Food Balance Sheets

# Food Balance Sheets Compilation at the national level

This chapter provides a step-by-step introduction to the practical compilation of FBSs, starting with the detailed Supply Utilization Accounts (SUA) of a given country in a given year. It exemplifies the calculation based on a selected number of commodities. It finally shows how the SUAs are aggregated into primary equivalents as presented in the FBS, the so-called standardization process.

As laid out earlier, the basic challenge is to populate a simple identity that balances all forms of supply with all forms of utilization. This holds for the highly disaggregated SUAs as well as for the primary product equivalents as shown in the FBS. The supply side is defined by the sum of its constituent variables:

Supply: **Production + Imports - Stock changes [[1]](#footnote-1)=**

While the utilization side is defined by:

Utilization: **Exports + Food + Food Processing + Feed + Seed + Tourist consumption + Industrial use + Loss + Residuals/other utilizations**

## Wheat

In a first example, we will first consider the full process for creating a food balance sheet for wheat. Note that if we do not otherwise mention the units, all quantities are in tonnes. We start with an empty SUA table () showing some commodities of the wheat "commodity tree" (wheat as the primary commodity, flour, etc. as the processed commodities). In this table, a dash (i.e. "-") will indicate that a value is currently unknown.

Table 1: Initial SUA table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | - | - | - | - | - | - | - | - | - | - | - |
| Wheat flour | - | - | - | - | - | - | - | - | - | - | - |
| Bulgur | - | - | - | - | - | - | - | - | - | - | - |
| Breakfast cereals | - | - | - | - | - | - | - | - | - | - | - |
| Wheat starch | - | - | - | - | - | - | - | - | - | - | - |
| Wheat bran | - | - | - | - | - | - | - | - | - | - | - |

### Production

For production data, we first fill in the table with any available official figures. To impute any missing production figures, we must also consider "yield" and "area harvested" data (in the absence of "area sown" data), since yield is defined as production divided by area harvested (and thus with any two variables the third is uniquely defined).

Suppose we only have the official data below. Please note that for the sake of demonstration we have considered the flour production quantity as given, and the wheat as unknown and must therefore be imputed (). In reality, of course, it is almost always the reverse (with wheat production officially available, and flour less so):

Table 2: Introducing production into the wheat table

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Area Harvested (hectare) | Yield (tonnes/hectare) | Production (tonnes) |
| Wheat | 18,500,000 | - | - |
| Wheat flour | - | - | 18,650,000 |

In this case, the production quantity is only known for wheat flour (it is missing for wheat), and for wheat we are also missing the yield value. The procedure for determining how to impute production data is:

* If all three variables are available, we use any two variables in the **Yield = Production / Area harvested** formula to cross-check the third variable. If the formula indicates an error for one of the given variables, a quick time-series check should identify the incorrect value.
* If only two variables are available, the third is computed with the above formula.
* If only data for production or area harvested are available, we impute yields using its historical time series (using the ensemble approach described in detail in Chapter 2). The other missing element would then be calculated using the aforementioned formula.
* If only the yield variable is available, we impute production using the historical time series (using the ensemble approach); then using the formula as above, the area harvested would be calculated.
* If all three variables (area harvested, yield, and production) are missing, we impute yield and production data using the historical time series (using the “ensemble’ approach). The area harvested would then be calculated by the formula: Area harvested = Production/Yield.

In this example, we need to impute the yield. In the graph below, several models are fit to the historical yield values (models are represented as lines and historical data as points). These models are combined in a weighted average (where the weights are chosen based on how well the model fits the data) to form a final ensemble of models. This ensemble is used to predict the yield value in the current year.

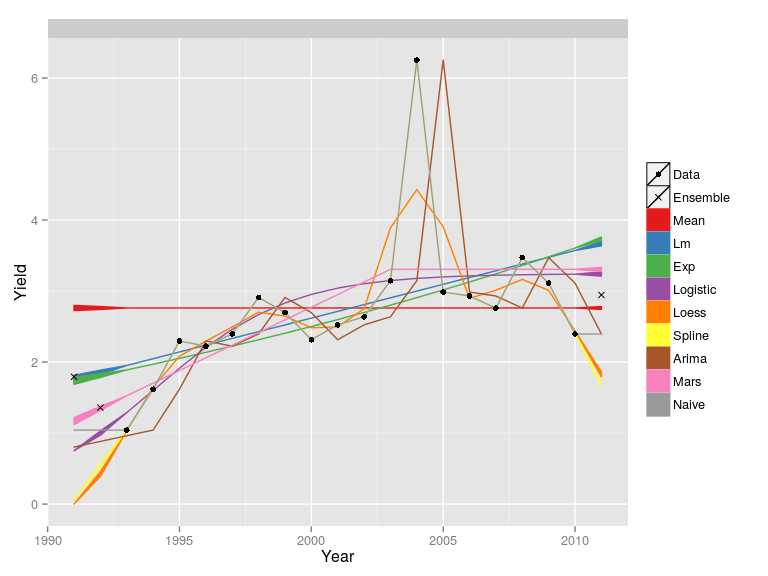


Figure 1: Ensemble modelling results for yield estimates

The final imputed value for yield in the most recent year (shown in the graph above as the last "x" representing the "ensemble" imputation result) is 2.94 tonnes/hectare. This is a reasonable estimate when compared to the historical time series. Some models () fit the data fairly well (such as the logistic regression, spline, and ARIMA). Some of these models do not produce good forecasts (in particular, the forecast for the loess model is quite low), but by averaging together well-performing models, we get a good final estimate for the yield. See Chapter 2 for further details on these models and the ensemble imputation approach.

Table 3: adding yield estimates to the SUA table

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Area Harvested (hectare) | Yield (tonnes/hectare) | Production (tonnes) |
| Wheat | 18,500,000 | 2.9422 | - |
| Wheat flour | - | - | 18,650,000 |

Now, we have enough information to compute the production data:

Table 4: completing the SUA table for wheat production

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Area Harvested (hectare) | Yield (tonnes/hectare) | Production (tonnes) |
| Wheat | 18,500,000 | 2.9422 | 54,420,000 |
| Wheat flour | - | - | 18,650,000 |

Next, we fill in the table with our imputed and official production quantities. Production is only imputed for primary products (and occasionally official figures are provided for processed products, as is the case here). So, in this case, no additional quantities are filled in outside of wheat and flour. FBS compilers at country level are however encouraged to add estimates for activity levels (area harvested for crops and herd sizes for livestock) as well as productivity estimates (yields and cropping intensity for crops and slaughter weights and take-off rates for livestock) to the FBS and SUA tables. This provides users of FBS tables are more complete picture of the supply side and additional information for policy decisions (e.g. promoting activity and/or productivity measures in case of a lack of production).

Table 5: SUA table with wheat and flour production

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | **54,420,000** | - | - | - | - | - | - | - | - | - | - |
| Wheat flour | **18,650,000** | - | - | - | - | - | - | - | - | - | - |
| Bulgur | **-** | - | - | - | - | - | - | - | - | - | - |
| Breakfast cereals | **-** | - | - | - | - | - | - | - | - | - | - |
| Wheat starch | **-** | - | - | - | - | - | - | - | - | - | - |
| Wheat bran | **-** | - | - | - | - | - | - | - | - | - | - |

### Trade

Trade data are usually recorded in much greater detail than presentable in the FBS tables, including a large number of processed products belonging to a given primary product of the FBS. The national trade dataset is usually provided by the customs office and will should consist of detailed quantity and value flows for imports and exports, typically classified by commodity using the Harmonized System (HS) codification. Trade data are available by partner country at least at annual frequency, sometimes also for monthly flows. The level of commodity detail is country-specific, with some countries reporting at the basic standard 6-digit level of the HS, while others go up to 12-digit HS detail (please refer to the section on trade data on page xx for more detail). Ideally, the country codes used should follow the international standard codes of the M49 country classification.

The total imports and exports for each commodity in this example, such as wheat, are obtained by aggregating the respective trade flows by partner. A typical trade dataset with wheat data would look like as displayed in (the dataset has been simplified for this example):

Table 6: trade flow information for wheat and products in HS6

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | reporter | partner | HS6 code | flow | Weight(kg) | Value (US$) |
| 2014 | 950 | 932 | 100110 | 1 | 3,350,000 | 502,500,000 |
| 2014 | 950 | 899 | 100110 | 1 | 1,200,000 | 264,000,000 |
| 2014 | 950 | 961 | 100190 | 2 | 870,000 | 113,100,000 |

In the country codes refer to a specific reporter and three different partners. The HS codes are a standard 6-digit, in this case indicating wheat (for more information on the HS classification please see the footnote/link in the trade section). The flows (1) and (2) indicate imports and exports, respectively. The quantity weights are in kilograms and the values are, in this case, in US Dollars. The totals for wheat imports would be obtained by summing up all the import flows, and likewise for the total exports (a typical trade dataset would have many more flows than the simple example above). For the compilation of the FBSs we are only interested in the quantities, and not in the monetary values[[2]](#footnote-2). We can now insert the total import and export quantities for wheat, as well as the other commodities, into the SUA table.

Table 7: adding trade information to the initial SUA tables

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | **1,999,100** | **32,790,000** | - | - | - | - | - | - | - | - |
| Wheat flour | 18,650,000 | **341,500** | **572,800** | - | - | - | - | - | - | - | - |
| Bulgur | - | **-** | **-** | - | - | - | - | - | - | - | - |
| Breakfast cereals | - | **312,500** | **217,300** | - | - | - | - | - | - | - | - |
| Wheat starch | - | **624,900** | **224,500** | - | - | - | - | - | - | - | - |
| Wheat bran | - | **2,589,000** | **2,343,700** | - | - | - | - | - | - | - | - |

We note that quantities for bulgur are missing. A historical time-series and “mirrored” trade data checks indicate that a quantity should be imputed here. The historical time-series check shows that there has been trade in this commodity in each of the last, say twenty, years. The “mirrored” trade data check indicates that there is trade for this country in bulgur in the year in question. Please refer to the trade section in Chapter 2 for more details on “mirrored” trade data. If no estimates for mirrored flows are available for national FBS compilers, the missing trade data (here for bulgar) can be obtained from trading partner data available on the FAOSTAT website[[3]](#footnote-3). We can now insert the "mirrored" imports and exports for bulgur, as shown in :

Table 8: completing trade data through imputing missing flows

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | - | - | - | - | - | - | - | - |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | - | - | - | - | - | - | - | - |
| Bulgur | - | **182,900** | **580,000** | - | - | - | - | - | - | - | - |
| Breakfast cereals | - | 312,500 | 217,300 | - | - | - | - | - | - | - | - |
| Wheat starch | - | 624,900 | 224,500 | - | - | - | - | - | - | - | - |
| Wheat bran | - | 2,589,000 | 2,343,700 | - | - | - | - | - | - | - | - |

Lastly, data quality validation indicates that there is a quantity error for wheat bran imports, based on median unit-value analysis in the original trade dataset. The unit-value is the monetary value/quantity (weight, numbers, etc.). Please refer to the trade section for more detail. In this case, the quantity error is simply an extra digit error; the actual quantity should therefore have one less zero (to reflect the correct import unit-value). We do this quantity correction and obtain the corrected trade data as shown in :

Table 9: Improving trade data by fixing obvious reporting errors

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | - | - | - | - | - | - | - | - |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | - | - | - | - | - | - | - | - |
| Bulgur | - | 182,900 | 580,000 | - | - | - | - | - | - | - | - |
| Breakfast cereals | - | 312,500 | 217,300 | - | - | - | - | - | - | - | - |
| Wheat starch | - | 624,900 | 224,500 | - | - | - | - | - | - | - | - |
| Wheat bran | - | **258,900** | 2,343,700 | - | - | - | - | - | - | - | - |

So far, we have demonstrated how to complete the supply side of the SUA table for wheat. To demonstrate how a SUA table can be produced through imputation, we assumed that information available to FBS compilers is very limited. To demonstrate other imputation approaches on for demand variables, the same basic assumption of very scant information will apply again in filling up the SUA tables for the utilization side. It must be noted however, that the sole purpose of this assumption is to demonstrate the application of imputation methods. It is by no means intended to discourage FBS compilers to collect reliable and measured data. As mentioned throughout this book, quite the contrary holds. Solid FBS tables require solid data and therefore data collection through censuses, surveys or at least administrative data.

### Stock Changes

We now estimate the stock changes. Generally, stocks will be held for a select number of primary level products (such as wheat or rice). The numbers below represent the estimated stock changes for the example country we are considering. The stock imputation methodology, as described more thoroughly in Chapter 2, estimates stock change in the current year as a linear regression on the cumulative stock changes in the previous years. In this case, our estimate represents a withdrawal (hence the negative sign) in the stocks held. The basic idea behind this assumption is that a drawdown in stocks will be all the more likely, the high the accumulation of stocks was in the past and vice versa. The results of the imputation are shown in .

Table 10: Adding stock changes to the SUA table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | **-230,600** | - | - | - | - | - | - | - |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | **0** | - | - | - | - | - | - | - |
| Bulgur | - | 182,900 | 580,000 | **0** | - | - | - | - | - | - | - |
| Breakfast cereals | - | 312,500 | 217,300 | **0** | - | - | - | - | - | - | - |
| Wheat starch | - | 624,900 | 224,500 | **0** | - | - | - | - | - | - | - |
| Wheat bran | - | 258,900 | 2,343,700 | **0** | - | - | - | - | - | - | - |

### Food

As explained in Chapter 2, there are several options to obtain estimates for food. In same case, food can essentially be obtained as the balancing item between supply and utilization. This can render good estimates where food is the sole of at least the main form of utilization, as is the case for the various meats, eggs, butter, or albeit to a lesser extent, milk and milk products. Food estimates can also be obtained by gathering data from first level processors such as flour mills, oilseed crushers, abattoirs, dairies, etc. Particularly where these industries reflect a bottleneck in the processing chain, i.e. cover a large share of the primary processing. For the sake of demonstrating imputation methods, we assume here that no such information is available and that assuming food as a balancing item is not a reasonable assumption. Instead, we show how to estimate food use based on previous estimates and changes in consumer income, etc.

To this end, we estimate food consumption from the previous year and extrapolates these estimates forward using changes in GDP and product-related income elasticities. The allocation to food can potentially be considered for any edible item at the SUA level; however, the food module estimates variables at the primary level only. This is done by estimating the food variable at the primary level if the commodity is eaten directly (this will not apply in the case of wheat) and by standardizing/aggregating all the processed consumption quantities to the primary level in the "Food Processing" variable. We now impute food consumption for the example country and update the SUA table () below.

Table 11: imputing and adding food estimates to the wheat SUA table

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | **0** | **26,720,000** | - | - | - | - | - |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | - | - | - | - |
| Bulgur | - | 182,900 | 580,000 | 0 | - | - | - | - | - | - | - |
| Breakfast cereals | - | 312,500 | 217,300 | 0 | - | - | - | - | - | - | - |
| Wheat starch | - | 624,900 | 224,500 | 0 | - | - | - | - | - | - | - |
| Wheat bran | - | 258,900 | 2,343,700 | 0 | - | - | - | - | - | - | - |

### Feed

The Feed variable is then imputed (see the methodology described in detail in Chapter 2, based on the animal numbers and feed "intensification" factors, resulting in calculated “feed requirements”). The assumption here is that some of the primary level quantities are used as feed, as well as almost all of the bran (which is a by-product of the flour production process). The feed requirements apply at a country level.

The calculation of the feed requirements is laid out in Chapter 2. It shall suffice here to repeat the basic steps. The first step entails the calculation of feed requirement based on the number of animals, their needs and feeding efficiency. In a second step, the actual amount of compound and concentrate feed is calculated applying country-specific intensification rates. In a third step, individual feedstuffs are allocated by availability. Before so doing, all commodities with the sole purpose of being fed to animals (oil cakes and meals, DDGS, dregs, brans, etc.) are deducted from the requirements. The remainder of the feed requirements will be satisfied by allocating to the FBS commodities at primary level (such as cereals, oil crops, etc.) according to their availability. Negligible amounts of bran may go into such products as breakfast cereals, but for the sake of simplicity, such quantities will be ignored in this example.

The feed amount allocated to bran is computed using the food amount allocated to flour (as they are produced in the same process). Thus, we take the flour production, convert it into wheat by dividing by the flour extraction rate, and then compute bran production by multiplying by the bran extraction rate. Here flour production is given as official; if it must be calculated then we first must deduct from the wheat food quantity the amount which will be processed into other commodities (i.e. bulgur, breakfast cereals, etc.) to satisfy trade imbalances. Then, the remainder of the food variable is processed into flour, and we create the bran commodity in this process as well. The resulting estimates for feed use are filled into .

Table 12: Adding feed estimates to the SUA table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,720,000 | 4,898,000 | - | - | - | - |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | - | - | - | - |
| Bulgur | - | 182,900 | 580,000 | 0 | - | - | - | - | - | - | - |
| Breakfast cereals | - | 312,500 | 217,300 | 0 | - | - | - | - | - | - | - |
| Wheat starch | - | 624,900 | 224,500 | 0 | - | - | - | - | - | - | - |
| Wheat bran | **5,699,300** | 258,900 | 2,343,700 | 0 | - | - | 3,614,500 | - | - | - | - |

### Food losses and waste (FLW)

These refer to losses from the post-harvest stage up to, but not including, the retail level. Neither retail nor household losses/wastes are included in the FBS/SUA system. The methodology for calculating agricultural and food losses is continuously being revised and improved. Currently, the imputation methodology, as described in Chapter 2, uses information about the perishable category of a commodity and the country/region to estimate a hierarchical linear regression model. Also, it should be noted here that losses are assumed to occur only at the primary level, processing losses are taken into account in the standardization process.

Table 13: Adding FLW to the wheat table

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,720,000 | 4,898,000 | - | - | - | **560,300** |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | - | - | - | **0** |
| Bulgur | - | 182,900 | 580,000 | 0 | - | - | - | - | - | - | **0** |
| Breakfast cereals | - | 312,500 | 217,300 | 0 | - | - | - | - | - | - | **0** |
| Wheat starch | - | 624,900 | 224,500 | 0 | - | - | - | - | - | - | **0** |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | - | - | 3,614,500 | - | - | - | **0** |

### Seed

Typically, FBS compilers will try to collect estimates for seed use from surveys or administrative data or simply impute seed use by multiplying standard seed rates with estimates for area harvested/area sown. If neither of these sources is available, seed quantities can be imputed, e.g. based on the methodology described in Chapter 2. The seed module fits a hierarchical linear model to seed data in previous years and uses global data. Seed, of course, is only allotted to the primary commodity.

Table 14: Adding seed use to the SUA table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,720,000 | 4,898,000 | **1,904,200** | - | - | 560,300 |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | **0** | - | - | 0 |
| Bulgur | - | 182,900 | 580,000 | 0 | - | - | - | **0** | - | - | 0 |
| Breakfast cereals | - | 312,500 | 217,300 | 0 | - | - | - | **0** | - | - | 0 |
| Wheat starch | - | 624,900 | 224,500 | 0 | - | - | - | **0** | - | - | 0 |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | - | - | 3,614,500 | **0** | - | - | 0 |

### Industrial Utilization

For most commodities, there is no industrial utilization and therefore its quantity will be zero. The estimates for this variable are often taken from external sources; see the methodology discussion in Chapter 2. This variable can be important when considering commodities related to biofuels (such as maize) and vegetable oils (such as palm oil). For the wheat "commodity tree," the main commodity that has industrial use is "wheat starch." While considerable efforts have been made to device a useful imputation method, none was deemed fit for purpose. FBS compilers at country level are encouraged to collect the relevant data from their industry associations, as available.

Table 15: Addition industrial use to the SUA/FBS table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,720,000 | 4,898,000 | 1,904,200 | - | **0** | 560,300 |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | 0 | - | **-** | 0 |
| Bulgur | - | 182,900 | 580,000 | 0 | - | - | - | 0 | - | **-** | 0 |
| Breakfast cereals | - | 312,500 | 217,300 | 0 | - | - | - | 0 | - | **-** | 0 |
| Wheat starch | - | 624,900 | 224,500 | 0 | - | - | - | 0 | - | **-** | 0 |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | - | - | 3,614,500 | 0 | - | **-** | 0 |

### Tourist Consumption

As for all form of utilization, national FBS compilers may have access to accurate data for food consumption by tourists. They are encouraged to use these estimates for the compilation of FBSs. In the absence of such data, they may want to resort to the imputation process applied here and laid out in Chapter 2. The approach used here uses tourist data from the World Trade Organization (UNWTO) to compute tourist flows as well as previous year consumption patterns of the country of origin to estimate tourist consumption amounts while abroad. Note that tourist consumption can be negative; as an extreme example consider a case where many nationals travel abroad but no tourists enter. In this case, the country will have a negative ``tourist consumption'' because more calories will be consumed abroad than locally. Applying the imputation method laid out in chapter 2 allows us to add estimates to the SUA/FBS table for wheat ().

Table 16: Adding estimates for tourist consumption to the SUA table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,720,000 | 4,898,000 | 1,904,200 | **-39,800** | 0 | 560,300 |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | 0 | **0** | - | 0 |
| Bulgur | - | 182,900 | 580,000 | 0 | - | - | - | 0 | **0** | - | 0 |
| Breakfast cereals | - | 312,500 | 217,300 | 0 | - | - | - | 0 | **0** | - | 0 |
| Wheat starch | - | 624,900 | 224,500 | 0 | - | - | - | 0 | **0** | - | 0 |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | - | - | 3,614,500 | 0 | **0** | - | 0 |

### Standardization and Balancing

Now, suppose we have the following wheat commodity tree:

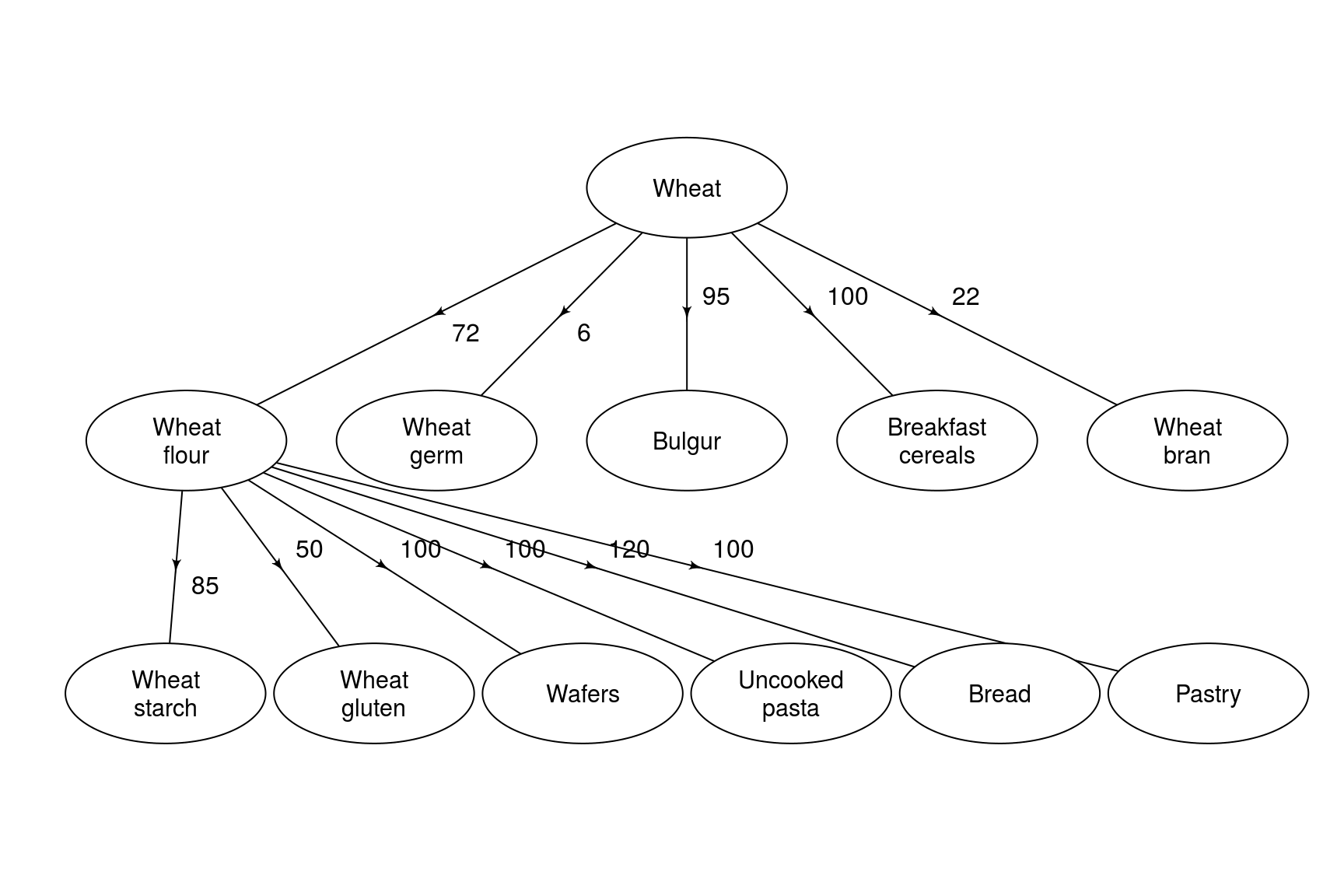


Figure 2: the processing/standardization tree for wheat and wheat products

We first start with the pre-standardized table that we have so far compiled ():

Table 17: initial, but complete pre-standardization table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,720,000 | 4,898,000 | 1,904,200 | -39,800 | 0 | 560,300 |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | 0 | 0 | - | 0 |
| Bulgur | - | 182,900 | 580,000 | 0 | - | - | - | 0 | 0 | - | 0 |
| Breakfast cereals | - | 312,500 | 217,300 | 0 | - | - | - | 0 | 0 | - | 0 |
| Wheat starch | - | 624,900 | 224,500 | 0 | - | - | - | 0 | 0 | - | 0 |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | - | - | 3,614,500 | 0 | 0 | - | 0 |

The initial "Food Processing" estimate was based on our module; however, we may have other information that need to be considered. For example, we know that we may have trade imbalances (e.g. exports higher than production + imports) or official production quantities of processed commodities, and these should inform the food-processing estimate. Thus, we will now calculate the production quantities of each processed/derived commodity where we do not yet have an estimate ().

Table 18: Wheat SUA/FBS table after the first standardization steps

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Pro-  duction | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,720,000 | 4,898,000 | 1,904,200 | -39,800 | 0 | 560,300 |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | - | - | 0 | 0 | - | 0 |
| Bulgur | **397,100** | 182,900 | 580,000 | 0 | - | - | - | 0 | 0 | - | 0 |
| Breakfast cereals | **0** | 312,500 | 217,300 | 0 | - | - | - | 0 | 0 | - | 0 |
| Wheat starch | **0** | 624,900 | 224,500 | 0 | - | - | - | 0 | 0 | - | 0 |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | - | - | 3,614,500 | 0 | 0 | - | 0 |

Since wheat starch is a derived by-product of wheat flour (as is wheat bran), we would first need to ensure the wheat flour "Food Processing" can cover any deficits of wheat starch. However, since wheat starch imports, in this example, exceed exports, we do not have to worry here about this requirement. Therefore, we can now standardize all the processed product quantities back to the "Food Processing" variable of wheat. The standardized quantities will, of course, be in the primary commodity (in this case wheat) equivalents. For example, suppose that 100 tonnes of a primary commodity produces 50 tonnes of the processed product (a 50% extraction rate). Then, these 50 tonnes of the processed product would be standardized back as 100 tonnes of wheat equivalent ().

Table 19: Accounting for derived products in the wheat SUA/FBS tables

|  |  |  |
| --- | --- | --- |
| Name | Production (processed) | Wheat Equivalent |
| Wheat flour | 18,650,000 | 25,910,000 |
| Bulgur | 397,100 | 418,000 |
| Breakfast cereals | 0 | 0 |
| Wheat bran | 5,699,300 | 25,910,000 |

The main requirement is in the wheat flour and bran, and these "two" requirements are really just one (as we already ensured that the bran production is consistent with the wheat production). In this case, since flour production is an official estimate (and accounts for the vast majority of wheat utilization), we should “fix” the "Food Processing" variable for wheat. Thus, the "Food Processing" variable of wheat is set to 26.3 million tonnes with a standard deviation of zero.

We now must ensure that we have generated all of the appropriate by-products in the processing of various commodities (). For example, when processing wheat into flour, we must also account for the by-products bran and germ. We must ensure that the production numbers for these processed products are in agreement.

Table 20: Complete, but still imbalanced SUA/FBS table for wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,330,000 | 4,898,000 | 1,904,200 | -39,800 | 0 | 560,300 |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | - | **0** | - | 0 | 0 | - | 0 |
| Wheat germ | **1,554,300** | **0** | **0** | **0** | **-** | **0** | **-** | **0** | **0** | **-** | **0** |
| Bulgur | 397,100 | 182,900 | 580,000 | 0 | - | **0** | - | 0 | 0 | - | 0 |
| Breakfast cereals | 0 | 312,500 | 217,300 | 0 | - | **0** | - | 0 | 0 | - | 0 |
| Wheat starch | 0 | 624,900 | 224,500 | 0 | - | **0** | - | 0 | 0 | - | 0 |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | - | **0** | 3,355,500 | 0 | 0 | - | 0 |

Some of the SUA lines are not balanced, and this is because we have not allocated utilizations in the case of excess supply. For these commodities, we should allocate the excess trade amount according to the variable, which makes the most sense for that particular commodity (or, multiple variables if we know the split share at which a commodity is utilized).

Table 21: allocating excess trade for the SUA/FBS table of wheat

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Food Processing | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 1,999,100 | 32,790,000 | -230,600 | 0 | 26,330,000 | 4,898,000 | 1,904,200 | -39,800 | 0 | 560,300 |
| Wheat flour | 18,650,000 | 341,500 | 572,800 | 0 | **18,420,000** | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat germ | 1,554,300 | 0 | 0 | 0 | 0 | 0 | **1,554,300** | 0 | 0 | 0 | 0 |
| Bulgur | 397,100 | 182,900 | 580,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Breakfast cereals | 0 | 312,500 | 217,300 | 0 | **95,200** | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheat starch | 0 | 624,900 | 224,500 | 0 | 0 | 0 | 0 | 0 | 0 | **400,400** | 0 |
| Wheat bran | 5,699,300 | 258,900 | 2,343,700 | 0 | 0 | 0 | 3,614,500 | 0 | 0 | 0 | 0 |

The next step is to aggregate this full table back into the primary commodity equivalent (in this case wheat). The final quantity for wheat equivalent production is simply the current quantity for wheat production. This is because "production" of bulgur (or any other processed product) is really a conversion of wheat into bulgur and not actually a production of bulgur. Thus, the reported quantity for production will always just be the production at the primary product level.

To standardize imports and exports, we can aggregate the imports and exports of the derived/processed commodities up into their primary equivalent by dividing by the extraction rate. We add these primary equivalents to the current quantity of imports and exports of wheat, and we have our final, primary equivalent import and export quantities of wheat.

Food processing is not standardized. In fact, this variable is in the SUA simply to allocate quantities when one commodity is converted into another. Thus, we remove it entirely from the balance at this point.

Feed commodity quantities (such as bran quantities) are not standardized back into their primary (wheat) equivalent as they are feed products. Thus, they are not reported at all in the food balance sheet but are instead reported in the commodity balances under a category such as "brans." For the remaining variables, standardization follows the same process as for trade. We now have the following standardized table ():

Table 22: Fully standardized, but still imbalanced SUA/FBS table for wheat

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Production | Imports | Exports | Stock Change | Food | Feed | Seed | Tourist | Industrial | Loss |
| Wheat | 54,420,000 | 3,999,600 | 34,780,000 | -230,600 | 25,680,000 | 4,898,000 | 1,904,200 | -39,800 | 654,300 | 560,300 |

Now, we must balance to satisfy the FBS equation of supply equals utilization. To do this, we need to extract the computed standard deviations of each variable. The table below shows the expected value and estimated standard deviation for each of the variables for wheat. The equation is initially not balanced, and will be balanced by adjusting figures according to their standard deviations. For example, a variable with a large standard deviation (low data confidence) can be adjusted substantially, while a variable with zero standard deviation will not be adjusted at all, such as official trade data (see more on this algorithm in chapter 2). Below is the unbalanced table.

Table 23: Unbalanced table for wheat including measurement errors

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Production | Imports | Exports | Stock Change | Food | Feed | Seed | Tourist | Industrial | Loss |
| Mean | 54,420,000 | 3,999,600 | 34,780,000 | -230,600 | 25,680,000 | 4,898,000 | 1,904,200 | -39,800 | 654,300 | 560,300 |
| Standard Dev. | 489,800 | 0 | 0 | 89,900 | 0 | 244,900 | 228,500 | -39,800 | 0 | 56,000 |

After balancing, some quantities are updated (and some remain unchanged, if they have a standard deviation of zero). Therefore, we get the final table as below (), now reported as "Wheat and Products" as it includes wheat and all of the processed products.

Table 24: Accounting for inaccuracies in the estimates of the various SUA/FBS variables

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Production | Imports | Exports | Stock Change | Food | Feed | Seed | Tourist | Industrial | Loss |
| Mean | 60,850,000 | 3,999,600 | 34,780,000 | -447,200 | 25,680,000 | 3,289,100 | 503,500 | -82,200 | 654,300 | 476,100 |
| Standard Dev. | 489,800 | 0 | 0 | 89,900 | 0 | 244,900 | 228,500 | -39,800 | 0 | 56,000 |

### Calculating nutrient supplies

The standardization process converted quantities of processed products back to the equivalent quantities of wheat. In fact, standardization is all about aggregating quantities. All nutrients are calculated at the disaggregated SUA level, before standardization takes place.

We go back to the SUA table and apply the calorie/fat/protein content nutritive factors to all SUA items for a food quantity. These nutritive factors are obtained from national sources or from international standard tables. Note that a GJ is a measure of energy equal to a billion joules, or roughly 239,000 Calories; also, a Mg is one million grams. This process renders the nutrient supply levels as shown in

Table 25: Calculating nutrient supplies (calories, protein, fat)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Quantity | kJ Energy/kg Wheat | g Protein/kg Wheat | g Fat/kg Wheat | Energy (GJ/day) | Protein (Mg/day) | Fat (Mg/day) |
| Wheat | 0 | 14,200 | 123.40 | 18.65 | 0 | 0 | 0 |
| Wheat flour | 18,420,000 | 14,700 | 110.47 | 13.39 | 743,000 | 5,600 | 680 |
| Breakfast cereals | 95,200 | NA | NA | NA | NA | NA | NA |

Standardization of nutrients is now a simple last step: all the variables here (i.e. calories, fats, and proteins) are purely additive, so the standardized calories/fats/proteins are simply the sum of the total calories/fats/proteins for each commodity:

Table 26: Final total nutrient content from wheat and wheat products

|  |  |  |  |
| --- | --- | --- | --- |
| Commodity | Energy (GJ/day) | Protein (Mg/day) | Fat (Mg/day) |
| Wheat and Products | 743,000 | 5,600 | 680 |

To convert these figures into useful indicators, we may divide by the population of the country to obtain per capita data (). If we assume this country has 600 million inhabitants, we have:

Table 27: Final per capita nutrient content from wheat and wheat products

|  |  |  |  |
| --- | --- | --- | --- |
| Commodity | Calories/person/day | g Protein/person/day | g Fat/person/day |
| Wheat and Products | 296 | 9 | 1 |

1. Stock changes are here defined as Stt-Stt-1. They are currently defined in FAOSTAT as Stt-Stt-1. The new definition ensures that increases in stocks have a positive sign, whereas stock drawdowns have a negative one. [↑](#footnote-ref-1)
2. Monetary values can and are being used to impute missing quantity data, for details see Chapter 2. [↑](#footnote-ref-2)
3. These "mirrored" data are the total trade flows as reported by all other countries (trading partners) for this reporter. Thus, the "mirrored" imports are the exports of this reporter; and conversely for the "mirrored" exports. [↑](#footnote-ref-3)