

Technical Conversion Factors for Agricultural Statistics: Sank into Oblivion? The Case of Tanzania Livestock Statistics

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Abstract

There are three major sources of data for agricultural statistics in the developing world: censuses, sample surveys and administrative data. In censuses and sample surveys, agricultural data are regularly collected through interviews; in the case of administrative data, agricultural data are collected through records of day to day operations. However, for many variables good quality agricultural statistics can only be generated when reliable and updated technical conversion factors or technical coefficients are available, which convert a calculated statistics to a different unit of measure. Examples are extraction rates, which convert agricultural primary products in processed products (e.g. flour from wheat), and dressed carcass weight, which converts the weight of a slaughtered animal into edible meat. Technical conversion factors can rarely be calculated with statistical precision using agricultural census / survey data and administrative records – particularly in developing countries where self-consumption is common and the informal economy large – and some direct measurement is needed. However, investments to improve agricultural data and statistics have been primarily focusing on improving the quality of data from surveys and administrative records, with little attention given to technical conversion factors. This paper makes the case for investing resources for regularly updating agricultural technical conversion factors, taking Tanzania livestock as a case in point. It provides rationales for maintaining reliable and updated livestock technical conversion factors and shows that estimates of livestock value added in the Tanzania National Accounts over the period 2001-2011 are based on constant technical coefficients, i.e. increases in livestock productivity are not reflected in official country statistics. It then presents some methodologies implemented to estimate key livestock technical conversion factors, which lead to improved GDP estimation. It recommends that resources be allocated to regularly update livestock technical conversion factors.

Keywords: livestock, Tanzania, technical coefficients

1. Introduction

Increases in agricultural productivity, including in livestock, are essential for economic growth and poverty reduction in much of the developing world. Livestock productivity relates inputs to outputs. Partial livestock productivity is the amount of output produced by one unit of a given factor of production over a reference period, e.g. labour productivity could be calculated as litres of milk produced/hours of labour devoted to milking per cow per day; feed productivity could be computed as kg weight gain/kg of dry matter fed to the animal over a stated period of time. Total factor or multi-factor livestock productivity measures output(s) (e.g. milk, manure, transport services; etc.) per unit of a set of factors of production (e.g. animal stock, feed, water, etc.) and gives a single overall measure of productivity. Total factor productivity is calculated using indices of outputs and inputs (e.g. the weighted sum) or by some econometric technique that links output(s) to a set of inputs. Both partial and total livestock productivity measures are either based on the physical quantities of inputs and outputs (primal measures of productivity) or on price, profit and cost information (dual measures of productivity) (Chambers, 1988).

The quality of any livestock productivity measure strongly depends on the quality of the data available to measure inputs and outputs. Data quality is typically high in research

institutions or stations mandated to undertake scientific studies. It is relatively good when *ad hoc* data collection activities are undertaken for some investment purpose, such as for implementing a time-bound project in a given geographical area. It is less good, and often poor, when nationally representative livestock statistics or indicators are to be generated: limited financial and human resources devoted to data collection; limited focus on livestock in most surveys, i.e. lack of livestock data; sampling errors; non-sampling errors (e.g. improper survey livestock question formulation); low frequency of livestock data collection, all make it difficult to generate good quality livestock productivity measures. The consequences of mismeasuring livestock productivity can be serious. Firstly, the Ministry responsible for livestock development becomes unable to fully assess the returns to sector policies, including investments on the ground, which could lead to a biased allocation of Ministerial resources. Secondly, livestock value added or the contribution of livestock to the Gross Domestic Product is unappreciated, which again could result in a less-than-optimal allocation of central government resources.

This paper presents some methodologies towards improved estimation of livestock productivity indicators at country level. The focus is on the enumerator of productivity measures, i.e. on the level of production, and in particular on the so-called livestock technical conversion factors, which convert a measured livestock parameter to a different unit of measure: for example, 'milk yield per cow per day' allows estimating the level of milk production by only counting the number of milking cows over a given period / area. The next section briefly reviews methods and challenges to collect data on livestock production to generate nationally representative statistics; section three introduces livestock technical conversion factors and their role to arrive at good quality livestock statistics; section four presents some low-cost methodologies to collect data to estimate selected livestock technical conversion factors, which have been recently applied by the Tanzania government. Section five presents conclusions.

2. Challenges in collecting livestock data on livestock production

Two main actors regularly collect livestock-related data in developing countries, including the National Statistical Institute and the Ministry responsible for animal resources. They make use of four major survey instruments to collect data to generate statistics on livestock production (LDIP, 2012):

- The agricultural census and, in some cases, the livestock census. These collate, process and disseminate data on a complete enumeration basis on a limited range of structural items of agriculture, which change relatively slowly over time. In some circumstances the agricultural/livestock census collects data on livestock production, more often on milk and egg production.
- Agricultural sample surveys, including specialized livestock sample surveys, provide governments with comprehensive data on the livestock sector, which supplement census information. These surveys usually collect data on production level of all major livestock products.
- Living standard measurement studies (LSMS) are multi-topic household surveys that aim to measure poverty and well-being and understand their major determinants. They collect data on livestock production, an important contributor of household livelihoods in developing countries.
- Administrative record data, also referred to as routine data, are regularly collected by national governments with the objective of planning, implementing and monitoring the delivery of public services. They often include data on livestock production level, including of all major livestock products.

Whatever the survey instrument, there are two main methodologies of data collection. The first consists of direct interviews, whereby an enumerator visits the (farm) household or some other stakeholder and asks him/her detailed questions on some livestock production variables. The second consists of visual observations, whereby some actor, such as an extension officer or a market agent, observe (in a more or less structured way) production related variables and fill a data spreadsheet (MLFD, 2012). Assuming that no actor has incentives to misreport, direct interviews and visual observations are appropriate to capture with statistical precision information on categorical variables which are slowly moving, such as the number of large and small ruminants owned by a household or available water sources. To a certain extent, they are also good at capturing, although with less accuracy, information on variables for which the respondent is likely to have some but not full knowledge / memory, such as the number of animals affected by a certain type of disease over the past 12 months or the amount of resources spent to treat sick animals over the reference period. Direct interviews and visual observations, however, are not the first best methods to collect data on variables which are difficult to measure: these are typically continuous variables with relatively high variability, and whose value also depends on factors that are not under the control of the household, such as rainfall. Cases in point are livestock production variables, such meat, manure and milk production. In these circumstances, technical conversion factors are often used or should be used to produce statistically robust livestock production indicators.

3. Livestock technical conversion factors

Technical conversion factors are coefficients that convert a measured quantity to a different unit of measure. Examples of livestock technical conversion factors are:

- ‘Meat per slaughtered animal’, which allows calculating total meat production when multiplied by the number of animals slaughtered over a certain period in a certain area.
- ‘Off take rate’, which allows arriving at an estimation of the number of animals slaughtered from data on the total livestock population over the reference period.
- ‘Milk production per cow/day’, which allows estimating the level of milk production by counting the number of milking cows over a given period / area.
- ‘Dung per adult cattle’, which allows the calculation of level of production for one of the major by-products from large ruminants, manure, by counting the adult cattle population over the reference period.
- ‘Eggs per hen’; ‘dry matter intake/day per animal’; ‘weight gain per kg of dry matter intake’; etc. are other technical conversion factors which, if available, are useful to generate nationally representative production and productivity statistics for the livestock sector.

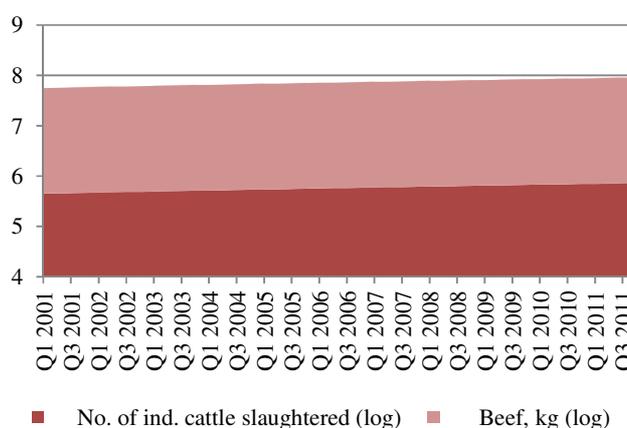
In order to measure level of production of livestock products and by-products, three different levels of technical conversion factors are typically used. First level technical conversion factors allow calculating the amount of meat, offals, fat and fresh hides from every slaughtered animal; or the amount of manure and milk from every animal/milking animal. Second level technical conversion factors are used to decompose, say, meat in boneless fresh, butcher fat, salted meat, sausage, and other. At the third level, technical coefficients are used to convert, say, cattle butcher fat into animal oil, tallow and other (FAO, 2000).

In developing country context, where self-consumption of livestock products is common and processing limited, first level technical conversion factors are of foremost importance and widely used to generate national livestock statistics. For example, in the Tanzania National Accounts, beef production is calculated by multiplying the total number of beef cattle slaughtered by 125, which is the technical conversion factor used to convert beef

carcasses into kg of meat. The ‘meat conversion factors’ for goats, pigs and indigenous chickens are 12, 45 and 2 kilos respectively; as for cow milk, the technical coefficient used is 1 litre of fresh milk/day per cow. The problem with Tanzania, and with most developing countries, is that the adopted technical conversion factors are often obsolete; calculated using data from non-representative or biased samples; taken from neighbouring countries; and/or rarely updated. The consequences for decision makers can be serious, as figure 1 below shows.

Figure 1 depicts the number of beef cattle slaughtered and the volume of beef production in Tanzania from first quarter 2001 to fourth quarter 2011, as reported in the National Accounts. Note that the slope of the two curves, and hence the distance between them, is constant over the reference period. This is so as, for the entire period, a constant technical conversion factor has been attached to carcasses to estimate beef production. The implication is that increases in production are all accounted for by the increased number of animals slaughtered, and that likely improvements in animal productivity – which are in part reflected in the value of livestock technical conversion factors – are not captured in official statistics, which thus mismeasure the contribution of livestock to the gross domestic product. From another perspective, all policies and investments implemented by the Ministry responsible for animal resources aimed to increase beef cattle productivity, such as wider vaccination coverage and better feeding, are unappreciated in official statistics. And the latter influence the way public resources are allocated across sectors and between Ministries.

Fig 1. Cattle beef slaughtered and beef production in Tanzania, 2001-2011



Source: Tanzania National Bureau of Statistics, unpublished data

4. Calculating livestock technical conversion factors

Updated livestock technical conversion factors are of paramount importance for ensuring an efficient allocation of public resources. As said, however, the data needed to calculate livestock technical conversion factors cannot be obtained with statistical precision through surveys or visual observation, and some direct, physical measurement is recommended. This can occur at different points along the value chains but, for the purpose of calculating first level technical conversion factors, two are the appropriate sampling units:

- Farms, or households keeping livestock;
- Abattoirs and / or slaughterhouses.

At the farm level, data to calculate the following key conversion factors can be collected as follows (MLFD, 2012):

- Milk production/day per milking animal

Graduated transparent high-quality plastic containers can be provided to farmers, who are then required to take record of milk production at each milking, usually in the morning and the evening. Farmers are also to be given a record card. This is a standard methodology to estimate (partial) milk productivity.

- Manure production/day per large and small ruminants
There are three methodologies available to measure daily manure production from large and small ruminants. The first consists of attaching a faecal bag to the animal and weighing the collected faeces at the end of the day. This method has been used in research stations and mainly in stall-fed system; in traditional systems, however, it is likely to influence animal 'behaviour' and hence to generate biased results. The second method consists of weighing for a few days the faeces of some animal and then asking the farmers to count the number of times that the sampled animals defecate each day. The third method, which is the most labour-intensive, consists of following a sample of animals for a number of days and weighing their faeces as they defecate. The latter is possibly the most accurate method to quantify manure production per animal/day in traditional production systems, even though it is quite labour intensive.
- Eggs/laying bird per clutching period
A simple record card can be given to farmers to record the number of eggs produced by each laying bird, provided that she is in her clutching period. This methodology is straightforward, but farmers need also to provide information on the length of the clutching period, a pre-condition to arrive at quarterly / annual estimates of egg production.

In abattoirs, slaughterhouses, data to calculate the following technical conversion factors can be collected:

- Live weight and carcass weight of slaughtered animals; and meat, offals and fat content of carcass.
There exist tools, equipment – such as scales and carcass weighers - that slaughterhouses use to measure live weight, carcass weight and the meat, offals and fat content of the carcass. Many slaughterhouse / abattoirs are already equipped with effective measurement tools and, in these premises, slaughterhouse managers should be easily able to record, if required, selected production parameters on a daily basis.

The proposed methodologies are not complex, but their implementation is challenging. Firstly, to be meaningful for statistical, policy and investment purposes, technical conversion factors should be representative for the country as a whole and, possibly, for its major agro-ecological zones. In addition, seasonality should be captured. This has implication for both the sample size and the time length of data collection (Thomson, 2012). Secondly, farmers in particular, but also abattoir / slaughterhouse managers, should be trained to properly collect the data needed to estimate livestock technical conversion factors, as well as provided with equipment/tools for measuring and recording production parameters, such as a graduated plastic containers for quantifying milk production. Thirdly, some incentives should be given to farmers and slaughterhouse/abattoir managers for proper data collection. As a general rule, cash incentives should be avoided, as they may jeopardize future data collection activities, and in-kind incentives are to be preferred. At the farm level, these should possibly target livestock production (e.g. balanced/supplemental feed for animals) and be provided at the end of the data collection exercise to avoid biased results. Basic equipment such as disinfectants, raincoats, knives and boots are appropriate incentives to ensure good data collection in slaughterhouses abattoirs. Finally, while one-off investments to update livestock conversion factors are valuable, country governments should make all efforts to ensure that livestock technical coefficients be regularly updated, a pre-condition for the efficient allocation of public resources.

Updated technical conversion factors also reduce the need to collect data on livestock production through surveys or administrative records, thereby reducing the financial and human resources needed for implementing agricultural/livestock surveys and routine data collection (administrative records).

5. Conclusions

Measuring livestock productivity, and understanding its determinants, is essential to design and implement investments that maximise the contribution of livestock to socio-economic development. Productivity relates inputs to outputs, and the quality of productivity measures strongly depends on the quality of the data available to measure them. These data, when it comes to produce nationally representative statistics, are often of poor quality.

Traditional methods of livestock data collection, including direct interviews and visual observation used in surveys and administrative records, are not the first best methods to collect data on variables which are continuous and difficult to measure in low-income settings, such as meat, milk and manure production. In these circumstances, technical conversion factors are often used or should be used to produce accurate nationally representative statistics. These are coefficients that convert a measured livestock variable to a different unit of measure: for example, 'milk yield per cow per day' allows estimating the level of milk production (enumerator) by only counting the number of milking cows over a given period / area. Technical conversion factors are best calculated by physically measuring the value of selected parameters at different points along the value chains, but in most countries the value of technical coefficients is obsolete or sourced from inappropriate datasets.

This paper presented methods to collect data to calculate key livestock technical conversion factors, namely milk production/day per milking animal; manure production/day per large and small ruminants; and eggs/laying bird per clutching period at the farm level; and to collect data to quantify live weight and carcass weight of slaughtered animals; and meat, offals and fat content of carcass in slaughterhouses and abattoirs. The proposed methods are straightforward, but appropriate sampling, incentives and institutional arrangements are needed for proper data collection and the ensuing calculation of technical conversion factors. Livestock technical coefficients should be updated regularly to properly measure livestock production and productivity. This allows to assess the effects of policies and programmes on the ground as well as to properly estimate livestock value added, i.e. the contribution of livestock to GDP, which both influence the way public resources are allocated for livestock developmental purposes.

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