# About this document

This document is the first draft of a resource book to guide the compilation of Food Balance Sheets (FBS) at country level. It is based on the new FBS methodology developed by the Statistics Division of FAO and allows FBS compilers at country level to build up their own FBSs in a step-by-step manner. To facilitate this capacity development process, the manual will be accompanied by a set of materials (PowerPoints, e-learning modules, online tests, etc.), all aimed at enabling the access to and the implementation of the new methods. It will also come with a separate software package that allows countries to (i) review the basic data used by FAO in the past, (ii) revise and possibly replace the principal parameters used by FAO in the new system and (iii) reproduce Food Balance Sheets for any year in the past and (iv) provide updated FBS to FAO as new basic data become available. The software package is designed as an internet application (“thin client”) and will enables FAO and FBS compilers at country level to share the same input and output files. It is written in “R” and thus allows to roll out all centrally written procedures in a seamless way.

The various elements of the revised FAO methodology have already been presented to the FAO Interdepartmental Working Group on Statistics (IDWG). IDWG Members provided comments, which have subsequently been incorporated into methodology and eventually into this document. In addition, the various elements of the new methodology have been exposed to various external reviews, notably the chapters on trade, the trade endorsement calculations, waste and losses or feed use. Some approaches have already been adopted by others users. The feed use methodology has for instance been adopted by the Agricultural Market Information System (AMIS), which now offers to its members, based on the new FBS feed methodology, an online calculator for feed use. Last but not least, all methods have been developed in close cooperation with technical divisions at FAO. Specifically, the following collaborations helped improve the SUA/FBS:

* With Agricultural Market Information System (AMIS) to improve stock data, sources and methodology.
* With the Rural Infrastructure and Agro-industry Division (AGS) of FAO on post-harvest losses (PHL) and waste as well as in exploring new data sources for industrial use of food commodities.
* With the Animal Production and Health Division of FAO (AGA) on feed estimates, using the expert knowledge and information from various databases, notably the GLEAM database.
* With Plant Production and Protection Division of FAO (AGP) on seed rates and the imputation method for seed use.
* With Statistical Division of the UN (UNSD) and the World Customs Organization (WCO) on improved classifications for production (CPC) and trade data (HS).
* With the regional statistical statutory meetings (AFCAS, APCAS, IICA) of FAO to solicit feedback, inputs, up-dates on methodological innovations and to build capacity.

**Overarching findings and principles guiding the FBS revisions**

A number of overarching principles guided the current FBS revisions. Importantly,

* All assumptions made are explicit and are documented. The same commitment holds for future changes and new assumptions made.
* Food Balance Sheets (FBS) are analytical data sets. They will always have to combine measured with imputed information. Imputation methods cannot replace data collection efforts, no matter how sophisticated they are.
* Every effort has to be made to collect more and better quality data at the country level, not least because the quality of the results of any imputation depends critically on the quality of measured information.
* Poor imputation methods can sometimes create vastly inappropriate results even where they are based on solid data. Every effort was made to identify sound imputation methods and base them to the extent possible on solid data.
* Imputation methods try to harness links between the various FBS variables and elements and information from outside the FBS. This allows triangulation of information and ensures overall consistency between FBS variables. The new feed use imputation method is probably the best example of how this has been implemented in practice.
* Analytical datasets are always associated with larger inaccuracies, stemming from differences in data definitions, classifications, measurement errors, imputation problems, etc. To reflect these issues in the FBS results, all estimates have expected values and an explicit measurement error. No claim is made that the estimates are point estimates. The overall philosophy guiding the revisions is to be “roughly right rather than precisely wrong”[[1]](#footnote-1).
* The new approaches seek to harness innovations in both statistical approaches and new information and communications technology (ICT) to a maximum extent. However, they do not intend to replace manual inputs and quality checks. On the contrary, time saved through automatic procedures is meant to provide more time for quality assurance and quality control (QA/QC).
* QC/QA procedures are built into the system at various stages. Full compliance with the new FAO Quality Assurance Framework (SQAF) will be achieved as both frameworks mature.

The rest of this document is organized as follows. The first section provides a basic introduction with a quick overview of the history of FBS, their basic use cases, their usefulness as well as the limits to which FBS can be used and be useful. The second part introduces the main sources of data, new imputation methods as well as the new balancing mechanism. The third part finally provides a step-by-step introduction of the new methods based on worked examples. The document concludes with an overview of the changes introduced by the shift to the new commodity classification systems, their compatibility (or lack of) and their relationship with the existing classification system.

# Introduction

The FAO Statistics Division (ESS) reviews and revises the methodological approaches for all its products on a regular basis. Such revisions include all databases maintained at ESS, their underlying and accompanying metadata, the approaches to impute missing data or to create analytical databases such as the Green House Gas (GHG) inventories, the Food Balance Sheets (FBS), or most recently, the System of Economic Environmental Accounts for Agriculture, Fisheries and Forestry, SEEA-AFF.

All analytical databases are, by their very nature, datasets that include a large number of imputed data or analytically derived data. Food Balance Sheets require many, and often particularly complex transformations of primary data. In undertaking these transformations, FAO always emphasizes how important it is for countries to undertake actual data collection and encourages all countries to improve and increase data collection efforts through the Global Strategy to Improve Rural Agricultural Statistics. The efforts to obtain a maximum of actual data notwithstanding, establishing Food Balance Sheets is often a process that starts with a rather limited set of hard statistics. For many countries and many commodities, actual measurement of the constituting variables is entirely absent, or where available, associated with large implicit or explicit measurement errors.

In addition to the need to impute an often large number of variables in a balance, setting up a complete set of Food Balances requires a multitude of conversion coefficients, extraction rates and nutritive factors. These too can change, albeit typically at a much lower speed. For this round of FBS revisions, the changes in conversion rates and factors were more important than on previous occasions. The main reason for additional changes lies in the fact that the underlying commodity classification systems have been revised as part of the overall reform efforts. The main change in this regard was that FAO’s proprietary classification system, the so-called FAO commodity list, has been replaced by adopting the Harmonized System for all trade variables, and the Central Product Classification CPC for all other variables in the balance. Every effort was made to ensure consistency between old and new systems and across the new systems. All these efforts notwithstanding, some conversion factors had to be adjusted to reflect the product definitions of the newly adopted systems.

The focus of the revisions was, however, placed on updating the various (imputation) methods of the FBS components and, importantly, the overall approach to set up and solve the balance between all variables of supply and utilization. The motivations for these changes and the differences to existing approaches are laid out in the various chapters of this document. An important change relates to the approach taken to solving the overall balance. In essence, it constitutes a move from a deterministic approach towards establishing a process that takes into account not only the expected values but also the accuracy with the various variables (“elements”) of the balance that are being measured. The approach eventually selects a combination of values for the various variables that provides the most likely outcome while taking into account the boundaries of confidence/measurement for every individual variable.

# Background

As defined by FAO, a Food Balance Sheet (FBS) provides a comprehensive picture of the pattern of a country's food supply during a specified reference period. The preparation of food balance sheets has a particularly long history, extending as far back as the period 1934-38. Over time, FBSs have undergone methodological change, but since 1984, when FBS were published in “standardized” format, FBS methods have been left largely unaltered, despite periodic review.

**Overview[[2]](#footnote-2)**

The food balance sheet shows for each food item, in most cases expressed in primary commodity equivalents and a few cases expressed as processed products, amounts of supply and utilization of foodstuffs[[3]](#footnote-3). The total quantity of foodstuffs produced in a country added to the total quantity imported and adjusted to any change in stocks that may have occurred since the beginning of the reference period gives the supply available during that period. On the utilization side, a distinction is made between the quantities exported, fed to livestock, used for seed, put to manufacture for food use and non-food uses, losses during storage and transportation, and food supplies available for human consumption. The per caput supply of each such food item available for human consumption is then obtained by dividing the respective quantity by the related data on the population actually partaking of it. Data on per capita food supplies are expressed in terms of quantity and - by applying appropriate food composition factors for all primary and processed products - also in terms of caloric value as well as protein and fat content.

Annual food balance sheets tabulated regularly over a period of years will show the trends in the overall national food supply, disclose changes that may have taken place in the types of food consumed, i.e., the pattern of the diet, and reveal the extent to which the food supply of the country, as a whole, is adequate in relation to nutritional requirements.

It is important to note that the quantities of food available for human consumption, as estimated in the food balance sheet, relate simply to the quantities of food reaching the consumer. The amount of food actually consumed will be lower than the quantity shown in the food balance sheet depending on the degree of losses of edible food and nutrients in the household and at retail, e.g. during storage, in preparation and cooking (which affect vitamins and minerals to a greater extent than they do calories, protein and fat), as plate-waste or quantities fed to domestic animals and pets, or thrown away.

Waste on the farm and during distribution and processing is taken into consideration as an element in the food balance sheet. Technical losses occurring during the transformation of primary commodities into processed products are taken into account in the assessment of respective extraction/conversion rates. There are very few surveys so far known on which to base sound figures for waste, and in some cases also these are subject to significant margins of error. In most cases, the assumptions for waste used in food balance sheets are based on expert opinion obtained in the countries.

The system involves the compilation and maintenance of 500+ primary and processed commodities, by way of supply utilization accounts that are compiled by country every year which are then “standardized” into over 90 FBS commodities and respective commodity aggregates for dissemination. The architecture is organized in commodity trees linking primary and derived commodities. Production data on the latter is mostly not available so a large number of imputations are needed to cover up for trade flows but which do not represent actual production or utilization

The food balance sheets are standardized in that processed commodities are converted back to their primary equivalent; this is called "vertical standardization". The extraction rates or technical coefficients which were used in building up the database are used to carry out the conversion back to the primary level by multiplication of the reciprocal of the technical coefficient. The reason for preparing standardized food balance sheets as opposed to detailed food balance sheets is firstly, to reduce the amount of data, and therefore the number of commodities involved, to a level and size more suited to analytical purposes, but this does negate the need for maintaining and balancing accounts for the underlying commodities. Nevertheless, such a reduction is thought not to cause any significant loss of the basic variables monitoring the agricultural sector. Secondly, preparing standardized food balance sheets and cancelling the intermediate production of derived commodities against the input use of primary products gives a clearer and more concise view of availability of a product. Moreover, by expressing output in primary product equivalence, data will be far more tractable for policy-making than would reporting production in processing form.

The accuracy of food balance sheets, which are in essence derived statistics, is of course dependent on the reliability of the underlying basic statistics of population, supply and utilization of foods and of their nutritive value. These vary a great deal between countries, both in terms of coverage as well as in accuracy. In fact, there are many gaps particularly in the statistics of utilization for non-food purposes, such as feed, seed and manufacture, as well as in those of farm, commercial and even government stocks. To overcome the former difficulty, estimates are made, while the effect of the absence of statistics on stocks is considered to be reduced by preparing the food balance sheets as an average for a three-year period.

**Use and usefulness of FBS**

Food Balance Sheets have been compiled for nearly 80 years and have been used for numerous different purposes ever since. They provide a wealth of information on food and nutrient availability and, when available over longer timeframes and compiled with consistent methodologies, provide the basis for trends and developments of the food economy of a country, a region or world-wide.

1. Arguably the most important use of the food balance sheets arises from the fact that they provide a measure of the overall average calories supply in a country. The DES (Dietary Energy Supply) is not only a standard output of the FBS, but also the key input into the FAO indicator of undernourishment, i.e. the number (NoU) and the prevalence of undernourishment (PoU). The DES enters the PoU measurement as the mean of a distribution, which together with a cut-off point, the Minimum Dietary Energy requirement (MDER) allows to calculate the number and percentage of people in a population without sufficient access to calories.
2. The FBS have also been used to examine changes in dietary patterns. While this is possible in principle, it is important to note that the observed changes are only the changes in the average diet and therefore no do allow to draw inferences on whether the dietary quality in a country has improved or deteriorated. In fact, it is not even possible to say much about the quality of the average diet. The measured averages may simply be the average of unhealthy overnutrition and unhealthy undernutrition and while the average diet, but in terms of volume and composition may appear to be about right, most people in a country may consume an unhealthy diet.
3. FBS are the starting and the end point of many, if not most, partial equilibrium models[[4]](#footnote-4). Models such as the OECD/FAO Aglink model, the IFPRI IMPACT model and partial equilibrium models for food and agriculture more generally use commodity balances as the basis for their projections. They typically use every element/variable of the balance on the left-hand-side of their equation system and project the starting values of the FBS (commodity balances) into the future. As most of these models use zero global net trade as their closure rules, imports and exports are not projected separately but collapsed into one variable, i.e. net trade. FBS are to be seen as a subset of the general family of commodity balances, i.e. commodity balances for food items.
4. FBS also provide a rich basis to calculate numerous other, simple indicators. The most straightforward indicators are simple ratios such as self-sufficiency and import-dependency ratios. But FBS also provide inputs into policy measures such as the producer subsidy and consumer subsidy equivalents, regularly updated by the OECD; the same holds for their analogue, the Aggregate Measure of Support used by the WTO.
5. Probably the most common use of FBS data in the published literature is the citation of daily energy intake and fat and protein intake (USDA/ERS, Grigg 1996, Grigg 1993, Hopper, Pinstrup-Andersen, Svedberg, Trueblood, Smil). Estimates of intakes of other nutrients including vitamins, minerals, and amino acids are also based on FBS data on food availability. FBS information has also been used to spot shortfalls in surplus in a nation’s energy and nutrient intake (SADC, USDA/ERS) or to examine the availability of a particular commodity or class of commodities (el Obeid, Hopper, Helsing).
6. Finally, the medical community has also made use of the FBS. Researchers have used food and protein availabilities from the FBS to study the availabilities and importance of various amino acids and different sources of proteins. They also have examined relationships among caloric intake, protein types, and amino acids in the diet (Hopper, Young, Kazuo). Additionally, medical research has used FBS data to investigate connections between diet and health, especially cardiac health and cancers (Sasaki, Helsing). Medical researchers have also evaluated the usability and relevance of FBS data. For example, Sasaki and Kesteloot examined correlations between FAO data and data from multiple surveys in 19 countries and deemed the FBS data usable and valuable. It should be noted however, that the majority of the studies are for developed countries, which have more reliable data and clearer methodological approaches.

**Limitations**

FBSs are the most comprehensive collection of data available on a very large set of countries that is related to food commodities supply and food commodity utilization. The data are regularly revised and continually improving and becoming more consistent. In their totality, FBS provide a wealth of information and offer numerous use cases. But there are also strict limits to their applicability and their usefulness. FBS compilers and users must be aware of these limitations as well as of the potential errors that exist in estimates, that e.g. availability is not the same as intake, or that the FBSs fail to say anything about the distribution of food and nutrient access within a country. Some key limitations can be summarized as follows:

Firstly, FBS merely provide estimates for *average* national food or nutrient availability. They do not offer any insights on distributional aspects for food and nutrient availability. This means that they would allow to say something e.g. about the average diet but NOT about the diet of the food insecure or poor. Nor do they provide information about the regional distribution within a country, access of a particular group of households or their dietary habits. With these caveats in mind, FBS can and are heavily used for the following purposes, either as a contributing factor or the sole basis for analysis.It is believed that the food balance sheets so prepared, while often being far from satisfactory in the proper statistical sense, provide an approximate picture of the overall food situation in the countries. However, data evaluation and consistency checks undertaken within the framework of the supply/utilization accounts for the preparation of food balance sheets suggests that there are a number of gaps and even potential inconsistencies in the underlying basic statistics for many, particularly for developing countries. Although an attempt at remedy is made by estimating gaps and/or performing adjustments in the food balance sheets, the end result does not always lead to a plausible picture of the food supply situation in the country.

Secondly, the possibility of imputing missing data cannot make good for proper data collection. This FBS resource book offers methods to detect inconsistencies, to impute missing data and to fill data gaps. However, such imputation methods cannot substitute the collection of basic data and the creation of a sound statistical system. No model-based approach can substitute for, let alone produce more accurate information than actual data collection. It is therefore imperative on countries in the process of creating their own FBSs to first take stock of food supply and utilization data, juxtapose available data with data needs and make the final decision of whether FBS can be built with confidence contingent on remaining data gaps. Where needs exceed availability for many commodities and variables/elements, it may be necessary to first improve the domestic database, focus on data collection of missing elements and resume the FBS compilation once the basic data are available at a sufficient level. The Global Strategy (GS) to Improve Rural and Agricultural Statistics provides the basis for such an endeavour. The GS offers cost-efficient methods for data collection and provides capacity development efforts that afford practical access to such cost-efficient methods.

Thirdly, even if most or all data needed to compile FBS are available, there is a considerable challenge to assemble FBS data from a number of different sources whose coverage and quality vary greatly. More often than not, the underlying accounting system is a collage of data from different sources of disparate quality with an unknown size of error. In practice, primary production and trade are often the only official data regularly collected, while data for the production of processed commodities and utilization *per se* are virtually non-existent or are sparse at best. In addition to the collection of basic data, the compilation of FBSs requires a multitude of coefficients. They are used, for instance, in the calculation of product flows in a commodity tree and in standardization were either collected or estimated years ago and are still used. They are also needed for in the assessment of feed use, the calculation of nutrients contained in the foods, for the derivation of food consumption by tourists and many more calculations. Finally, where food is used as a balancing variable/element, which was the case in the FAO FBS system in the past, extra caution in checking the results is warranted. The balancing item in a supply/utilization system always assumes all measurement errors of all other elements in the balance. As there is no a priori reason to assume that these measurement errors cancel out, the balancing element is most likely to be the least reliable variable in the system. This sourcebook therefore proposes a new approach that explicitly takes into account that all variables/elements are measured with a certain degree of inaccuracy and avoids relegating measurement errors to one single element.

Fourthly, FBS results require careful interpretation and handling. For instance, food availability assessed through the FBS is not directly comparable with food consumption data from household surveys. The differences are manifold, they include, inter alia, a different coverage of food consumption (HH surveys do not include “collective” consumption in hospitals, schools, military or prisons), not or not completely out of home consumption in restaurants, streets foods, etc. while they are presenting food consumption net of retail waste, which is included in the FBSs). HH surveys may also lack representative coverage over the complete reference period of a FBS, i.e. a calendar year. In this resource book, no systematic attempt is made to tally FBS results with food consumption or expenditures from household surveys. But FAO working papers are available that have systematically compared FBS estimates with results from HH surveys and should be consulted before using HH survey results to guide FBS food estimates[[5]](#footnote-5).

1. John Maynard Keynes [↑](#footnote-ref-1)
2. Drawn from <http://www.fao.org/waicent/faostat/agricult/fbs-e.htm> [↑](#footnote-ref-2)
3. Not all items currently presented in the FBS are food commodities. The FBS e.g. also include non-food alcohol, which is by its very name, a non-food item. [↑](#footnote-ref-3)
4. Strictly speaking, they are just a sub-set of these starting and endpoints. Commodity balances for food and non-food items are the complete basis for these models. [↑](#footnote-ref-4)
5. For details on the methodology of the comparison between FBS and HH surveys, its scope and limits see: <http://www.fao.org/3/a-i4315e.pdf> [↑](#footnote-ref-5)