# 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. Notwithstanding the efforts to obtain measured data in as many cases as possible, establishing Food Balance Sheets is often a process that starts with a rather limited set of actual collected or measured data. 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 rate. For this round of FBS revisions, the changes in these 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 The commodity list traditionally used in the system, the so-called FAOSTAT commodity list (FCL), has been replaced by adopting a system of international classifications. In particular the Harmonized System (HS) will be used for all trade variables, and the UN Central Product Classification (CPC) expanded for FAO purpose will be used 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. Arguably, the most 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.

A number of overarching findings emerged from these revisions. They have also informed the revisions of the various approaches and methods. Most 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-2).
* The new methodologies seek to harness innovations in both statistical approaches and 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 QAF will be achieved as both frameworks mature.

The rest of this document is organized as follows. The first section lays out the details of the new balancing mechanism. It introduces the balancing mechanism, standardization and the methods to identify measurement errors.

The subsequent section introduces the innovations for all individual components. It starts with the supply side variables, i.e. production, imports, exports and stock changes, which are then followed by the description of all utilization variables, namely food, feed, seed, losses and waste, industrial use and tourist consumption. 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.

# The purpose of this document

This document provides an overview of the innovations introduced with the new Food Balance Sheets methodology. The emphasis is placed on providing an overview of individual innovations, their motivation and how the various innovations are linked to each other. It uses illustrations and examples where possible to explain the nature of the various innovations. As an overview it can be read from front-to-back. It may whet the appetite to dig deeper into methodological or practical aspects of any or all of the innovations presented.

The document is, however, not a surrogate for the detailed description of the methodologies used for every change and innovation. These are provided as separate documents and reference is made to them at the appropriate juncture inside this document. The document is not meant to be a document to help roll out the new methodology to FAO member countries. Such a step-by-step introduction to the new Food Balance Sheets will be provided at a later stage. It will be part of an overall package that includes “worked examples”, e-learning material and a multitude of practical applications, including a software package that allows practitioners to implement the methodology at country level.

Finally, many of the innovations developed will be applied to balances for non-food products such as cotton, jute or rubber. The difference to and analogies with the FBS system will be laid out in a separate document.

The IDWG-Statistics will be invited to review all methodological documents and to provide comments and suggestions for further improvements. At a later stage, comments will also be sought on all new capacity development materials.

**Overview[[2]](#footnote-3)**

Food balance sheets show for each food item (usually expressed in primary commodity equivalents, with a few cases expressed as processed products) the amounts of supply and utilization of foodstuffs[[3]](#footnote-4). 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 capita 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 at the retail level and in the household, 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 these are also 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, and 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. The links are formalized through extraction rates and a clear hierarchy spanning over up to four levels of processing.

When 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 conversion coefficient. There are several reasons for this standardization process. Firstly, there is to reduce excess information of many different and heterogeneous processed and primary products to a set of products that allow analysts and policy makers to obtain a quick and meaningful overview of the food economy of a country. Secondly, preparing standardized food balance sheets at an aggregate level makes the food supply and use data more comparable across countries and over time. Finally, many practical tools and applications such as projections models require a high level of product aggregation, in fact, often beyond the level of aggregation offered in the FAO FBS. For instance, FAO’s long-term outlook is based on 34 commodity groups derived from the 60+ individual commodities presented in the Food balance sheets.

## 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 worldwide.

1. Arguably the most important use of the food balance sheets arises from the fact that they provide a measure of the overall average calorie 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 FBS users 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 do not allow drawing of 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 estimates provided may simply be the average of unhealthy overnutrition and unhealthy undernutrition, while the average diet may appear to be about right in terms of volume and composition; thus, 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-5). 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 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 and simpler 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 trade policy 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 and surpluses 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 commodity supply and food commodity utilization. The data are regularly revised: 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, e.g. that 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:

1. 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 FBS users to draw inferences on the average diet, but not on 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 be and are being used either as a contributing factor or the sole basis for the analysis of food demand and supply. They provide an approximate picture of the overall food situation in the countries.
2. The possibility of imputing missing data cannot replace 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 replace proper data collection. No model-based approach can substitute for, let alone produce more accurate information, than actual data collection. It is therefore imperative that countries, in the process of creating their own FBSs, 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.
3. 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, and were either collected or estimated years ago and are still used. They are also needed in the assessment of feed use, the calculation of nutrients contained in the foods, 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 the least reliable, or at least most variable, item 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.
4. FBS results require careful interpretation. 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, the military or prisons, nor do they cover, at least completely, out of home consumption in restaurants, street food, etc. They are, however, 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-6).

1. [↑](#footnote-ref-2)
2. Drawn from <http://www.fao.org/waicent/faostat/agricult/fbs-e.htm> [↑](#footnote-ref-3)
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-4)
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-5)
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-6)