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Modelling the economic contribution of livestock to households in African countries - what data do we have and what do we still need?

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Abstract

Given the on-going global trend of rising consumption of animal products worldwide, one main question for African economies is the effect of these international nutrition trends on households keeping livestock. The application of existing quantitative analytical models mostly requires the availability of specific data information. However, for some developing economies this data required to perform particular analyses may not always be collected or estimated. This paper screens current features of livestock production systems in African countries and gives hints on how these features can be integrated properly into Computable General Equilibrium (CGE) models. We found some studies already linking certain aspects of livestock production with livestock-dependent households in CGE models. These studies represent an important starting point to assess the importance of livestock holding for households in a CGE framework. Finally, this paper draws on future adjustments to the requirements of CGE models to capture the special characteristics of livestock kept by households in African countries. These methodologies could become crucial for policy studies linking African households with international livestock markets.

Keywords:
Livestock keeping, household analysis, equilibrium analysis

1. Introduction

Market projections anticipate an increase in prices for cereals, meat and dairy products worldwide (FAO, 2011). According to these projections, world demand for agricultural products is expected to grow at 1.1% per year until 2050. Main drivers of such forecasts are expected population growth, increases in per capita consumption and changes in diets leading to the consumption of more livestock products. Given the ongoing global trend of rising consumption of animal products, one main question for African economies is how different farm households will adapt to these ongoing developments. In addition, expected changes in world agricultural production as well as domestic food availability will cause diverse impacts on different household types, thus special attention should be given to the different needs and preferences of rural vs. urban households.

In order to foster evidence-based decision making, one of the main priorities for African countries should be the adoption of existing analytical quantitative tools as instruments to analyze agricultural policy. These instruments could support policy makers, scientists and stake holders in measuring the contribution of agriculture to other economic sectors and to reach goals of poverty- and hunger-reduction. Computable General Equilibrium (CGE) models link the whole economy within a country and in some models a country is linked with the world. Thus, CGE models could be used as analytical instruments to measure the likely contribution of livestock to households, to other economic sectors and to the national economy. However, the application of CGE models requires mostly the availability of specific data information that for some developing economies may not always be available. As only few researchers have used CGE models to analyze effects of livestock on households and on the whole economy (Gelan et al., 2012), this study aims at giving a first insight on the data availability for its further integration into CGEs as possible analytical quantitative tools.

Thus, this paper focuses on the availability of data to analyse linkages between the general situation in Africa for livestock dependent-households and changes in agricultural supply, demand and trade. Available household data is depicted towards requirements for integration in CGE models. We cover data availability on national accounts for CGEs, as with the specific data required to include household dependence on livestock husbandry.

Data considered in this paper as required for its integration into a CGE model has the following characteristics: a) disaggregated information on poor or rural households and their linkages with livestock keeping activities, b) available for several African countries; and c) standardized procedure to collect the data (e.g., standard survey). From the diverse data sets available, data fulfilling the criteria described is provided by the panel approach of the recent Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA). These surveys allow modellers to tackle African-specific issues such as the importance of livestock as transport means or as a credit instrument, given that the questionnaires are adequately adjusted to some needs of macro-level models. Furthermore, a comparative cross-country study could be performed by extracting information from the LSMS-ISA and complementing information with national data from each country.

Some relevant shortcomings in the available datasets to introduce different households into CGE models are as well pointed out in this paper. As an example, CGE require information on the taxes paid for the selling of agricultural products, livestock and livestock products. This data is not available for all agricultural commodities across countries, only for Niger data on taxes paid by the sale of living animals has been found (LDIP,2012). Thus, there is still

information required which is not yet been collected and that would considerably improve the quality of this kind of analyses.

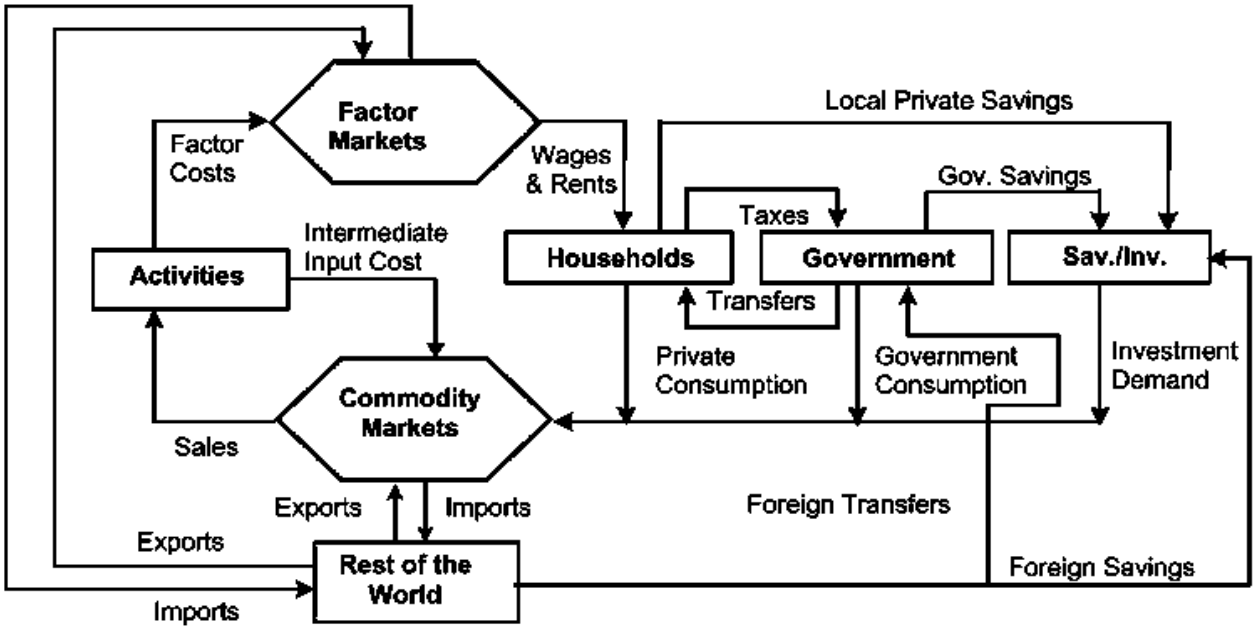
The paper is structured as follows. Section 2 provides a brief description of CGE models, their structure as well as their data requirements. Section 3 describes potential databases useful as input for CGE models. Section 4 gives some hints on possible improvements for the databases. Finally, section 5 draws some conclusions.

2. Data requirements for CGE models

Computable general equilibrium (CGE) models have a data set which contains the values of economic transaction in a closed economy. The CGE data represents the monetary starting point for the economy. CGEs also contain two different set of equations, the first set of equations define the market equilibrium conditions of the model, while the second set of equations defines the economic behavior of single economic activities based on microeconomic theory (e.g., demand of private households). Another element of a CGE model is a set of behavioral parameters (elasticities) that drive the changes in the economic behavior in a closed economy. CGE models are a standard tool of empirical analysis, and are widely used to analyze the distributional impacts of policies whose effects may be transmitted through multiple markets, or contain menus of different tax, subsidy, quota or transfer instruments. In contrast to partial equilibrium (PE) models, CGE models can provide information on the effects observed in other non-agricultural sectors, on government, firms and on all input factors in production. As PE multi-market models focus only on agricultural sectors (Robinson et al., 2014).

A typical CGE model flow is depicted by Figure 1. The base data upon which a CGE model is constructed relies on a static accounting for economic transactions taking place in a specific year (known as base year) and specific to the region of interest.

Figure 1. Circular flow in a typical CGE model



Adapted from Lofgren et al., 2001

A comprehensive dataset for CGE modeling of African economies is provided by the GTAP database. This database contains the Input Output data for 42 regions (32 African regions plus 10 other aggregated regions) and the 57 sectors of the GTAP 8.1 Data Base. Countries are linked to each other by trade flows and specific bilateral policy instruments (e.g., bilateral tariffs). Furthermore the GTAP database has harmonized data on import and export flows across countries and sectors worldwide.

Other kind of data used in CGE modeling is a Social Accounting Matrix (SAM). A SAM is a comprehensive, economy-wide data framework representing the economy of a nation by taking into account the fundamental relationships between all agents in the economy and across all sectors. The SAM is a data matrix of two dimensions containing a series of accounts describing circular flows between producers, factor markets and institutions. Main data sources to build a SAM are I-O tables, national accounts and trade accounts. Data from national surveys and census are needed for the creation of a micro SAM in which activities, commodities and households are disaggregated according to the needs of the study.

2.1. Integrating livestock-dependent households into CGE models

Computable General equilibrium (CGE) modelling may shed light on the effects of exogenous shocks and policies on different sectors of the economy, on production, consumption and trade, on use of production factors like labour and land, their remuneration and on economic agents which are government, households and firms. The base data upon which a CGE model is constructed on relies on a static accounting for economic transactions taking place in a specific year (known as base year) and in a certain region of interest (Dervis et al., 1982). A CGE can analyse both household income and household expenditures. As an example, households receive income from labour in different sectors, but also incomes from land rents and there are governmental transfers such as subsidies, social security, medical assistance etc. (Pyatt and Roe, 1977). On the expenditure side, households consume, pay taxes and save money. Consumption of final goods and services from sectors takes place according to specific consumption preferences. Households also pay taxes to the government and save money for future consumption (or pay credits if expenditures exceeds total income) (Robinson, 2003). However, in most of the standard CGEs households are aggregated into one single agent, which makes it difficult to address impacts across different household types. Livestock keeping contributes to several household livelihood purposes offering nutrition, income generation sources and services provision. Understanding the livestock keeping conditions, the nature and drivers of decision-making by livestock-dependent households are primary requirements to design a suitable link between household analysis and CGE modeling. As empirical example, we address three specific features of livestock-dependent households and present the data requirements to include these issues.

2.2 Production conditions

For livestock production, three inputs are considered as important in a CGE: labor, land and capital. In general labor as an input is the most abundant production input since there are enough household members who can contribute to livestock husbandry. In the case of African livestock-dependent households, labor can substitute and even cope with restrictions on the other two production inputs: capital and land (Coleman G., 1982; Jahnke et al, 1998). In contrast, access to capital is limited due to the low importance of monetary incomes and the relative high importance of subsistence (Pica-Ciamarra et al., 2011). Furthermore, live

animals and livestock products serve as capital assets, the former yielding an interest in the form of milk, eggs, manure, honey, etc. (Jahnke et al, 1998; Randolph et. al., 2007).

With respect to land, there are distinguished features that affect livestock production. Commonly, pastoralists are highly mobile (ILCA, 1990) searching for a good quality of nutrition conditions for the herds such as grasses, shrubs tree leaves and water to assure subsistence. Good nutrients for the herd result in higher milk yields, induce animals putting on weight quicker, be healthier and reproducing faster (de Jode E. ed., 2009). However, mobility has also an opaque aspect, as the animals move; they are more susceptible to contagious diseases (EAC, 2004). In sub-humid zones, which borders on transhumance areas, herders and farmers compete for land use because land tenure follows a common property tenure system. The pressure on land comes from a competition between livestock husbandry and increase in the human population. Clearly this situation limits livestock production due to scarcity of land (Robinson et al, 2011).

Livestock productivity is highly related to an upgraded feed supply for animals at a low cost (Jahnke et al, 1998). As pointed by Randolph et. al., (2007) in the general case, relative prices of feed and livestock products provide insufficient incentives to purchase feed to increase livestock productivity. As result livestock productivity in African countries is relatively lower than productivity in developed countries. Livestock productivity is mainly dependent on the weather and on the quantity and quality of other household production factors (ILRI, 1995). These may include: a) use of surplus labor for bush clearing and erosion control; b) use of animal manure to raise soil fertility (ILRI, 1995).

A description of the data required for the integration of livestock production conditions is presented in Table 1, when possible information should be disaggregated for different livestock species (cattle, sheeps, goats, pigs, etc.) and when requested for different livestock products (eggs, milk, manure, etc.) for each household type. For the differentiation of household certain criteria has to be defined and followed. The household classification is not always straightforward as several arguments tend to overlap. Household classification will depend on the specific research question pursued. As example, a question about the effects of market price transmission on livestock kept by household requires household categorization by geographical distribution taking into account the distance from the household location to the next city. When the research question focuses on the effects of a national policy on different kind of farm systems, household categorization will be determined by the kind of system followed by households (pastoralism, agro-pastoralism, farming, ranching, etc.).

Table 1 Data requirements to include livestock production conditions for different household types into CGEs

CGE data needed	**Criteria**	**Disaggregation**
Household categories	a) Urban/rural b) Pastoralism/ agro-pastoralism/ mixed smallholder farming/ ranching/ commercial farming/ co-operative farming /state farming c) according to geographical distribution (different agro-ecological zones)	
Land	rent prices / imputed prices (in case of pastoralists)	Land used only for livestock keeping
Labour	wages paid to employees (monetary or in kind), imputed value of family labour	Wages or imputed value of labor allocated for livestock keeping and for livestock products
Capital	Monetary value or imputed value	Values disaggregated for livestock keeping and for livestock products

Source: own design

2.3 Economic and nutritional contributions of livestock and livestock product

Livestock can produce important products that contribute to the nutrition and to the income generation of households. Mainly meat, milk, eggs, ghee, honey, hides, skins, manure, animal traction, acredit instrument and transport services are delivered from livestock. In many livestock-dependent households, livestock products are principal components of the diets and income sources (Thomas and Rangnekar, 2004). Livestock-dependent households in areas remote from urban markets and more than half a day's walk from a main road are mainly subsistence-oriented (ILRI, 1995). Namely most of their production is consumed within the households; in case of small surpluses they might be sold or bartered locally. Typically, these households remain unresponsive to price changes at markets. Livestock-dependent households located closer to main roads and urban markets allocate production into subsistence on-household consumption and at local markets. These households tend to have larger herds compared to subsistence livestock-dependent households. Livestock-dependent households located close to (or within) major urban markets allocate small amounts for consumption at home and most of their products are sold at the market (ILRI, 1995). If households have surpluses of livestock products to be sold, transactions can be monetary taking place at markets (for live animals, meat, milk, ghee, eggs, hides, skins and manure). However, there are also non-monetary transactions such as exchanges or gifts, cultural and religious practices, bride wealth, or wage payments in kind e.g. milk, meat and eggs (Jahnke, 1982). These non-monetary transactions can be modeled in a CGE as inter-household transactions using imputed values from other monetary transaction in which the value is known.

Other income sources derived from livestock keeping are manure, the usage of animals as transport, and as farm equipment. Manure is an important source of non-monetary income. In Kenya, three kilograms of dry manure has been estimated to have an imputed value of one liter of milk (Strobel, 2004). Manure is often an important input for maintaining soil fertility,

and so contributes to greater natural capital by increasing crop production for food and income (Wilson et al., 2005, Behnke, 2010).
Finally, larger livestock-dependent household can keep mixed crop-livestock systems. These households use animals as farm equipment, providing traction power for transportation and crop production (Wilson et al., 2005, ILRI, 1995). Several studies have estimated the increase in crop output when using cattle as draught power for the production of annual crops. As summarized by Behnke (2010) for the case of highland farmers in Ethiopia, where net cereal production with one oxen increased by 267kg more than for farmers with no oxen (Behnke, 2010).

Thus, in Table 2, data requirements to a comprehensive integration of linkages between livestock and its products and household nutrition and economy are depicted. This data includes flows which are not typically integrated into a CGE as the contribution of livestock to transport services or the contribution of livestock products to crop production (manure, farm equipment). These linkages have to be also considered in an extension of the modelling framework and of the CGE data set.

Table 2 Data requirements to assess the nutritional and economic contributions of livestock and livestock product to households

CGE data needed	**Criteria**	**Disaggregation**
Livestock and livestock products to household`s own-consumption	own-consumption of livestock products (imputed value)	By livestock type and livestock product type
Livestock and livestock products sales	sales of livestock and livestock products	By livestock type and livestock product type to each destination (other households, slaughter houses, traders, etc)
Use of livestock to other sectors	Contribution to crop production, transportation, services sold to other households (real or imputed value)	livestock type and livestock product type to crops and to services
Livestock exchange or gifts	Imputed value of livestock devoted to cultural and religious practices, bride wealth	To each household type/ commodity/activity (destination)
Livestock products exchange or gifts	Imputed value of livestock products exchanged or given away such as milk, meat and eggs, wage paid in kind	To each household type/ commodity/activity (destination)
Livestock as transport	Sold or used be the own household as transport mean (value or imputed value)	To each household type/ commodity/activity (destination)
Manure	Sold or used in the production of crops (value or imputed value)	To each household type/ commodity/activity (destination)

Source: own design

2.4 Livestock diseases

As mentioned above, the majority of dependent-livestock households in SSA mobilise livestock in search of good quality pasture and water. In the process of these movements, animal diseases are spread. The most common animal diseases are: contagious bovine pleuropneumonia, African swine fever, pasteurellosis, anthrax, blackleg, foot-and-mouth disease (FMD), brucellosis, Newcastle disease etc. These diseases not only affect livestock productivity, but also animal losses reduce household capital. Furthermore, according to

estimations they can kill up to 20% of animal adults and a larger share of young animals (Grace et al., 2008 and Bonnet and Lesnoff, 2009). Although vaccines for these diseases exist, and some of them are produced in Africa, the infrastructure for vaccination programs (Ayantunde et al., 2011 and Tambi et al., 2006). Animal diseases are a major problem for livestock keeping in Africa mainly due to the lack of adequate diagnostic facilities in rural regions and an adequate distribution network for vaccination coverage (Fadiga et al, 2013). The prevalence of livestock diseases is considered as the most limiting constraint in livestock production in SSA, particularly the trans-boundary animal diseases (EAC, 2004). The indigenous animals usually are more resistant to diseases, yet many countries still import exotic breeds aiming at improving meat productivity (Strobel, 2004). An overview of the data required to assess the impact of diseases in a CGE model are presented in Table 3.

Table 3. Data requirements to assess the impact of livestock diseases to households

CGE data needed	**Criteria**	**Disaggregation**
Impact on household income caused by diseases	Reduction on lambing/calving/kidding rate (percent, number of animals per year or imputed value)	by household type/and livestock type
Impact on household income caused by diseases	Increase calf/lamb/pig mortality (percent, number of animals per year or imputed value)	by household type/and livestock type
Impact on livestock products caused by diseases	Reduction of milk production, egg production, manure production (percent, liters per year or imputed value)	By household type, livestock type and livestock product type
Impacts on agriculture and other activities /commodities caused by diseases	Decrease in crop production or provision of services (percent, or imputed value)	By household type, livestock type and livestock product type to crops and to services

Source: own design

3 Available databases

There are several national data sources on livestock in Africa, including livestock censuses, market information systems and disease surveillance reports. These data sources can provide important information on livestock, while data quality may be an issue dependent on the country (LDIP, 2012). The quality and availability of these data is highly dependent on the country, and by definition they only shed light on parts of the livestock sector, so that in principle they cannot deliver all information necessary for GE analyses. Given that quality and content of these data sources significantly vary by country, we do not focus on these data sources but encourage researchers to look for their usefulness.

Other data sources available in most African countries are multi-purpose household surveys that follow the format of the World Bank's Living Standard Measurement Study (LSMS). These surveys are conducted in several African countries under different names, and are representative at the national as well as, usually, at selected sub-regional level. They include information on agricultural production as well as on socioeconomic characteristics, such as household expenditures, consumption, wages, and agricultural sales. It has however to be considered that these survey sometimes do not contain all types of households or areas, and that they have to be stratified so that national representativeness is also warranted for farm

households[1]. The LSMS-type surveys therefore provide rich data for the calculation of parameters necessary in CGE analyses. The former LSMS-type surveys however included relatively few data on livestock. For instance, data on production cost was not or only very imprecisely collected. The recent LSMS – Integrated Surveys on Agriculture (LSMS-ISA) format provides a much more comprehensive set of questions about agriculture, including livestock[2]. LSMS-ISA surveys are the first set of data delivering nationally representative household data in Africa adequate for panel data analysis. They therefore allow capturing household linkages with livestock markets on the income and expenditure side and long-term developments of herd dynamics. The LSMS-ISA format was first applied 2008-9 in Tanzania, and it has been used in six African countries so far. The following sub-sections indicate to what extent these data sources can deliver the information needed for CGEs.

3.1 Production conditions

The LSMS-type household surveys typically allow disaggregation between urban and rural households, as well as geographic regions. If countries range over different ecological zones, these are also often surveyed[3]. Since these surveys capture crop and livestock activities of a household, it is possible to distinguish different production systems such as pastoralist and mixed-systems. Subsistence farmers can also be distinguished from commercial farmers, and many surveys also indicate whether farmers are organized in co-operatives.

The CGE-relevant variables that identify the amount and value of land, labor and capital allocated to livestock farming are listed in Table 4.

Table 4. Variables indicating livestock production conditions

Data required	Description	Country	Unit and Disaggregation
Land			
Land for livestock	Area of land used for livestock	Ethiopia	Acres
	Plots used for pasture	Malawi Uganda	Acres
	Fallow area used for grazing (for own and other households' animals)	Niger	Acres
Fodder land	Area of land that provides feed for animals	Ethiopia Niger	Acres
Land rent	Payment for renting land	Ethiopia Malawi Nigeria Tanzania Uganda	Value
Transhumance	Movement of the herd during the dry season	Niger	No. by livestock type, destination

[1] For example, the Ethiopian ERSS survey only includes households in rural areas and small cities, and does not contain nomadic production systems due to high costs of data collection in those remote pastoralist areas. Large farms responsible for high amounts of livestock production may not fall into the sample drawn. These problems may make the use of additional surveys necessary to complement the analysis.

[2] The livestock module in these types of survey was developed together with researchers of the Livestock Data Innovation in Africa initiative.

[3] In general modern LSMS-ISA questionnaires also include GPS coordinates, which allows geographic and ecological classification even if this is not directly stated in the questionnaire.

Labour			
Livestock labour cost	Total cost of hired labour for livestock keeping	Ethiopia Malawi Nigeria Tanzania Uganda	Value by livestock type Value Value Value by livestock type Value
	Days of non-family labour for livestock keeping and their payment per day	Niger	Value by livestock type, local/exotic breeds
Livestock family labour	Family member avg. hours per day for maintenance of livestock	Niger	Hours by livestock type, sex, local/exotic breeds
	Family member hours per day worked on pasture plot	Malawi	Hours/day by work task on plot
	Family members doing livestock activities (max. 2)	Tanzania	No. of persons by work task
Livestock non-labour input cost	Cost of non-labour inputs for livestock keeping	Ethiopia Malawi Niger Nigeria Tanzania Uganda	Value by livestock type Value by input type Value by livestock type, input type Value by input type Value by livestock type (only feed) Value by livestock type, local/exotic breed, input type
Livestock kept for work tasks	Number of livestock held for specific work tasks	Ethiopia Niger Uganda	No. by livestock type (only transportation) No. by livestock type, local/exotic breed, transportation/fieldwork (binomial answer(y/n) by livestock type, transportation/fieldwork)
	Number of oxen for ploughing	Ethiopia	No. of oxen
Capital			
Livestock number	Total number of livestock kept	Ethiopia Malawi Niger Nigeria Tanzania Uganda	No. by livestock type, sex No. by livestock type, sex No. by livestock type, sex, local/exotic breed, ownership (own, other hh's) No. by livestock type, sex No. by livestock type, sex, local/exotic breed No. by livestock type, sex, local/exotic breed
Livestock purchase value	Total value of livestock bought	Malawi Niger Nigeria Tanzania Uganda	Value by livestock type, sex Value by livestock type, sex, local/exotic breed, main seller Value by livestock type, sex, main source Value by livestock type, sex Value by livestock type, sex, local/exotic breed
Product input cost	Total cost of production of livestock products	Ethiopia Malawi Tanzania	Value by livestock product Value by livestock product Value by livestock product

Source: own design. Notes: Screened datasets include the latest LSMS panel household surveys in Ethiopia (2011/12), Malawi (2010/11), Niger (2010/11), Nigeria (2012/13), Tanzania (2010/11), and Uganda (2011/12).

3.2 Nutritional and economic contributions of livestock and livestock product

Information required on the benefits raised from livestock keeping either for own-consumption, sales of livestock and livestock products as well as the gifts and exchanges for most of the countries is available. Information required is presented in Table 5. Information can be found almost for all countries (Ethiopia, Malawi, Niger, Nigeria, Tanzania and Uganda). As it can be seen in column "Disaggregation" of Table 5, the kind of information available varies across countries.

Table 5. Variables indicating the economic contribution of livestock

Variable	Description	Country	Disaggregation
Own consumption			
Production for own consumption	Quantity of livestock products consumed that came from own-production	Ethiopia Malawi Niger Tanzania Uganda	Kg/litre/No. by product type Kg/litre/other by product type Kg/litre/other by product type Kg/litre/pieces by product type Litres (only milk)
Sales			
Livestock sales value	Total revenue received from selling livestock	Malawi Niger Nigeria Tanzania Uganda	Value by livestock type, sex Value by livestock type, sex, local/exotic breed, Value by livestock type, sex, Value by livestock type, sex Value by livestock type, sex, local/exotic breed
Products sold	Quantity of livestock products sold	Ethiopia Malawi Niger Nigeria Tanzania Uganda	Kg/litre/No. by product type Kg/litre/other by product type Kg/litre/pieces by product type, main outlet Kg/litre/other by product type Kg/litre/pieces by product type Kg/litre/No. by product type
Products produced	Quantity of livestock products produced	Ethiopia Malawi Niger Nigeria Tanzania Uganda	Kg/litre/No. by product type Kg/litre/other by product type Kg/litre/other by product type Kg/litre/other by product type Kg/litre/pieces by product type Kg/litre/No. by product type
Product revenue	Value of selling livestock products	Ethiopia Malawi Niger Nigeria Tanzania Uganda	Value by product type Value by product type Value by product type Kg/litre/other by product type Value by product type Value by product type
Manure sold	Quantity of dung sold	Malawi Tanzania	Kg/litre/other Kg/litre
Manure revenue	Value of selling dung	Malawi Niger Tanzania Uganda	Value Value Value Value by livestock type, local/exotic breed

Use of livestock and livestock products in other sectors			
Draught and transport service revenue	Earnings of the household through provision of livestock transport or draught services to other households	Niger Tanzania Uganda	Value by livestock type, local/exotic breed Value by main outlet area (max. 2) Value by local/exotic cattle breed, by work task
Price of offered draught/transport service	Computable with No. of times services were sold and Total value of services	Tanzania	Unit value by main outlet area (max. 2)
Work animal usage for traction	days	Nigeria	Days by plot, own/rented animals
Work animal rent	Cost of renting work animal for traction	Nigeria	Cost (either stated per time or land unit) by plot
Manure own usage	Quantity of produced dung for own usage	Ethiopia Niger Nigeria Uganda	(binomial answer(y/n) manure used by plot) Sack/heap/other by plot (only manure for crop production) Kg by plot (only stated if manure is main fertilizer) binomial answer(y/n) dung by usage, livestock type)
Gifts and or exchanges			
Products given away	Quantity of livestock products given away as gifts and/or in exchange for goods and services	Malawi Niger	Kg/litres/other by product type (aggregated with reimbursements) Kg/litres/other by product type, gift/exchange
Livestock given away	Number of livestock given away as gift and/or in exchange for goods and services	Ethiopia Malawi Niger Nigeria Uganda	No. by livestock type, sex No. by livestock type, sex (gifts & payments aggregated) No. by livestock type, sex, local/exotic breed No. by livestock type, sex, gift/exchange No. by livestock type, sex, local/exotic breed (gifts & payments aggregated)

Source: own design. Notes: Screened datasets include the latest LSMS panel household surveys in Ethiopia (2011/12), Malawi (2010/11), Niger (2010/11), Nigeria (2012/13), Tanzania (2010/11), and Uganda (2011/12).

3.3 Livestock diseases

As can be seen in table 6, in most of the analysed countries the effects of livestock diseases are captured as the number of lost animals. Only Tanzania also surveys the value of those losses, which might be important given that valuing the lost animals with market prices might severely misestimate the value of losses (e.g. those livestock lost may be the weakest, with lesser value than the average traded animals).
Niger and Nigeria also survey other external circumstances that led to losses of animals.

Table 6. Variables indicating impacts on households caused by livestock diseases

Variable	Description	Country	Disaggregation
Affected animals	Number of animals affected by diseases	Ethiopia Nigeria	No. by livestock type, sex No. by livestock type, sex, type of disease
Losses through diseases	Number of animals lost to diseases	Ethiopia Malawi Niger Tanzania Uganda	No. by livestock type, sex No. by livestock type, disease No. by livestock type, local/exotic breed No. by livestock type No. by livestock type, local/exotic breed
Disease costs	Value of the animals lost	Tanzania	Value by livestock type

Source: own design. Notes: Screened datasets include the latest LSMS panel household surveys in Ethiopia (2011/12), Malawi (2010/11), Niger (2010/11), Nigeria (2012/13), Tanzania (2010/11), and Uganda (2011/12).

4 What can be modelled?

An important component required for the extension of a CGE to cover different household types is the availability of national household surveys for the inclusion of specific household preferences and decision-making structures. The quality of the household data is an important factor which defines the kind of linkage that can be constructed between the CGE model and households (Thurlow and Wobst, 2003). As shown in Section 3, available databases in SSA countries comprise detailed information on the livestock economy, which may be used in CGE models. A significant share of data needed for implementation of different household types and categories has already been compiled and is suitable for an adequate representation for simulating of a broad variety of policies; however still data is missing.

Production conditions: In general, there are enough data describing the conditions of inputs used for keeping livestock and processing livestock products. Data on land used for keeping livestock found for Ethiopia, Malawi, Uganda and Niger gives the possibility to model areas used, their prices as well as the value of renting land. Furthermore, data on labour engaged in livestock activities can be used to depict the differences between hired labour and family labour for Malawi, Tanzania and Niger. For Niger the information describes even whether the differences of labour engaged in local or exotic breeds, thus, a comparison of differences between keeping local and exotic breeding is possible. However data for livestock products is scarce and less detailed than data for livestock keeping for all countries. Even though there is information on transhumance for Niger, there is no information addressing the benefits of transhumance vs. sedentary farming and thus, a possible study on the benefits/loses of transhumance cannot be assess (e.g., the increase in output of livestock products obtained

from animals grazing in different regions in comparison of output from animals under sedentary production patterns).

Economic and nutritional contributions of livestock and livestock products: Differentiation between own-farm use and sales for different livestock product types are well represented in the data for Ethiopia, Malawi, Niger, Tanzania and Uganda. Thus, for this set of countries, trade-off between self-consumption and production for sales can be assessed in a CGE framework. Furthermore, information on the link of livestock with other sectors such as the usage of animals as draught in fields and as transport means is only available for Niger, Nigeria, Tanzania and Uganda.
Therefore, regarding the economic importance of livestock keeping for households, a sizeable CGE analysis with the available data could be performed for Niger, Tanzania and Uganda; lack on data of the main destination for the sales is missing for all countries.

Diseases: The value of animals lost due to diseases is directly found for Tanzania, while for Ethiopia, Malawi, Niger and Uganda it might be calculated with the value of animals and the number of animal lost. Furthermore, given the available analysis in the case of Malawi, the analysis could be centered on the effects of particular diseases on the household economics. For Niger and Uganda, the analysis could center on the susceptibility of local vs. exotic animals and their effects on the households, as the information available allows for this differentiation. The effects of weakened animals on productivity, e.g. through a reduced birth rate or milk production, is not directly surveyed. In many surveys such an effect could however be estimated, for example with regression techniques.

As shown, there is available and detailed information on the livestock effects on African households for some countries, which may be used in CGE models; however, several points may call for improvement. Although a significant share of data needed for implementation of different household types have already been compiled and are suitable for an adequate representation in simulations of a broad variety of policies, distinct data is still missing. In this respect, especially the harmonization across countries required for a cross-country study is lacking. For example, when the “livestock main buyer” is addressed, available options allow for a mix up selling points (border market, local market) and agents (butcher) without quantification or weighting. Thus, to achieve certain accuracy it is necessary to specify the same units across households and countries.

Moreover, the distribution in the use of inputs and production factors across different livestock products (and household types) are commonly missing data. A disaggregation of sales, purchases and gifts by the sources and destinations in terms of value and quantities would be extremely valuable, but is lacking for both livestock and its produce. Furthermore, a lack of detailed information on subsidies and taxes limits the applicability of macroeconomic models for policy simulations. For example, the databases found provide some information on the amount of aid received by household either donated from government, NGOs or other international donors, but no information is collected on how much of these subsidies households specifically spend on livestock and livestock products.

5 Conclusions

Livestock and livestock products are an important source of protein in African countries, furthermore, households keeping livestock benefit from a wide range of livestock products which can be consumed, sold or utilized to substitute energy, labor, or capital. Depending on climatic conditions, cultural customs, economic status etc., households can face different keeping conditions and thus react differently to same national economic changes. Therefore, a suitable policy analysis applying CGE models extended with household data may be a helpful instrument to analyze policy changes will affect those groups very differently. These models can be used as a methodological instrument to evaluate the effects of changes in agricultural policy on livestock as one main component of household income in African countries and on the household economic patterns as well. In this paper as an empirical example we focus on data available from multi-purpose household surveys to extend CGE models to assess: livestock production conditions, economic contribution of livestock keeping to households and the impact of livestock diseases on household economics.

Our investigation shows that available information is country-dependent. The extension of a CGE model to analyze the effects of livestock keeping requires in first place the implementation of livestock production conditions by household type. For this purpose, we found data covering most of the production aspects only for three countries: Malawi, Tanzania and Niger, and with some model constrains for Ethiopia, Nigeria and Uganda. Furthermore, if policy makers want to evaluate effects that diseases have on the households, it is not only required to integrate the production conditions, but also the impact of diseases on livestock. Information on animals lost by diseases is available only for Ethiopia, Malawi, Niger, Tanzania and Uganda. In the case of Malawi, it could be possible to analyze the impacts by diseases, as the number of animal lost by disease has been collected. For Niger and Uganda a differentiation between local and exotic breeds is possible as the information is available in this format. Thus policy makers could distinguish between the impact of diseases on local vs. exotic breeds or the economic impact that single diseases might have in Malawi and thus strategically target specific diseases.

Other issue which has been repeatedly mentioned as crucial for policy makers in Africa is the usage of livestock in other household activities such as capital source, draught power, manure provider, transport mean etc. Suitable data to cover the usage of livestock into other sectors has been collected for Malawi, Tanzania and Niger. Thus, specific studies on the multi-purpose and advantages of livestock keeping and the spill-over into other sectors could only be performed for Tanzania and Niger, as for Malawi all the required information on production conditions is not available.

Our main finding was the availability of a broad scope of data from Niger. Most of the data required according to the criteria we defined was found only for Niger. Considering that livestock represents the main source of subsistence for most of households in Niger, the usage of a CGE including a detail modeling of livestock and their inter-linkages with households could be an important policy instrument.

In this paper we provide empirical examples of only three household characteristics. However, other aspects such as price transmission across the value chain, marketing of livestock and livestock products have not been addressed. According to the current findings, probably information required to assess these aspects might not be found for all countries in the same scope.

In conclusion, the databases found represent an important starting point to assess the importance of livestock holding for households in a CGE framework. With some improvements these databases could become a crucial data source for policy studies linking African households with international markets.

6 References

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