## Standardization

### FBSs and SUAs

In general[[1]](#footnote-2), food balance sheets present all variables of a supply-utilization balance in their primary equivalents. For instance, in the balance for wheat all elements are expressed in wheat as a primary product, while the only variables that are readily available in their primary forms are production and, in principle, seed use of wheat. In many cases, information in terms of primary equivalents is not available or only partially available. Imports or exports of wheat, for instance, take place in the form of wheat, but also in the form of different wheat products such as flour (1st level of processing), bread or pastry (2nd level of processing) or even more processed forms.

Some variables of the balance may be exclusively available in their processed terms. Food of wheat, for instance, only exists in the form of flour, or in the form of flour products such as bread, noodles, pastry or biscuits. Wheat is practically never eaten as such; the same holds for all other cereals and indeed many primary products.

Given the fact that all variables of the balance (except production) occur in practice in forms other than their primary form, all variables need to be converted back to primary equivalents. This allows comparisons of the various variables with each other, and eventually the union of them together into a balance. Put differently, only if all elements are expressed using a common denominator can they be added up in the FBS balance. To this end, the FAO Statistics Division has developed a process known as “standardization”, which is analogous to a process of creating a common denominator that allows processed products to be added up and expressed in their primary product equivalents. The different processing steps in the food chain create many processed products which all need to be “rolled-up” into their primary equivalents. Supply and use of these processed products are also put into balances, which are here referred to as Supply Utilization Accounts (SUAs), at least by the FAO Statistics Division. Even if the naming convention reflects tradition rather than statistical or economic rationale, it has been maintained here for the sake of simplicity and continuity.

The new methodology has adopted the standardization method of the previous method in principle. It largely maintains existing processing streams and thus the same commodity tree structure. The standardization programmes have been re-written in the R language and a number of problems have been addressed in this process. Important changes have also been implemented in the parameters that link the processing levels, notably the so-called extraction rates. The same holds for other parameters, such as nutrient conversion factors and shares of uses (splitting utilization side). Please see the section beginning on page 89 for a concrete description of the standardization process.

*Extraction rates (ERs).* Extraction rates reflect the amount of primary product that sits in the next level of processed product; for instance, the extraction rate of wheat flour is, without going into the specificities of a country’s milling sector, about 0.79. This simply means that 1 tonne of wheat that goes through a country’s flour milling industry renders on average 790 kg of flour. In addition to the flour production, flour milling also produces a certain amount of bran, on average 180kg as well as a certain amount of wheat germ, e.g. 20kg. The remaining 10 kg are losses that occur in the milling process. A detailed account of changes in the used extraction rates is dealt with in a separate document; thus, it should suffice here to identify the two major developments that have caused changes in the ERs. The first is a shift of the definition in the product definition, brought about by the shift to the Central Product Classification (CPC). Generally this rendered lower extraction rates. In the case of wheat, this is simply a reflection of the fact that the degree of purity in CPC is higher, i.e. wheat is defined without groats and pellets. The second is the recognition of the fact that some ERs are far from their expected values and not grounded in any empirical evidence. Such extreme values have been reviewed and, where necessary, adjusted.

Another important change in the use and calculation of extractions rates was that all extraction rates are now exogenously assumed. In the past, some extraction rates were implicit (endogenous), calculated from available information for processed production (e.g. flour) and an allocation of primary products for processing (e.g. wheat). While endogenous extraction rates are largely limited to developed countries and a limited number of products, this process often created implicit extraction rates with highly unlikely values. For Japan’s cereal sector, for instance, the extraction rates were unduly low, suggesting that the country’s flour milling industry is processing wheat in an inefficient way. In reality, the opposite is true. The reason for the low implicit extraction rate lies not in a low estimate for flour produced in Japan, but in the high allocation of wheat going into its flour milling industry. The new approach therefore is to keep flour production as a starting point, apply a reasonable extraction rate and calculate primary food (in this case wheat) based on flour production and the given extraction rate. The added advantage of this process is a simplification in the standardization method and the possibility to get rid of a complicated ex-post reallocation process between processed products.

*Nutrient conversion factors.* Food balance sheets provide an account not only of quantities of food supplied and utilized, but they also provide an account of key nutrients, such as calories, protein and fat. Other nutrients could be added. As food products are typically eaten in processed form (rather than primary), nutrient conversion factors also apply to and are available for processed products. The new approach applies caloric conversion factors typically at the 1st level of processing. For the example of wheat, this means that caloric, fat and protein conversion takes place at the flour level. The nutrient conversion for biscuits takes place when biscuits have been split up according to their shares, at the level of sugar, flour and vegetable oils.

*Product specificity*. Products of the same name and classification but from different provenances may have different characteristics in terms of nutrient contents and food values. Grass-fed beef from Argentina, for instance, is typically less caloric than corn-fed beef from the US. The same holds for many fruits and vegetables, other meats, and even cereals of the same type from different countries or farming systems. There is a growing recognition of the need to account for these differences in the standardization process and in applying more specific calorie conversion factors. Additionally, such factors should be continuously studied over time and adjusted when necessary. There are plans to account for these specificities in future versions of the SUA/FBS system. While there is awareness of the problem, the specificities are limited to region-specific calorie conversion factors.

*Shares for different uses.* In the current approach, the utilization side is constructed by applying fixed shares to availability. This applies to feed, waste, food manufacture and in part also to other variables. The new approach made an effort to determine all forms of utilization by the factors that drive them rather than applying simple shares to availability. This means that shares in the previous methodology (e.g. for feed or waste) are no longer required. The shares of food that enter a manufacturing process outside the normal commodity trees are a notable exception. Such shares can be based on historical allocations in such processes, if available, or from global average allocations.

*Shares for food manufacture.* For some FBS commodity trees, the underlying set of processing activities is rather diverse, resulting in many links between trees. These commodities are pruned off the main trees and crafted into the FBS as a separate balance. As separate branches, they re-enter the balances as processed rather than primary products. They include products such as sweeteners, beer, or other alcoholic beverages. During the process of food manufacturing and processing, these products often receive inputs from several FBS commodities. As an example, beer can and is being produced from many different starchy inputs, i.e. barley, maize, wheat, or sorghum, but also more exotic products such as bananas or plantains. In order to avoid double counting, they need to be identified as separate products in the FBS, and are not included in the original commodity tree. The shares allocated to these manufacturing processes have been reviewed and adjusted where needed. All other products will be standardized up the commodity tree from which they were produced.

## SUAs and processed products

Every primary product is the basis for a broad variety of processed products. A modern food-processing sector is characterized by a vast variety of different products; the further one goes down the processing chain, the more possible combinations and varieties of food products there are. Information from the USDA database on food nutrients (ARS SR 27[[2]](#footnote-3)), for instance, suggests that out of the 10 basic commodity groups (cereals, oilseeds, etc.) and the 60 primary FBS commodities, the US food industry produces more than 8000 different food products. These products can be consumed in the US but also be exported to destinations abroad. No doubt, not all 8000 processed food products are genuinely different in their food composition; many are simply different brand names with the same or similar combinations of first level food processing products. But the many different combinations suggest that the variety of food products is indeed large and that many more than 60 products are being eaten and traded. Trade information is available for about 3000 products. About 300 are genuinely distinguishable in terms of their composition and need to be converted into their primary equivalents.

## SUAs and commodity trees

Standardization, i.e. the conversion and subsequent aggregation of processed products into their primary equivalents, aims to bring these products into a hierarchical order that reflects the various food processing chains in which primary products are converted into their processed equivalents. The most straightforward way to depict the hierarchy is in the form of commodity trees. The primary product, say wheat, represents the stem of such a tree. The main components of the first level processing (flour, bran and germ) form the main branches of the tree; eventually these split into ever finer twigs of higher levels of processing (bread, rolls, or dextrose). The hierarchy between various levels of processing captures the various steps of processing; the different levels and products are connected through the extraction rates (see Figure 2 below and other examples in section on classifications).



Figure 2: Standardization of wheat, processing flows

A single tree cannot capture the fact that modern food processing connects such trees by combining the processed products of one tree with those of other trees (refined sugar with flour and refined vegetable oils, see below), or processed products with primary products such as milk and eggs with flour and vegetable oils for other bakery products. This means that the trees are actually connected with one another through processed food products. The trees also provide connections at lower levels of processing, e.g. wheat or maize germ is connected to the balance of vegetable oils; likewise, bran, the other 1st level by-product of flour milling is connected to the feed balance (see section on feed use).

A review of the existing programmes revealed a number of issues. They included programming errors, breaks in the structure of the trees, hardcoded and undocumented exceptions, or as outlined above, inappropriate conversion factors. These problems become most visible when standardization leads to obviously wrong results, most notably negative utilization. Figure 3 below provides just one example of how wrong standardization can and indeed has led to increasing negative utilization. The current revisions tried to identify as many of these cases as possible and address them by using appropriate shares, identical commodity trees for different variables/elements of the balance and more reasonable extraction rates. These rates should be periodically reviewed and updated to ensure they remain valid.

Figure 3: Standardization and negative utilization

## Standardization and trade

Notionally, all commodities of the SUAs are to be standardized, i.e. all underlying processed products are to be converted back into their primary equivalents. If, for instance, wheat is stored in terms of flour, these quantities would need to be converted back into their wheat equivalents for stocks. Indeed, where data are available, this is being implemented. In practice, however, the lion’s share of information about processed products use and supply is limited to imports and exports.

*Data availability*. While information about trade is both most reliable and most detailed, not all countries report, and by far, not all countries provide information for all processed products. Details are available by region, year, and individual country on the UN Comtrade webpage[[3]](#footnote-4). To overcome incomplete and unreliable trade information, a trade matrix has been constructed that fills missing flows and where necessary, i.e. unreliable, overwrites even officially provided trade information. Overwriting official trade information is kept to the absolute minimum (see section on trade); it is done with the aim to create a system of trade flows that is fully square, i.e. where total imports match exports for every commodity. This offers the added advantage that at world level the FBS balances show balanced trade and more importantly, no country has food supplies in excess or deficit only because of non-reported or underreported trade.

Products of the same name and classification but from different provenances have different characteristics in terms of nutrient contents and food values. .While there is awareness of the problem, these subtleties could not be implemented in the current version of the system.

### The Standardization Algorithm

The specifics of the standardization process are outlined below:

1. For a few commodity trees (such as the sugar cane and beet trees), the balancing level is not at the top level of the commodity tree. For example, we balance these commodity trees at the raw sugar level rather than the sugar cane/beet. In these cases, the primary product is processed immediately with all supply (minus small allocations to seed, feed, etc. if applicable) being converted down the commodity tree.
2. We then take the full SUA table of elements, and we create a balance for each processed commodity:

* If there is an imbalance such that supply exceeds utilization for some commodity, we can balance this commodity by allocating the difference to food/feed/etc. (whatever is most relevant for that commodity).
* If utilization exceeds supply, then we balance by creating production of this element.
* If production is official, we balance the commodity by adjusting the food/feed/... elements accordingly to create a balance (as trade and production are fixed when they are official).

1. Some processed commodities can be created from several "parent" products. Lacking better information, we define shares for these processed products based on the proportional availability of all parents. For example, suppose breakfast cereals are created from only wheat and oats, and that the availability of wheat is twice that of oats. Then, we assume twice as high of a "share" for wheat to breakfast cereals than the "share" of oats to breakfast cereals. Shares are uniquely defined by assuming that the shares from one commodity to all it's parents must add to 100%.
2. Using the shares previously computed, we standardize all SUA elements up to the "balancing level." For standardization of quantities, this involves summing quantities after dividing by extraction rates; for standardization of calories this is a simple summation. For most commodity trees, the "balancing level" is the primary level, but in the case of some commodities (such as sugar) this is a processed level. The share is used to define the proportion of a commodity standardizing up into its parents. Some elements are not standardized:

* Production is not standardized for commodities below the balancing level; this is because the production of these processed commodities is simply just the conversion of the parent commodity into the processed commodity. It differs from true production of a primary product where food is actually created.
* Some commodities (such as beer, wine, etc.) are standardized back to different parents than how they were created. In this case, the production (and only the production variable) of beer, for example, must be standardized back to wheat as the amount of wheat utilized for food processing.

1. At the balancing level, there is likely an imbalance between supply and utilization. Each element is therefore updated based on its expected variability (see the section on balancing), and a final balance is achieved. As quantities are adjusted, calories should also be scaled up or down in proportion to the adjustment applied to the food element.
2. Lastly, the balanced level items are summed together to create the various FBS aggregates.

1. Some few products are specified as processed products, such as butter or vegetable oils. [↑](#footnote-ref-2)
2. http://www.ars.usda.gov/Services/docs.htm?docid=8964 [↑](#footnote-ref-3)
3. http://comtrade.un.org/db/mr/daReportersResults.aspx [↑](#footnote-ref-4)