# Measurement and collection of FBS source data

FBS constitute an integrated dataset. They combine and need to reconcile data from a variety of sources, which poses challenges but also offers benefits. A main advantage is that FBS provide a full picture of the food and agricultural economy of the country spanning over different domains comprising agricultural production, international trade, nutrition, and over the various subsectors of food and agriculture, namely crops and livestock as well as fisheries. Coherently collating production, trade and various forms of food utilization allows users of FBS information to derive a multitude of different indicators, not only overall supplies of nutrients but also indicators such as import dependency or self-sufficiency ratios. FBSs also provide a framework to check and eventually ensure data consistency. By aligning data from different sources, FBSs need to ensure coherence across domains. As each single set of data is confronted with evidence from other sources, FBSs can help identifying problems in the compilation of the source data and thereby contribute to enhanced accuracy. The coherence achieved within the FBS can come at the cost of potential incoherence between the FBS and the underlying source data. Explaining the reasons for these incoherencies is important for maintaining credibility and may sometimes constitute a challenge.

Compiling complete FBS requires a considerable amount of data. Ideally, these are collected from reliable sources, based on solid measurement methods and grounded in concepts and definitions compliant with international standards. FBS compilers should use imputed or estimated data only when measured data are not available. National statistical systems around the world have disparate capacities in collecting and measuring the required source data, usually reflecting the different strengths of the national agricultural statistical systems[[1]](#footnote-1).

Providing primary data on losses, stock changes and food appears to be particularly difficult for the national statistical systems in all parts of the world (see Table 1). For instance, the FAO Statistics Division has only been able to collect from government agencies about 1% of the required data for these variables. For other forms of utilization, such as feed and seed, the availability of official data is slightly higher. provides an overview of data availability by region and variable. Obtaining official data is much less difficult for agricultural production, imports and exports, as systems for compilation of these variables are usually in place, among other purposes for the production of the national accounts. This means that the supply part of the FBS can generally be compiled with data of higher quality than the utilization side[[2]](#footnote-2). The availability of data from official sources is particularly low in Asia and Oceania as well as in Africa.

Table 1: Proportion of data for FBS compilation collected from official sources, 2011-2013, in percent

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Production | Imports | Stock  changes | Exports | Feed | Seed | Losses | Food |
| Developed countries | 54.8 | 77.4 | 0.4 | 72.5 | 5.5 | 15.5 | 1.6 | 0.4 |
| Africa | 27.1 | 41.8 | 0.3 | 35.1 | 2.3 | 3.2 | 0.2 | 0.0 |
| Latin America & Caribbean | 40.5 | 45.6 | 3.4 | 44.2 | 2.6 | 4.7 | 1.2 | 0.3 |
| Asia & Oceania | 37.8 | 54.7 | 0.0 | 48.2 | 1.1 | 1.3 | 0.1 | 0.0 |
| *World* | *39.0* | *54.9* | *0.8* | *51.5* | *3.3* | *5.9* | *0.8* | *0.1* |

Coverage: all data cells for primary products, excluding fishery, with valid non-zero values. Source: FAOSTAT internal working system, extracted on 14 August 2015.

### Data collection for FBS compilation

The first step in setting up an FBS compilation system should take stock and review the quality of possible data sources. Based on the initial review, data gaps can be identified and a needs assessment for additional data collection efforts can be conducted. The data gaps can then be reviewed against available data collection methods, including new, cost efficient methods available through the GS, and should involve both public and private sources. Provisions should be made to enable efficient transfer of data. Ideally, all data will be transferred electronically on the basis of standard templates.

In a second step, an institutional mechanism to sustainably compile FBS should be identified. Such a mechanism could be facilitated through a national working group as a governing body of the FBS compilation process, in which the main data providers, from both the public and the private sector, are represented. The working group can coordinate the entire FBS production process. In the design phase, it will serve as a forum to discuss the commodity coverage, the concepts and methods to be applied, and the development of the infrastructure of the data exchange. During the production phase, the working group may jointly validate all data provided by its members and review the compiled FBS before dissemination. The working group should also pursue the standardization of data formats and concepts and suggest new ways for filling data gaps.

In the following, the most common, in some cases recommended, sources of data and methods for their measurement and collection are reviewed, separately for the main variables included in the FBS.

## Production estimates

### Data sources and collection

There are several sources of reliable information about agricultural production in a given country. Regular and representative production surveys are the tried and tested vehicle to collect and improve information about crop and livestock production. To ease the relevant data collection processes and, importantly, to lower their costs, the Global Strategy to improve Rural and Agricultural Statistics has proposed a number of innovations for survey design and sampling frames, which should enable also poorer developing countries to embark on regular and cost-efficient surveys. For instance, the GS has identified possibilities to enhance the accuracy of the estimates and lower data collection costs at the same time, e.g. by combining different sampling frames into a multiple-frame sampling exercise (Vogel 2015). Some countries already apply a two-stage sampling design, mostly with cluster-sampling, where the administrative areas or geographic territories are usually used as primary sampling units.

In addition to regular surveys, useful FBS information (e.g. number and type of animals) can also be gleaned from agricultural censuses; however, censuses are typically conducted less frequently, mostly in ten-year intervals, in rare cases in five year intervals[[3]](#footnote-3). Not only are censuses conducted less frequently, most variables surveyed are of a structural nature. This means that census information can cover some FBS production needs (e.g. number of livestock, number of hectares) but would leave other needs (productivity measures) largely unaddressed.

In addition to censuses and surveys, some countries keep useful administrative records on agricultural production; for example, local government officials need to track the number of slaughtering in their district (Pica-Ciamarra *et al.* 2014, p. 35f) and thus instruct their relevant agencies to keep a record. These administrative data can constitute a valuable source of information for the compilation of the FBS production figures. This is particularly the case where production is concentrated in a small number of large production or processing units. Likewise, where farmers sell their produce to only a very small number of agro-industrial companies, as is the case for cash-crops, administrative data can provide an excellent source of production estimates, one with high accuracy and frequent updates. In these cases, the total amount of production can be derived from the sales or purchase records of companies. Those records may be obtained from different sources. These include tax authorities, the involved companies directly or, through branch-specific industry organizations (flour millers association, etc.) which keep records of the purchases and sales of their constituent members.

In developing countries, where smallholders account for a large proportion of agricultural production, integrating dedicated modules on agricultural production into existing household surveys has rendered very reliable and FBS-relevant results. One example is represented by the Integrated Surveys on Agriculture (LSMS-ISA) which have been created by integrating a questionnaire on agricultural production into the questionnaire and sampling design of the Living Standard Measurement Survey (LSMS). As a first major implementation of the newly developed Global Strategy survey instruments, the FAO is currently developing a multipurpose survey, based on combined samples of agricultural holdings in the household (small-holdings) and non-household (larger farms and cooperatives) sector. This so-called Agricultural and Rural Integrated Survey (AGRIS) will be implemented in priority countries targeted by the Global Strategy for developing their national agricultural systems. Its themes will cover the whole range of topics addressed by the Global Strategy, thereby comprising also production of the main crops of livestock products (FAO Statistics Division 2015).

Once a sample has been drawn, by any of the methods above, production needs to be measured for every sampled unit. To this end, a variety of methods have been developed. They are reviewed below, first for production of crops, then for production of livestock products.[[4]](#footnote-4)

### Measurement of primary crops production

Production of primary crops can be measured either by following a direct approach, which relies on counting the harvest obtained during the reference period, or an indirect approach, which relies on the assessment of harvested area and average yield and subsequent multiplication of the two.

For *direct measurement* of crops production the whole-plot harvest method, according to which the harvest of the whole plot is observed and the result recorded by the enumerator, is considered to be the most accurate, although time-consuming, method. To save time, the enumerator may count the number of units, such as sacks, baskets or bundles, harvested by the farmer, and multiply that number by the average weight of one unit, assessed on the basis of a sample of units drawn by the enumerator. When harvest takes place at several times of the year, enumerators may visit farmers regularly, ideally each day, to record the amount of any crop harvested since the previous visit. Alternatively, the amount of the harvest can be inquired from the farmers, ideally in combination with certain checks by the numerator, *e.g.* by inspecting the storage facilities, to prevent false reporting. To reduce recall error, particularly in cases of extended harvest periods, a common method consists in the use of so-called crop cards on which farmers record the results of each single harvest. As under the direct approach only one variable is measured, this approach can in general be expected to lead to smaller measurement error of the estimate of production than the indirect one which involves measurement of two variables, namely area harvested and yield. Thereby, the direct approach appears particularly suited for the purpose of FBS compilation. However, direct measurement of crops production, unless based on farmers’ self-assessment or on the purchase records of large companies, is often time consuming.

*Indirect measurement* of crops production requires, in the first step, measurement of the harvested area. This measurement can be conducted on the basis of maps, by identifying segments with physical boundaries, cells of a grid or individual sample points, and determining the crop for which these area units are cultivated shortly before the harvest on the basis of local visual inspection. Alternatively, the area under different types of crops can also be identified by means of remote sensing, particularly by establishing the proportion of pixels, included in a segment of a satellite image, which have been assigned to different crop types on the basis of their color, and extrapolating that proportion by the known area of the entire segment. A more traditional method consists in visiting the sampled pieces of land and assess their size, for example by fitting the area to an equivalent set of rectangles, triangles or other type of polygons, then measuring the side lengths of these polygons, applying standard geometric formulas to each polygon, and summing the results up. Another method, suggested by FAO (1982) relies on the measurement of the perimeter, which is divided by a number between 4 and 5, depending on the closeness of the area to a square or instead to a complex polygon, and then squared. Based on field experience, fairly accurate results can be obtained with global positioning systems (GPS). Equipped with a GPS device, the enumerator walks along the whole perimeter of the field and the GPS automatically calculates the surrounded area, based on the coordinates of points included in the walk. The assessment of the area harvested of individual crops is complicated when more than one crop are grown, simultaneously on the same field. In that case, imputations are required to assign a certain amount of area to each individual crop. An overview of the different methods is provided by Fermont and Benson (2011, pp. 29-34)

In the second step, indirect measurement of crops production requires an assessment of the average yield. The most common method for that assessment, recommended by FAO (1982) as standard, consists in the crop-cutting method. Under this method, a small sub-plot is randomly located within each field prior to the harvest. Instead of harvesting the entire field, only the sub-plot is harvested, by the enumerators or by the farmers themselves, and the yield of that harvest is measured. Selecting more than one sub-plot per field for crop-cutting will enhance the accuracy of the yield estimator and enable estimating its within-field variance. Alternatively, the yield can be predicted already before the harvest takes place, either by the farmers themselves, accompanied by the enumerator, or by experts such as extension staff or field technicians. The expected crop yield can be determined by means of an eye-assessment or by empirical formulae taking account of particular measurable characteristics or morphological attributes of the growing crop, such as the number of open cotton balls over a certain row length, grains per head, plant height or ear length. A technically more advanced, and not yet fully technically developed, method consists in the analysis of spectral data obtained from the spectral reflection of different bands in satellite images.

### Measurement of livestock production

Measurement of data on livestock production, such as production of meat, milk or eggs, does not require any measurement of area. As in the case of crops production, physical assessment is generally considered to be more reliable than self-reporting by farmers. Physical assessments are usually carried out by an enumerator, an extension officer or market agent who observes and records the number of slaughtered animals and measures their average carcass weight, or the amount of milk, eggs or wool produced. Carcass weights may also be predicted before slaughter, based on eye-assessment by experts of the animals’ characteristics, particularly their live weight and fat content, probably complemented by technical devices such as scanners. Self-reporting by farmers, which requires in general less resources, represents the more common method particularly in developing countries. Self-reporting can be conducted in the scope of face-to-face or interviews or interviews on the phone, based on set questionnaires. Alternatively, respondents can fill paper questionnaires and return them by mail, or fill web-forms, to submit their responses.

Certain difficulties arise in the collection of data on livestock production from surveys which require particular attention in the survey design. Firstly, the owner of the livestock is often not the same as the owner of the ground on which the livestock is grazing and who has been selected as respondent in the survey. The livestock owner may in fact not have any land holding at all. In these cases, the respondent is usually not capable to provide the requested information on the livestock found on their farm. Secondly, in production systems where livestock are moved from one place to the other to find fresh pastures for grazing (nomadic pastoralism), particular data collection methods, such as aerial flyover surveys and electronic tagging of animals, combined with remote collection of production data, are required to guarantee appropriate coverage of these animals and to avoid double-counting. Finally, holdings with intensified animal farming, while including a large number of animals and producing high output, usually cover small space. Therefore, these holdings’ probability to be included in area-frame based surveys is exceptionally small (Vogel 2015, p. 35).

### Imports and Exports

National legislation usually obliges importers and exporters of goods to provide information about their cross-border transactions to the customs office in the form of tax declarations. The tax declarations include, among other information, a description of the product, the applicable commodity code, based on the Harmonized System Classification,[[5]](#footnote-5) the weight of the traded good, the country of origin (for imports) or destination (for exports), and the date of the transaction. As principally all transactions of cross-border merchandize trade should be collected by the customs offices on the basis of tax declarations, and this data collection therefore ensures a large coverage as well as low additional reporting burden and low collection costs, UNSD recommends that customs records be treated as the “most prevalent source” of data on international trade and that “statisticians take advantage” of that source (UNSD 2004, p. 11).

Nevertheless, customs records are not free of errors. Errors emerge, for example as a result of erroneous customs declarations. Typical reporting mistakes arise from the erroneous designation of product codes, wrong units of measurement, transcription errors or simple typos. Moreover, certain transactions are not at all declared by the traders to avoid customs duties or trade circumvent trade restrictions. Errors may also slip in during the processing of the tax declarations by the tax administration or other institutions involved (Eurostat 2009, Annex I). In addition, albeit less frequently, certain transactions are not reported for confidentiality reasons. This is often the case for military equipment but also occurs for commercial reasons (trade secrets). While customs officers are requested to conduct quality checks on a regular basis, there is no guarantee that the final records are free of errors. This makes additional quality assurance and validation steps inevitable, bot at country level and for FAO.

To clean the customs records from errors they should be carefully edited by the customs office to correct obvious false reporting. Furthermore, the quality of the trade data can be enhanced by merging the customs records with data from other sources. These may comprise:

* the records of financial flows accompanying transactions between residents and non-residents kept by the central bank and collected from the financial institutions in charge of the settlement of these transactions in the framework of the International Transactions Reporting System (ITRS);
* the foreign shipping manifests prepared for ships, aircrafts and vehicles crossing the border, which list details on their cargo;
* records of port administrations which are sometimes prepared on the basis of the shipping manifests;
* records of the parcel post and letter post which need to be kept in the majority of countries, as stipulated by the acts of the Universal Postal Union;
* aircraft and ship registers, particularly to record exports and imports of ships and aircrafts, which do not always imply border-crossing of the traded objects; reports of commodity boards; records compiled for the collection of value added tax; and enterprise surveys (2004, chapter 4).

In some countries, such as the Democratic Republic of the Congo, records on cross-border trade in agricultural products are compiled by the national veterinary service which is represented on the main customs points to verify compliance of animal- and plant-based products with hygienic standards.[[6]](#footnote-6) It should be ensured that food aid obtained from relief agencies is appropriately measured; failing this, additional imputations can be conducted, for instance, with data from the Food Aid Information System maintained by the World Food Programme (WFP 2015). Finally, the data may be reconciled with values recorded for the same trade flows by the trading partner country (mirror data). Comparison of exports with mirror data is considered to be particularly helpful, as imports are usually documented more exhaustively and checked more accurately than data on exports (UNSD 2004, chapter 13).

National trade estimates are eventually forwarded to the UN, further checked for quality and eventually be brought into the public domain. The FAO Statistics Division and UNSD regularly collect the official trade files of around 180 countries. The FAO Statistics Division makes diverse efforts to further enhance the quality of the trade records for agricultural products, subjects them to additional quality-checks and reconciles them with statistics from other sources. Data gaps are filled by various imputation approaches; for instance, missing values are calculated from available quantities and missing quantities from available values via appropriate unit values. Likewise, trade flows are “mirrored”, i.e. missing flows from reporters are taken from partners and vice versa. Additional trade data can also come from multinational industry organization. Eventually, trade flows are aggregated and the aggregate flows are subjected to further validation checks, notable commodity specific global consistency checks (minimal net trade). Once all validation and imputation steps are completed, and the final data are published on the FAOSTAT website (FAO 2015)[[7]](#footnote-7).

A particular challenge for the compilation of trade statistics consists is the inclusion of shadow trade, especially in developing countries. Shadow trade comprises all trade in goods that has not been subjected to statutory border formalities such as customs clearance (Afrika and Ajumbo, 2012. p. 2). It is therefore not included in the statistics compiled on the basis of customs records. Although it is estimated that in Africa shadow trade is an important source of income for a large share of the population and even provides a noticeable contribution to food security (*ibd.*, p.1), only few developing countries regularly compile data on shadow trade and take these data into account in their official trade statistics[[8]](#footnote-8).

### Stocks

Stocks of agricultural products are held by a variety of market participants, such as farms, processing or trading companies, government agencies or even international relief organizations such as the WFP. A number of factors determine the amount of stocks held by the various players. In general, stocks are held to smooth consumption, in remote settings of developing countries stocks are also kept as a reserve for insurance against food shortage or, for want of a fully developed rural finance system, as a store of value.

There a several ways of measuring on farm stocks. One option would be through agricultural censuses, but in reality, stocks are rarely an integral part of censuses. Out of 196 national censuses, only 30 collect information on storage infrastructure and capacities, while only 7 directly include stock levels (Fonteneau 2014). What is more, agricultural censuses are carried out with large time intervals, and therefore not really a useful way of measuring stocks. The fact that stock levels exhibit significant short term variations limits the usefulness of censuses for the assessment of stocks, as interpolations are difficult to undertake.

Data on the stocks held by government agencies and private sector companies, such as warehouses, retail traders and wholesalers, can be collected from the respective offices or companies. As regards the stocks of agricultural holdings, agricultural surveys are usually the most suited data collection method. Efforts to develop surveys covering stocks in all countries are currently made by AMIS as well as the by the Global Strategy.

The combination of both, farm survey data and data collected from institutional stock holders provides a fairly accurate estimate of stocks on a national level. Indeed, the USDA is operating such an approach where farms are surveyed bi-annually. The East African Community is also adopting this methodology for the compilation of monthly FBS.

### Feed

Farmers feed their animals with agricultural products which they purchase from elsewhere as well as with products which form part of their own agricultural production. The importance of both components in the overall feed supply varies across countries, depending on the type of the prevailing livestock production systems, their degree of specialization, commercialization and intensification.

FBS compilers need to create a comprehensive picture of food items used as feed supply, which requires coverage of both feeds produced by farmers and feed compounders. It requires information about the amounts and the types of products both farmers and compounders use to produce the feeds. As such surveys are costly, only few representative and comprehensive surveys are actually available (Westcott and Norton 2012, p. 5).[[9]](#footnote-9) In some cases, exhaustive surveys of feed use are included as one-off modules annexed to the regular agricultural survey in a certain year.[[10]](#footnote-10)

In the absence of such comprehensive surveys, useful information may be obtained by including the relevant questions into the regular agricultural surveys. This is a particularly appealing option in developing countries where a large proportion of the livestock is reared by smallholders and the proportion of purchased feed can be considered to be comparatively low[[11]](#footnote-11). In tandem, compound feeders can be contacted either directly or through industry associations. Combined with the statistics on external trade, the combination of various sources may provide a worthwhile substitute for a specialized data collection process

### Food

For the measurement of food consumption, two principal sources can provide estimates. The first source are production estimates from the food processing industry. Information from the food processing industry can provide excellent estimates for FBS-consistent food availability, particularly (i) where the processing industry covers a large part of food use, i.e. where home/subsistence production and consumption plays a small role; and (ii) where the degree of coverage/organization by a processing industry is high (e.g. all flour produced is produced and reported by commercial flour millers). Typically, that’s the case in all developed countries, but increasingly also in emerging economies. Estimates of production from flour millers, sugar refiners, oilseed crushers, or abattoirs can be used to as direct inputs into the SUA system and, through the process of standardization, be converted back into primary equivalents as shown in the FBS. While a high degree of coverage/industry organization may not always be given in developing countries and certainly not for all processing industries, certain “bottleneck” industries such as the sugar refineries provide useful estimates in all countries.

Results from household surveys provide a second option to obtain estimates for food consumption data. There are, however, a number of caveats to be raised and a number of adjustment to be made before such data can be used to inform estimates for food consumption/supply/availability in FBSs. Firstly, such surveys are usually carried out rather infrequently, i.e. once every three or five years, and in many developing countries even less frequently. Secondly, while these surveys are designed to capture a representative sample of a country’s population, some specific population subgroups are typically under-represented. This is the case particularly for the homeless and marginalized population groups, which inevitably introduces a bias for overall food consumption. Thirdly, these surveys practically always exclude “collective consumption”, i.e. food consumption in institutionalized households, such as the military, prisons, canteens, schools, universities, hospitals or seniority centres. Also not all household surveys fully account for food eaten outside of home, i.e. in restaurants, as street food, etc.

To obtain FBS-consistent food supply information, food consumption estimates from HH surveys need to be adjusted to be consistent with the scope and definitions of FBS. For instance, under-representation of particular population groups can be adjusted for by means of re-calculation of those weights. However, as often only one vector of weights is applied, this requires a choice of the variable with respect to which under-representation is aimed to be eliminated, such as employment status, total income or total expenditure. In most cases the chosen variable is not ‘food consumption in quantities’, which can create a bias in the estimate of the population total.

Moreover, food consumption measured in household surveys needs to be brought up to the food availability definition in the FBS.[[12]](#footnote-12) This means that all food consumed in collective household needs to be estimated and household survey results need to be scaled up accordingly. The same holds for food consumed in restaurants or as street food.

To gauge the extent of differences and facilitate necessary adjustments, FAO has systematically compared results from household surveys with those of FBS. The results suggest that food estimates obtained from the two sources are only modestly correlated across countries. Throughout a sample of 64 countries, data on food consumption compiled from FBS turn out to be on average higher than those obtained from household surveys. In some extreme cases, that difference amounts to up to two thirds of the value obtained from household surveys. In other cases the value derived from FBS is by up to one fifth smaller than the household-survey result. In contrast to the limited correlation in levels, the shares of the individual types of food in total consumption appear to match more closely between the two sources of data (FAO Statistics Division 2015b).

Given the principal and practical discrepancies between HH surveys and FBS, FBS compilers are encouraged to (i) make every effort to fully understand the scope and definitions of HH surveys, and (ii) based on the results of this analysis, identify a way to reconcile with/scale the results of HH surveys to FBS definitions. The FAO has devised such a method, the details of which are laid out in an ESS working paper (Grünberger, 2014).

### Food losses and waste (FLW)

The measurement of FLW should cover all stages of the food supply chain at which such losses can occur (see e.g. Chapter 3). Data collection could be organized along the food supply chain and cover the entire process from production, storage, processing, retailing down to the final household, i.e. from “farm to fork[[13]](#footnote-13)”. Before setting up the data collection system, it is also advisable to conduct a general baseline study (FAO 2015, p. 13; O’Connor *et al.*, 2015).

Whenever FLW data cannot be obtained from records kept by public or private entities, studies based on samples are considered to be the most efficient way to collect those data. The sampling design should take account of the main characteristics and structure of the targeted subsector of the food industry. As regards the data collection instruments, objective measurement, based on weighing, counting or assessment of volume, is commonly acknowledged to be the preferred one, even if that may require more time than others. Use of questionnaires and oral interviews with product owners can be useful for cross-checking the results of the measurement, but they are not recommended as stand-alone instruments, as non-response rates and reporting error are usually high. Product owners are often reluctant to admit large amounts of losses.[[14]](#footnote-14)

Objective measurement can be carried out in a number of ways, depending on the type of the prevalent food loss in the particular process of the food supply chain. Food losses can take the form of *disappearances*, in the case of which pieces of the product drop out of the food chain, or *biodegradation*, in the case of which pieces lose their adequacy to be used as food. Disappearance occurs mainly as a result of actions to which the product is exposed over the food supply chain, for example during stacking, stooking, threshing, shelling, cleaning, winnowing and drying of crops on farm, during transport, during processing as well as during commissioning of food in wholesale and retail. Biodegradation occurs mainly over time as a result of biological or chemical transformations or infestation by insects. These take place mainly during storage, to a certain extent also during drying and longer transports.[[15]](#footnote-15)

Measurement of disappearance can be carried out by the following methods:

* *collecting the dropouts caused by a certain activity*, for example by laying out plastic sheets on the floor during the stacking, stooking and threshing of cereals on farm, to catch the scattered grains, by analysing the grain that has remained on the straw after threshing, in catering companies, by collecting the food left on counters for selling at the end of the serving period, by analysing the business waste container, or, when scanning-based systems are in place, for example in wholesale and retail trade, by extracting the records of food items classified as losses from the database;
* *following up units or sets of food products and comparing their state before and after the activity*, which is the predominant method for the estimation of losses during transport, and which can also be easily applied for example to measuring losses during wholesale and retail trading when scanning-systems are in place;[[16]](#footnote-16)
* *comparison of the outcomes of an activity with and without taking particular care for prevention of losses,* which has been recommended, for example, for measurement of the grain damage caused by threshing.[[17]](#footnote-17)

In the later stages of the food supply chain, where agricultural products often occur in mixed form with other products, waste composition analysis may be required, to separate the losses of different products from each other of from materials not to be recorded as food loss (FLWP 2015, chapter 13.6).

For the measurement of biodegradation, a traditional, and relatively precise, method consists in the, so called, count-and weigh method initially recommended for the measurement of grain loss during storage. Under this method, first, a sample of the damaged grain is analyzed in a laboratory to assess the weight loss per grain, under the perspective of adequacy for consumption as food; then, the weight loss per grain is extrapolated to the total weight loss in the sample by taking into account the proportion of damaged grain (Harris and Lindblad 1978, p. 90f). A main disadvantage of the count-and-weigh method consists in the high amount of time and work required. Furthermore, the fact that parts of the produce need to be removed from the food chain for analysis in the laboratory and that the product owners are not involved in the assessment may considerably reduce their willingness to agree to the loss measurement. To overcome these disadvantages, the African Postharvest Losses Information System (APHLIS) suggests a simplified method based on visual scales (Hodges 2013). A visual scale consists in a set of images of grain samples, representing different intensities of losses, and the associated expected weight loss expressed as percentages of the total depicted grain. These percentages have been established previously on the basis of laboratory analysis. For the measurement of the loss, the enumerator compares the grain with the pictures on the visual scale, together with the grain owner, and applies the respective percentage weight loss to calculate to total loss in the sample.

### Seed

The most common method for measuring seed use is to include questions on seed use in the questionnaire of an agricultural survey. These usually address only the use of own production for seed. Farmers may also buy seeds on the market, but these seeds consist mostly of so-called ‘improved’ seed only. Data on the use of seed purchased on the market may be obtained from the records of commercial seed companies.

As the amount of seed for a specific type of crop is strongly determined by the area sawn, it may be sufficient to measure the size of that area, based on some of the techniques outlined above for the measurement of area harvested (see section “Production”), and multiply by a seed rate. The seed rate is defined as quantity of seed used per hectare. It may be surveyed from farmers or known from other sources, taking into account that this rate usually does not change much from one year to the next. If the area sown is not known, it may, as a second best option, be approximated by measuring area harvested, although the area sawn is usually larger than the area harvested. Differences between area harvested and area sawn can result from damage of the crop while it is grown, due to natural disasters, pests, poor germination, animal grazing or floods. Furthermore, farmers may decline from harvesting due to lack of labour, lack of demand or, in the case of cassava, with the purpose to keep a reserve for times with drought or food shortage (Sud *et al.* 2015, p. 9f.).

### Tourist Consumption

Naturally, surveys carried out among tourists to retrieve detailed data, in particular on types of food consumed, represent the superior way to measure the food consumption of tourists. However, in case that this is not easily feasible, estimating tourist consumption through tourism data represents an adequate alternative. Such data may be collected from the large hotels and travel agencies of the country. Hotels may be requested to share their records on meals supplied to their guests.

Data on the number of tourists entering a given country, including their origin and duration of stay, is collected at country boarders and globally gathered by the United Nations World Tourist Organization (UNWTO 2015). These datasets provide a useful basis for estimating the amounts of food consumed by tourists. In some small islands states, which are popular holiday destinations, such as the Maldives or Seychelles, foreign visitors consume the largest share of available food. In these cases, accurate measurement of tourist consumption is particularly important to identify the amount of food available for consumption by the resident population.

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1. A global assessment of agricultural data, carried out by FAO and the World Bank, concludes that many developing countries do not dispose of the capacities to collect and disseminate the most basic agricultural data required to monitor national trends or to inform the international development discussion, and that the quantity and quality of agricultural statistics worldwide has even decreased over time (World Bank 2011). [↑](#footnote-ref-1)
2. A lack of integration within national agricultural systems has been identified as a main reason for the decline in coverage and quality of agricultural data in developing countries, apart from limited capacities and financial resources. This is a crucial obstacle particularly for the compilation of FBS which relies on gathering and reconciliation of data from various subdomains of agricultural statistics and thus on involvement of a number of different organizations. Establishing efficient working arrangements with the different actors to be involved in FBS compilation is therefore of paramount importance for FBS compilation. [↑](#footnote-ref-2)
3. The FAO provides the basic guidance on how to collect census information, what variables to cover, how to prepare for a census and how to process the data collected. The FAO guidelines for the 2020 round of censuses (WCA 2020) have just been released. [↑](#footnote-ref-3)
4. The review below is based on two unpublished reports recently prepared in the context of the Global Strategy to Improve Agricultural and Rural Statistics – for crops production by Sud *et al.* (2015) and for production of livestock products by Moss *et al.* (2015). [↑](#footnote-ref-4)
5. See chapter 5 below for details about the Harmonized System classification. [↑](#footnote-ref-5)
6. Information gathered during a country visit by the FAO Statistics Division in the Democratic Republic of the Congo in 2011. [↑](#footnote-ref-6)
7. UNSD disseminates the collected trade files in raw form on the Comtrade Database (United Nations 2015). Also the Global Trade Information System, a private sector company, collects official trade files from around 80 countries and makes them accessible on their website (GTIS 2015). [↑](#footnote-ref-7)
8. A survey on informal cross-border trade in Africa, recently carried out by UNSD among 22 compilers of national statistics on international merchandise trade, revealed that only two countries in Africa, namely Rwanda and Cameroon, regularly compile statistics on informal trade (Muryavan and Iversen 2014). For Eastern and Southern Africa, the Famine Early Warning Systems Network (FEWS Net), funded by USAID and WFP, compiles non-official data on shadow trade each quarter year and publishes the results in its reports (FEWS Net 2012, 2015). The aforementioned approaches to measuring shadow trade rely on monitoring the main border points and surveying persons crossing the borders carrying goods. In Rwanda, such surveys are carried out each day of the year at all major border points of the country (Habinshuti 2014). In Cameroun the data collection is less complete and complemented by econometric estimation (Nguingnang 2014). In Rwanda, it is estimated that informal trade makes up for 1% of all imports and 24% of all exports, while in Cameroon 10% of all imports and 2% of all exports are informal, according to the compiled data (Muryavan and Iversen 2014). [↑](#footnote-ref-8)
9. An exception consists in the compulsory data collection “Annual Data of Agricultural Enterprises” carried out by the CSO of Hungary among all organizations carrying out agricultural activities except agricultural surveys. (KSH 2014). [↑](#footnote-ref-9)
10. Such module has been added for example to the Agricultural Survey among Agricultural Smallholders in Moldova in 2012. [↑](#footnote-ref-10)
11. This approach is followed for example in the Seasonal Agricultural Survey of Rwanda (NISR 2014). [↑](#footnote-ref-11)
12. See the description above at the beginning of chapter 2. [↑](#footnote-ref-12)
13. The FBS purposes, coverage from farm to retail would suffice. [↑](#footnote-ref-13)
14. Detailed guidelines on the design and implementation of food loss surveys can be found in FLWP (2015, chapters 5, 6, 13) and, tailored to the crops sector in African countries, in Hodges (2013, chapter 2.4). [↑](#footnote-ref-14)
15. See Harris and Lindblad (1978, chapter 5) for a more detailed description of the various types of grain losses, and O’Connor *et al.* (2015, chapters 6-8) for a description of food losses caused by wholesalers, retail, markets and food services. [↑](#footnote-ref-15)
16. This method can involve more than one activity. With the “load tracking” method, a sample of the primary product is followed throughout the entire supply chain (FLWP 2015, chapter 13.3). [↑](#footnote-ref-16)
17. Detailed descriptions of the aforementioned methods can be found in: Harris and Lindblad (1978, chapter 5); Møller *et al.* (2014, chapter 5), FLWP (2015, chapter 13). [↑](#footnote-ref-17)