	1.3	1.3
cost per unit of purchased concentrates (birr/kg)	3.0	3.0	3.0	3.0
Cost of roughage per annum (million birr)	2400.8	105.0	138.3	25.2
Cost of concentrate per annum (million birr)	6729.2	295.0	387.4	70.7
Total feed cost (million birr)	**9130.0**	**400.0**	**525.7**	**95.9**

Table 14 - Estimation Of Health Related Costs For Animals For The Year 2009/10

Type products	Unit	Unit price (Birr)	Performance of 2009/10	
			Quantity (Dose)	Value (Birr)
Bacterial vaccines				
CBPP (Contagious Bovine Pleuropneumonia)	Dose	0.25	5,201,400	1,300,350
Anthrax	"	0.25	8,061,100	2,015,275
Blackleg	"	0.50	6,398,450	3,199,225
Sheep and Goat pasteurellosis	"	0.40	6,241,900	2,496,760
Bovine pasteurellosis	"	0.40	4,999,200	1,999,680
CCPP (Contagious Caprine Pleuropneumonia)	"	1.35	543,712	994,276
Fowl Typhoid	"	0.20	839,700	167,940
Viral Vaccines	"			
LSD (Lumpy Skin Disease)	"	0.30	5,081,610	1,524,483
Sheep and Goat Pox	"	0.15	8,864,340	1,329,651
PPR (Peste Des Petits Ruminants)	"	0.25	11,653,850	2,913,463
FMD (Foot and Mouth Disease)	"	7.00	348,370	2,438,590

African Horse Sickness	"	0.45	1,206,660	542,997
Newcastle Disease Lasotu	"	0.12	1,189,140	142,697
Newcastle Disease HB1		0.12	1,271,800	152,616
Newcastle Disease Thermo Stable Vaccine	"	0.15	2,950,513	442,577
Fowlpox Vaccine	"	0.20	586,210	117,242
Gumboro Standard Vaccine	"	0.15	1,235,500	185,325
Rabies Vaccine	"	7.00	24,922	174,454
Sub-total			66,698,377	22,137,600
Saline		3.25	43,334.00	171,288
Total				**22,308,889**

Source: National Veterinary Institute

3.6 ESTIMATES OF LIVESTOCK GROSS DOMESTOC LIVESTOCK PRODUCT

Table 15 provides summary statistics and estimates of livestock sector GDP. This is done by bringing together estimates reported in Table 6-14. The first rows report gross value of livestock output as sum of values obtained from estimates of off-takes, milk, poultry, honey and manure. This gives birr 46,671 million.

Table 15 – Estimates Of Gross Domestic Products Related To Livestock Activities

Categories	**Values (million birr)**	
Gross value of outputs		46,671
Off-takes (cattle, shoats, and camel)	20,237	
Milk	20,558	
Poultry	2,488	
Honey	553	
Dung	2,834	
Cost of livestock production		10,176
GDP of livestock activities (GDP - LA)		36,495
GDP of livestock services in other sectors (GDP - LDA)		22,454
GDP of livestock related activities (GDP-LRA)		58,949
GDP - agricultural (2009) GDP-AGRI*		165,489
GDP - aggregate (2009) - GDP-AGG*		357,340
GDP-LA/GDP-AGRI (%)		22.1
GDP-LA/GDP-AGG (%)		10.2
GDP-LRA/GDP-AGRI (%)		35.6
GDP-LRA/GDP-AGG (%)		16.5

Source: computed from different tables; * obtained from MOFED's website.

By far the most confusing aspect of Behnke's report was the fact that he reported gross value of livestock production as livestock sector GDP (see Behnke 2010, pp. 31-32). Therefore, the main difference between this study and Behnke's report lies in the fact that Behnke does not distinguish between **gross value of livestock output** and **gross value added in livestock activities (or livestock GDP)**. However, it is vital to make distinguish between values of gross output and gross value added.

Accordingly, we go further and calculate livestock GDP by deducting total intermediate costs from the total gross output, as clearly discussed in the conceptual framework in Table 2 and reported below in table 15. Accordingly, the size of GDP generated in the process of livestock production was estimated at birr 36,495 million. Clearly, the GDP figure we report here is considerably lower than the figure Behnke reported as GDP. In table 15, GDP generated in the livestock sector itself is labelled as GDP-LA (GDP in livestock activity).

It should be noted that GDP generated by livestock capital services in "other sectors" added up to a birr 22,454 million. This is the sum of oxen and equines GDP generated by draft power in cropping subsector of agriculture, V2 in Table 2, and equines transportation services in the non-agricultural sector, V3 in table 2. In table 15, we labelled these as GDP-LDA (livestock dependent activities). If we sum together GDP-LA and GDP-LDA, then we obtain birr 58,949 million which is GDP generated in all livestock related activities (GDP-LRA).

Now it is appropriate to present these figures as percentage of agricultural and aggregate national GDP. GDP-LA constitutes 22.1% and 10.2% of agricultural and national GDP respectively. On the other hand, GDP-LRA constitutes 35.6% and 16.5% of agricultural and national GDP respectively.

4. CONCLUSION

The primary purpose of this study was to examine and evaluate findings in Behnke reports (2010 and 2011) on economic accounts related the livestock sector in Ethiopia. For this purpose a taskforce was formed by bringing together experts from different governmental and non-governmental organisations in the country. The taskforce started its activities by focusing on establishing a consistent and comprehensive conceptual and analytical framework, which was then used it to examine details of findings in the two reports produced by Behnke. The activities of the taskforce was not limited to establishing an analytical framework, but it was also necessary to redo the task of the estimation of gross outputs produced through a number of livestock activities, costs of livestock production and then gross value added generated in the process of livestock production. In the process, the gross livestock output for different subsidiary accounts in the system of livestock sector accounts reported in Benhke report were compared with the corresponding findings of the taskforce. In each case, we have provided commentaries throughout the report explaining possible sources of divergence between our findings and those reported in Behinke's reports. Consequently, it is not appropriate to repeat the detailed assessments here since they are clearly stated in the body of this report in different sections. Here we concentrate on providing comments on four broader methodological problems in Behnke's approach to estimating livestock sector GDP.

First, by far the most serious conceptual and methodological problem in Behnke's report is this – no distinction was made between "gross value of output" and "gross value added or GDP". In fact, in both reports (2010 and 2011) gross output figures are conveniently referred to as gross value added or gross domestic product. This is a very unusual method and it departs from the convention of systems of national accounts in a major way.

Second, the established system of national accounts (SNA), which guides the estimation and establishments of system of national accounts in all countries in a standardised way clearly defines "sectoral value-added" – compensation for different factors of production **employed** in that sector or industry. The value-added by a particular factor of production in a specific sector

is accounted for as value-added in the sector that has employed the factor of production. For instance, "oxen draft power" is a capital service employed in the cropping sector and the value-added should be accounted for in the cropping sector – NOT in the livestock sector. Of course, the owner of the oxen receives payments for the services of the oxen, and in most cases, actually it is the same farmer who used the oxen to plough his own field where he would like to grow crops. However, the system of national accounts records these separately, even if the activities are generated on the same farm. The fact that the value-added attributable to oxen draft power is recorded in the cropping sector does not make the livestock sector any less important in its role to support livelihoods. In spite of these facts, Behnke's report presented draft power and transport services related value-added or GDP as "livestock sector GDP". However, we have clearly shown in Table 15 that these constitute part of GDP generated in livestock dependent other sectors. For this purpose, we have separately reported livestock specific value-added (GDP-LA), livestock dependent sectors value-added (GDP-LDA), and livestock related value-added (GDP-LRA = GDP-LA + GDP-LDA).

Third, the lack of conceptual clarity and the extent of departure from the standard methods of SNA got even worse in the second Behnke report (Behnke 2011). The "financial, insurance, and risk" related values reported as "livestock sector GDP" are by far the most strange and unheard of methods. This is not to say such concepts do not exist in the literature on the rural economies, particularly in the context of livelihood frameworks. However, these are not yet brought in line with system of national accounts, as reported in aggregate economic statistics. Even if we decide to be innovative and start imputing such services including them into Ethiopia's system of national accounts, Behnke's report has not applied the kind of rigor required to accomplish such a task. For instance, inflation adjusted rural credit in Ethiopia was assumed to bear 100% interest rate, this was arrived at by applying the maximum of references cited (see Behnke 2011, p. 16, table 4). At the very least, some average figure should have been taken. In any event, this was simply grossed over implicitly through some double counting – in effect, the off-take value estimates were simply multiplied by 2. This implies that, for instance, when a farmer sales an oxen for birr 3000, then this off-take value constitutes a sales value, a direct benefit, and then we would need to account for the insurance value of the oxen during

its stay on farm, because the farmer did not take any credit on which he would have paid another 3000 as interest. However, we do not find this logic convincing at all, and we would need to confine the estimates to existing practices.

Fourth, in addition to the finance and risk related conceptual problem, the second Behnke report confused the "production" and "expenditure" approaches, on the one hand, and the SNA based direct estimations of economic accounts with "multiplier" methods. In spite of some shortcomings, most of which were reported in this study, Behnke's first report (Behnke 2010) was confined to the production approach in estimating gross outputs. However, the second report has gone overboard, mixing production, expenditure, and even multiplier effects. Consequently, Behnke moved very rapidly from the realistic range of estimates for the livestock sector GDP - interchangeably using gross outputs, gross value-added or GDP, on the one hand, and production approach and expenditure approach on the other, and as well as multiplier effects and economic benefits (see Behnke 2011, p. 20 Table 11).

5. KEY FINDINGS AND RECOMMENDATIONS

In line with the remits of this study, the taskforce is expected to come up with recommendations for MoFED, CSA and MoA to improve the accuracy of estimates of livestock's contribution to Ethiopia's GDP. Such recommendations are already stated in different sections of this report where further details of recommendations for methodological improvements can be found. Here we focus on summary of key recommendations by classifying them under broad topics.

Improvements of livestock statistics

The taskforce agrees with the findings of the Behnke reports – Ethiopia's livestock statistics is incomplete and fluctuates considerably between years. First, the livestock data is incomplete because it has been confined to sedentary farming parts of Ethiopia, and the pastoralist areas are yet to be brought into the CSA census and sample survey frameworks. However, a good proportion of the livestock population is located, and most importantly, the role of livestock in livelihoods is most critical in lowland, pastoral and peripheral parts of the country.

Recommendation 1: The CSA, in collaboration with the MoA, will need to conduct a baseline estimate of the livestock population in pastoralist areas.

Second, the CSA livestock data lies in its extreme year-on-year variation. It is not clear whether such oscillations in the time series data are due to exogenous shocks such as droughts or animal diseases or data inaccuracy. In any event, the existence of such variations is likely to considerably reduced confidence among researchers and policy makers in the reliability of the data series.

Recommendation 2: The CSA censuses and sample survey reports should be accompanied by explanations for extreme year-on-year variations in the livestock data series. If the variations are due to changes in survey methods and procedures, then it is important to update the data series by adjusting the data series of the previous years by using methods and procedures applied to the latest year. The key point here is that CSA has to improve livestock data reliability and hence gain confidence of users of the data series.

Livestock productivity measurements

It should be noted that the consultancy study presented in the Behnke reports as well as the taskforce study have not had enough time and resources to undertake a complete and comprehensive assessment of productivity of Ethiopia's livestock. Like the Behnke report, this study relied on ad hoc coefficients to estimate productivity of the livestock population. However, the taskforce study has developed consistent and comprehensive sets of logic to improve measurements of livestock productivity. A major shortcoming of the existing methods employed by MoFED and also implemented in the consultancy study was the inappropriate valuation method. As noted in the report, average prices of live animals are extremely arbitrary since they involve averages over livestock units in different age, sex categories as well as different body conditions. As a result, it is important to follow established FAO methodology in using "carcass weight" and then applying prices of meat per unit of weight (kg or tonnes).

Recommendation 3: In estimating gross value of livestock output, MoFED should follow the animal carcass weight based valuation method, changing from the current practice of applying

average prices of livestock units. Similarly, CSA will need to change valuation of livestock units to weight based methods in generating producer prices and consumer prices for livestock products.

In addition to valuation methods, livestock productivity is affected by the coefficients applied in measuring such key variables as "off-take rates". In livestock weight based productivity measurements, estimated gross values of "off-takes" of different livestock types are determined by the "off-take rates" or the ratio of livestock sold to the corresponding livestock population and the estimated "average carcass weight" of each animal sold. The most important point to take into consideration in revising these coefficients is to check the accuracy of the existing estimates by comparing the coefficients to the actual productivity, on the one hand, and comparing findings from local estimates to international standards. For instance, the "off-take rates" applied to "cattle" in Ethiopia's data in the FAO statistical database, 0.07, is closely to the corresponding figures applied to livestock data in the same database to neighbouring countries in the same level of development – Uganda (0.07) and Sudan (0.09), although Kenya (0.21) is much higher and perhaps rightly so since the livestock sector in that country is more developed than that of Ethiopia or the other countries. However, "carcass weight" applied to each cattle for Ethiopia is considerably lower than the corresponding figures for the other countries – lower by 38% than Ugandan cattle, 11% than Sudan cattle, and 28% than Kenya cattle.

Recommendation 4: CSA and MoFED should conduct a collaborative study to estimate "off-take rates" and "carcass weight per animal" for different livestock units. Revising these estimates is extremely important to update Ethiopia's livestock productivity and make them comparable to other countries. The productivity assessments should aim at updating productivity of most livestock units and their products as displayed in Table 5 the derivation methods discussed in the subsequent sections.

Economic value of manure

The measurement of the economic value of manure has traditionally been confined to dung production, and hence by implication it is limited to "cattle manure". As noted in the Behnke report, this tradition has simply followed the early start of the Ethiopian Energy Authority to estimate the energy role of dung. However, there is no reason to limit the economic value of manure to dung production. It is important to expand the role of manure to its role as fertilizer.

Recommendation 5: MoFED should expand the gross value of manure production by going beyond the role of dung cake as fuel and recognizing the role of manure as fertilizer. To this effect, we recommend the conversion of manure biomass produced to fertilizer equivalent and hence compute the gross value of manure production accordingly.

Rental values of livestock as capital

This study has provided a conceptual framework for studying the role of livestock as capital. However, we have relied on incomplete information to provide the initial estimates of the sizes of the gross value added generated thorough livestock capital in other sectors of the Ethiopian economy.

Recommendation 6: MoFED should revise and reallocate factor payments in the cropping subsector of agriculture and the transport sector to recognize the roles of equines and oxen in generating gross value added in these sectors. In the existing estimates of cropping sector and transport sector GDP figures, the share of livestock capital have been subsumed under the share of "capital", without explicitly and specifically recognising the shares of the livestock capital in aggregate capital. Therefore, MoFED should spit shares of payments for capital services in these sectors into two: livestock capital and other capital. This will leave the sizes of the GDP in those sectors unchanged but it recognises the share of the livestock capital (and hence owners of livestock assets or capital). If this revision is undertaken, then the role of livestock in improving livelihoods will be recognised not only in terms of direct livestock production but also indirectly by generating income to owners of livestock capital.

Recommendation 7: The initial estimates on the sizes of GDP attributable to livestock capital are likely to underestimate the actual role of livestock capital in the Ethiopian economy. For this

reason, CSA, MoA and MoFED should work together in establishing a methodological framework in CSA and MoA census and sampling surveys to more accurately estimate gross value added by the livestock as capital in different sectors of the Ethiopian economy.

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