The Food Balance Sheets of the Food and Agriculture Organization: A Review of Potential Ways to Broaden the Appropriate Uses of the Data

A Review Sponsored by FAO

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March 2002

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Issues of hunger and food security are always with us. Many disciplines and approaches contribute to a better understanding of food issues on a global basis, but for all of these approaches, it is vital to have reliable information upon which to base assessments and analysis. Better data does not guarantee better analysis or policy outcomes, but reliable information can be an important contributor.

The Food and Agriculture Organization (FAO) has for decades been a key contributor to the alleviation of food insecurity and malnutrition through research, policy advice and special programs, and data collection and dissemination. The basic FAO data regarding national food supply are contained in the Food Balance Sheets (FBS). These data are widely used and cited by research economists and other scholars as well as by public health officials and aid or development agencies. The FBS data have been an important contributor to analysis and policy creation. These data are useful for knowing where food insecurity is most prevalent and monitoring food security trends over time. They are also used for projecting future food insecurity. These uses of the data directly or indirectly affect the health and well being of poor people in many countries.

Given the importance of the decisions for which FBS data has an influence, it is imperative that users of the FBS have a good understanding of the data, including both its appropriate uses and its potential weaknesses. One purpose of this brief essay is to provide some background to help potential users better understand these data. In order to help potential users, we attempt to indicate where our review has suggested some concerns with the data. We attempt here to assess the construction of the FBS and to illuminate and explain the implications of problems with the FBS. Where these concerns may be addressed by FAO, we suggest some potential remedies. Also, we provide a brief summary and evaluation of how the FBS has been used in recent years. We then propose our own suggestions for how FBS data is most appropriately used.

Description of the Food Balance Sheet Data

The FBS comprise a very large set of information about food supply and use. These data show snapshots as food commodities travel from field or border to final market for domestic consumption. The files include more than 180 countries (and territories) and about 100 different food commodities. The units of observation are annual accounts for individual countries, and the flows deal with farm-level food commodities. The name of the data refers to the attempt to balance accounts in each country between supply of a particular commodity, production, imports and exports, and stock changes, and uses, food, feed, seed, waste, food manufacture, and other uses. Quantities are expressed in thousands of metric tons. Quantities of processed foods are measured in the amounts of the original farm commodities. Conversion factors tell how much of the parent food is needed to make the processed food. In calculating the supply of a commodity available for food use, all utilization activities apart from human food consumption are subtracted from the total supply. Additionally, the FBS include estimates of the nutritional characteristics of food available. These include calories/person/day, fat/person/day, and

protein/person/day. These are obtained by applying nutritional tables and related information to the amount of each commodity estimated for food use and dividing by estimates of national population. Whenever possible the FAO uses nutrient composition tables tailored to the specific country or world region.

Data used to develop the FBS come mainly from the governments of individual countries and are official estimates or counts. However, FBS data do include unofficial estimates and reports as well as adjustments and estimates made by FAO staff.

In the "Handbook for the Preparation of Food Balance Sheets," the FAO provides several cautionary notes regarding FBS data in general. FAO also addresses specific variables that may be troublesome. FAO lists known problems in the quality, completeness, and consistency of data it receives from multiple sources. FAO also warns that differences in definitions and methodologies between countries may lead to some incomparability of figures. Data related to changes in stocks are of particular concern, due lack of complete and quality data. FAO notes that variability in stock changes is a main motivation for publishing the FBS as three-year moving averages. However, the FBS are also provided as annual time series that are regularly updated and revised which can be manipulated to create averages over any number of years.

The best and most accessible source of detailed information on the construction of FAO Food Balance Sheets is contained in the various webpages available at the FAO Statistics Division's website <http://www.fao.org/ES/ESS/stats.htm>. Particularly useful sections are: "Handbook for the Preparation of Food Balance Sheets," "Food Balance Sheets: Application and Uses," "Food Balance Sheets and the Food Consumption Surveys: A Comparison of Methodologies and Results," and "Supply and Utilization Accounts and Food Balance Sheets--Background for your Better Understanding."

Suggestions for Potential Improvements in the Usefulness of Food Balance Sheet Data

The FBS are used for a variety of purposes, which we will later discuss. In order to improve how FBS are used, in this section, we highlight three important issues for both users of the data and the FAO. Our purpose is to enable users to make more careful use of the data and the FAO to make improvements where practical.

For this section we mainly have in mind the FBS from the on-line database from FAOSTAT which has annual time series data. Our main points will address documentation, comparability, and how to identify and cope with errors.

Documentation

Documentation is always an issue for careful data users. The tradeoff for those making data available is that full documentation is necessarily complex and may become a barrier for those who want a simple introduction to only a few basic statistics. But, full information on definitions and sources is required for serious data users. Some additional documentation that is useful is listed here.

1. The on-line FAO FBS portion of the database has no option to request indicators regarding what figures are FAO estimates or are unofficial. Ideally, there should be documentation for every statistic and every country, which explains if the data point is of official or unofficial origin or is an FAO estimate. In the FAO's Food Supply and Commodity Balance databases such documentation exists. However for statistics such as calories, fat and protein per person per day or food supply per person, which are derived from these unofficial or estimated figures, no notice is given of their alternative origins. Some documentation of how the estimate was made and why it was necessary to do so would guide users.

2. To better appreciate the importance of documentation, let us consider subsistence production and its incomplete presentation in FBS data. Subsistence or nomadic production of certain commodities is of great significance in several developing countries (for example, subsistence production accounted for 74% total 2001 maize production in Zimbabwe, 87% in Malawi, and 85% in Tanzania (Chaura)). When the FAO receives data which it deems to not account for subsistence production, it estimates subsistence production in one or more of the following ways: (a) looking for alternate sources of production data, (b) using national nutrition or consumption surveys (or those of neighboring countries) to attain an estimate of how much of the commodity is consumed, or (c) using a national nutrition survey to see average caloric consumption and then adjusting production figures based upon what percent of total production is deemed to be subsistence production (Tampieri). These processes are used to improve the accuracy and usefulness of the data, but the procedures are evidently informal and are not fully documented. Knowing that these adjustments occur but not knowing for which countries or for what percentage of production is a concern for serious users of the adjusted figures (food, calories, etc. per person). Perhaps of more concern is the appropriateness of making comparisons between countries whose data may have undergone such adjustments. In the current system users do not know what they are comparing and may have difficulty comparing their work to similar research that uses different data.

3. FAO is working to improve documentation of its data, and this is an important enterprise. Currently, documentation is provided over multiple FAO websites. A new endeavor is the Agricultural Bulletin Board on Data Collection, Dissemination and Quality of Statistics Project (ABCDQ) which names the government, ministry, or agency that provided data and also explains a general methodology of how the data was collected. Currently under development, the ABCDQ will seek to provide metadata for each country relating to concepts, definitions, classification of variables, "accuracy and reliability aspects analyzing ... errors associated with the estimates," information on where data are located and how to obtain them, and methods of data collection (http://apps3.fao.org/abcdQ). Still, there remains some uncertainty as to how errors in estimates will be analyzed (Gillin). ABCDQ will also evaluate the data as to its "relevance, accuracy, timeliness and punctuality, accessibility and clarity, comparability, coherence and completeness...." Although presently all such information is not available at high levels of detail for all countries, the ABCDQ project is an important endeavor and crucial to informed use of FAO data. When completed it should address several concerns we discuss.

Ideally, users would be best served a dynamic database with links and descriptive information. Links would display the origin of a particular statistic and any adjustments or estimation undertaken to create it. Statistics that derive from estimated or unofficial figures would be noted

as such. All descriptions of sources and methodologies could be accessed by country or statistic. Users would likely find this more usable and informative than the current situation of having to know where to look for documentation or explanation on the FAO website. This is a large task to design and complete, but one that would be worthwhile for serious users.

Coping with Inevitable Errors

In the "Handbook for the Preparation of Food Balance Sheets" as well as other FAO documentation, FAO acknowledges that the figures it supplies ultimately can only be as good as the underlying data. This underlying data from "a variety of sources" will necessarily be comprised of sources with differences in quality and in coverage of commodities for different countries. There are also problems of differing concepts, definitions, and methodologies involved in data gathering and generation among countries. To the degree that these are reported in the ABCDQ site, the user can be aware of them (after looking at the documentation for each country involved) and make any necessary compensations for their own purposes.

Since many numbers given in the FBS are estimates or adjusted, it is important to know the degree of associated potential error. Figures for feed estimates and stock changes are believed to be subject to considerable potential error (Gillin). As a result, the estimates of food supply derived by subtracting feed and stock changes would also contain substantial error. Currently, users of FBS do not have measures of the size of potential errors across countries of individual data points. Svedberg assessed the sensitivity to potential errors by the following methodology. For Sub-Saharan Africa Svedberg followed the FAO procedure for estimating the percentage of the population that is undernourished. He then introduced a 10% error in either direction in the estimate of daily caloric intake per person. He used the FAO's 1800 kcal/day individual minimum cutoff point and the FAO-estimated coefficient of variation. The result was a very large variation in the share of the population that was undernourished; at the lower and upper extremes 52% and 35%, respectively, of the population was calculated to be undernourished. Svedberg's exercise shows that data errors well within a plausible range have considerable effects on estimates of the share of undernourished populations. Furthermore when potential errors vary across countries, then food insecurity and hunger rankings may change.

Serious data users want information on the potential magnitude of errors in estimates and the sources of these errors. FAO data has generally undergone consistency checks, either by the government agency supplying the data or by the FAO who may compare incoming figures with past figures as well as checking balances for a single year (FAO, ABCDQ, "Handbook for the Preparation of Food Balance Sheets").

There have also been comparisons of FBS figures to other sources of data, though some of these are quite dated. Dowler and Seo compared calories per capita per day from FBS and national household consumption surveys for selected South-East Asian countries in the 1970s and found that FBS estimates are consistently higher by anywhere from 245 to 645 calories per capita per day. The FAO itself has conducted similar comparisons for developed and developing countries for a similar time period and found differences (FBS - household survey) ranging from -579 to +1100 calories per person per day (Dowler and Seo). Fox and Ruttan compared projections for production, disappearance, and deficit made by the FAO (using FBS data), IFPRI, and Iowa

State University for the years 1990 and 2000 in less developed countries. They found that the FAO trend scenario was closest to IFPRI's high population growth scenario; its predicted 1990 deficit was 30% less than IFPRI's. Smil argued based on Japanese and U.S. figures that "reduction of FAO means [of food availability] by 25 per cent would thus appear a sensible, conservative correction - at least for rich countries," to close the gap between the FBS and consumption surveys. He went on to suggest that across-the-board reduction of FBS availability estimates by 15-40% would bring them in line with actual food consumed. Svedberg goes so far to suggest that, with high quality consumption data and anthropometric data, there is no need for FBS data in assessing the state of nutrition in a country or region. These studies were all published before 1988. The FAO regularly updates and revises its Food Balance Sheets for current and past years. A new thoughtful comparison that takes into consideration the points addressed above is long overdue.

Clearly, there is potential for considerable error in FBS measurements. But comparisons with household surveys are extremely complex and the FBS would not be expected to replicate household surveys. Food and nutrient availability is not the same as food and nutrient consumption, neither of which are the same as *projections* of availability or consumption. Between household consumption surveys and food balance sheets there lie discrepancies in waste from cooking, waste from spoilage, plate waste, meals not eaten at home (which are not included in some surveys), home production, in-kind payments, and food that does not reach the household from retail markets. Additionally there may be differences in which foods are covered by typical household surveys and by the FBS. Most researchers that make the comparisons acknowledge these factors to some degree and have attempted to account for some of the discrepancies. If we are to continue to compare balance sheets with household surveys, it is imperative to improve our understanding of the gap between them, perhaps with some combination of waste and spoilage studies, home production information and data on meals not eaten in the home.

Four of the statistics in the FBS are particularly prone error. First, FAO acknowledges variability in stock change data. This motivates FAO to average data over multiple years. They explain that there simply is little reliable data of food stocks. Second, feed data are also subject to considerable error, but this is not laid out fully in FBS documentation. Due to a general paucity and vagueness of data on feed utilization and problems with knowing how much grassland or range animals consume, feed statistics are, for nearly all countries, "guesstimates" (Gillin) which include residuals and other non-food uses (Gillin). Third, the Other Uses category of the FBS comprises non-food manufacture, food consumed by tourists, and statistical discrepancies in the balance. These three parts do not appear separately, and there is no way to examine them individually in the FBS. In some cases, this residual figure is negative, which is somewhat counterintuitive, but is a reflection of errors elsewhere in the balance. The following figures, which include data averaged over the years 1997 to 1999, indicate that for many countries, Feed or Other Uses categories comprise a substantial share of Total Supply, suggesting that errors or ambiguities in these figures may not be dismissed as unimportant.

	Number of countries in which feed/supply ≥ 10%	*Number of countries in which other use/supply ≥ 10%*
Wheat	48	27
Rice (milled equivalent)	12	19
Maize	125	59

Source: FAO online FBS database, retrieved 9/01

Finally, a fourth problem statistic is Food Supply (and consequently all other derived statistics are problematic). Food supply is calculated as the residual from subtracting all other utilization, including Feed and Other Uses, from Total Supply, including Stock Changes. Hence, Food Supply is a residual with unknown size or direction in its error created from variables that are subject to considerable error or contain other residuals.

The usefulness and validity of the FBS methodology depend on the quality of the data, which can be assessed only with full documentation. In light of the potential size of accuracy problems, it is worth exploring rearranging the categories that are used to create the food use data. For example, the statistical discrepancy portion of Other Uses might be its own category, and Feed, Stock Change, and the remainder of the Other Uses categories were to form a new category of all Non-food Uses of Current Supply. This new category would include both individual estimates of its components, as well as appropriate caveats warning of potential errors. Advantages of this proposed rearrangement are that there is less potential for misinformation and the more intuitive grouping separates estimates with error from pure statistical discrepancies. A potential disadvantage is that users would not be able to see so clearly the different paths that a food commodity takes on a single sheet.

Another method to highlight potential errors is to report intervals instead of point estimates, especially for caloric, fat, and protein availabilities (which are the result of another separate process of conversions based on the food and the country which entails its own errors). Alternatively if point estimates remain, reporting the errors for the estimates would allow the user to create ranges. Implementation of this hinges on the availability of necessary quantitative information on potential errors. It is possible for some countries to obtain data from multiple sources, which would provide an idea of any discrepancy. However, this issue also highlights the need for more recent comparisons of FBS data to other sources. While reporting intervals or errors would be more informative and perhaps more useful to planners and policy makers, there is a possibility that it may complicate calculations and the display of information.

How Food Balance Sheets are Used

The FAO suggests various uses for their FBS. The FAO cautions that the estimates for national food or nutrient availability do not deal with distribution of food or nutrient supply between regions with a country or among other groups of households. FAO suggests that the data may be used to: a) observe a country's food supply and its trends, b) compare food supply to nutritional requirements for healthy diets, c) estimate supply/shortage measures, d) evaluate food and

nutrition policies, e) measure the degree of chronic undernutrition, e) examine changes in diet patterns, f) investigate relationships between food supplies, famine, and malnutrition, g) calculate self-sufficiency and import-dependency ratios, h) set goals for trade and production, and project future supply and demand.

Uses of the FBS data include government policy and planning and research studies. We will focus on uses in the published literature. These focus on (1) food availability, food shortfalls, and identification of countries below recommended food/nutrient intakes; (2) comparisons of food/nutrient intakes or production among countries or over time; (3) constructing measurements of undernourishment; (4) evaluating food security; and (5) epidemiological research.

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. Also, trends and changes over time for the intake of energy and various nutrients are examined using FBS data. Using this information, countries, international agencies, and researchers can look for any shortfall or surplus in a nation's energy and nutrient intake (SADC, USDA/ERS) and can identify countries above or below certain standards (Pinstrup-Andersen). FBS data is also used to examine the availability of a particular commodity or class of commodities (el Obeid, Hopper, Helsing). These are important uses of FBS data. Informed researchers must be aware that potential errors exist in estimates, that availability is not the same as intake, and that the figures do not apply to distribution of nutrition within a country.

The USDA uses FBS data as an input to construct its own measure of food availability. They use FBS historical data for non-food use of commodities to estimate current and future non-food use, which they then subtract from their data on total domestic food supply (USDA/ERS). Since these FAO and USDA use similar methodologies and often the same basic data sources, there ought to be little methodological problem with this practice.

FBS data is also used to compare food availability over time and among countries (USDA/ERS, el Obeid, Hopper, Grigg 1996, Grigg 1993, Diaz-Bonilla, Smil, Pinstrup-Andersen). For instance, Hopper compares per capita daily supplies of calories in India, Japan, and China during the time period of 1955-1995. Grigg compares percentage of calories derived from starchy staples in developed and less developed countries between two time periods. We separate this as a distinct category of use in order to highlight issues of comparability among estimates across nations and time. Due to difference in definitions, data gathering, concepts, and methodology over time and among countries, as well as possible errors in estimation, inter-temporal and international comparisons involve their own set of rules and cautions. The validity of such comparisons depend on the quality and similarity of the data, definitions, and methodologies for the countries involved over time. In order to facilitate such comparisons over time, the FBS data is regularly revised for past years. To the extent that errors are similar over time or across similar countries, comparisons may be more accurate and useful than the actual level of food availability themselves.

A third major use of FBS data is construction of measures of undernourishment. These measures are used by planners, policy makers, and non-governmental organizations to direct resources to address nutritional concerns (Smith). Smith and Svedberg detail how the FAO uses FBS figures for daily per person caloric availability as the mean of a lognormal distribution of each country's caloric availability from which is determined a citizen of that country's probability of not meeting a minimum dietary energy requirement. (The spread of the distribution is determined by the variability in dietary intake over a country's population that is determined by a household survey.) Smith argues that under this methodology the prevalence of undernutrition is more or less determined by the figure for per capita daily energy supply which is taken from the FBS. Svedberg argues that such estimates of undernutrition are overly sensitive to the daily food energy supply. Pinstrup-Andersen compiled a list of all countries with daily per capita caloric intake less that 2200 calories a day as a loose index of undernourished countries. However, there may be enough error in the underlying data that one must use any ranking with extreme care. Svedberg's sensitivity analysis, which demonstrated notable changes in prevalence of undernutrition constructed using FBS caloric figures, suggests that errors well with a plausible range could easily change rankings substantially. Clearly, whenever household consumption or anthropometric data are available, it may be more appropriate to base estimates of undernutrition on these data rather than food balance sheet data.

Researchers have also used caloric and protein availability from FBS data to in creating other food security measures. Diaz-Bonilla, et al. include daily per capita caloric and protein intakes from the FBS with non-agricultural share of population, food production per capita, and the ratio of total exports to food imports and perform various clustering exercises. They create groups of different "types" of food security based on these variables. In this type of analysis potential error in FBS estimates is no less real but may be largely hidden behind a more complex statistical methodology.

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 may have clearer data and methodology.

Discussion of Uses of the Food Balance Sheet Data

The FBS is 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 part because of the regular revisions, the FBS data are valuable to monitor within-country trends in food availabilities. The FBS data are also used for information on food and nutrient availability at the national level. Additionally, they provide data for developing assessments and predictions of

surpluses or shortfalls of commodities at the national level. However, given the concerns about differences in concepts and methodologies and difficulties fully documenting these differences, comparisons of FBS food or nutrient availability among countries must proceed cautiously. Further, because food consumption, health environment, and poverty are not measured by the FBS, any measure of undernourishment or of food insecurity must use a large amount of additional information to supplement FBS data. The information contained in the food balance sheets comprise valuable tools best used in combination with complementary information.

As with any information source, the Food Balance Sheet data may also be abused. First, it is inappropriate to compare data for countries without knowing the whether definitions are similar and how much methodological differences or differential errors may affect estimates. Second, for information regarding individual variables that are likely to contain substantial error, a source other than the FBS may be a better choice as a primary source. Third, measuring the degree of undernutrition and assessing nutrition adequacy requires data beyond food availability, and such data are not supplied by the FBS. FBS data do not contain estimates of food consumption data. Since the FBS does not say who consumes what amount of calories, and since a household survey may not address for how long an individual consumed a certain amount of calories, it also seems questionable to base measurements of chronic undernourishment on either simple consumption surveys or the FBS.

Improved food and agricultural policy analysis requires quality data that addresses availability, consumption, prices, and the discrepancies between available food and consumed food. The FBS provide the most comprehensive information on availability for the most countries and commodities on only some of the useful indicators. The FBS do not report other data useful in food policy analysis. The FBS cannot be the sole source of information for food policy determination. Consider a dramatic global example. For the period of 1990 to 1992, Sub-Saharan Africa had a chronic undernutrition rate (as constructed by the FAO from FBS daily individual caloric estimates) of 43%, while in Southeast Asia the rate was 22%. However, based on other measures Southeast Asia had a rate of child malnutrition over 50%, as measured by stunting. Meanwhile Sub-Saharan Africa's rate of child malnutrition was less than 40% (Smith, Svedberg). Clearly, there is much more to understanding nutritional adequacy than just daily calorie estimates. Reasonable policy and programs require a variety of information sources.

Most observers would argue that food supply and use data would better serve food policy decisions if the information were disaggregated within countries. Clearly, measures of food availability in local areas or among certain income groups is crucial for targeting. This is obviously a role for within-country resources, it is less obviously a role for the FAO. Furthermore, since food and agricultural policies are often formed at the national level and food security is cited as a national concern for a host of policies, there is also a strong justification for developing data on a national basis. And, of course, given the complications and problems encountered with comparability, documentation, and errors with national data, attempting local data seems especially troublesome in many countries.

Conclusions

The Food Balance Sheets provided by the Food and Agriculture Organization of the United Nations are the most comprehensive data on national food availability in the world. They are also among the most important sources of information on vital food issues. FBS data has been used to study food supply, calorie and nutrient supplies, the nutritional importance of certain commodities, trends in food availability and insecurity, comparisons of food availability among countries, and relationships between wealth and nutrition. The data have been made readily accessible on the World Wide Web, and considerable documentation is available to users. The FAO provides guidance to users about the data and a great effort has been made to monitor the quality of the data and improve its usefulness. Nonetheless, improvements are possible.

All users must be reminded that the FBS are compiled from data from sources that vary in quality and in documentation. Every sophisticated user knows that there are unavoidable errors in the basic statistics. Although the FAO works with national statistical offices to improve the basic data, there remain concerns with the quality of the estimates in certain places. Their potential errors are not uniform, and FAO statisticians often know better than anyone else does where the potential weak points are in the published estimates. Additionally, users must exercise additional caution in applying data where subsistence production is important or when comparing FBS data across countries that have different statistical systems and especially where relevant documentation is not available. The more this information can be made available to users the better uses may be made of the data. In addition, since one of the strengths of the FBS is that they facilitate cross-country analysis and international comparisons, more effort to create data using the same methodologies and definitions is important. Of course full explanations of where the data are more or less comparable is vital to informed use of the data.

Further effort to document the sources of the FBS data and all the adjustments and corrections necessary for the development data may be the most feasible and useful change that the FAO can contribute. Casual data users may not demand such full accounting of the sources of the estimates, but careful users including policy analysts and researchers will be well served by understanding more precisely how the various numbers were developed. This may also help improve the quality of the numbers themselves by allowing a broader community the access to critique the many judgements that necessarily go into the development of a complex international data base. The ABCDQ website has begun an important innovation, and may prove to have been an extremely valuable contribution. Comparisons with data that are developed from alternate information sources to FBS data may also be facilitated by the FAO using the ABCDQ. Such effort would improve the careful and informed use of the data and increased communication between the FAO and all users of its data. Such exchanges might take place on a website that was part of the ABCDQ and that contained abstracts or links to papers and projects using the FBS or closely related data, as well as a forum for recommendations, explanations of how the data were used, and questions to be shared among users and with the FAO.

The Food Balance Sheets are huge resource for policy analysts and advisors as well as researchers. They comprise the only comprehensive source for food and commodity data on a national level for a huge variety of countries. The FBS are widely used, accessible, and informative. We suggest that their value can be enhanced and the data used more effectively

when applied conjunction with other complementary data and when additional documentation and amendments are implemented.

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Appendix A. Other Sources of Information Related to the Food Balance Sheets

A variety of governments and international organizations have published data that are similar in some ways to the Food Balance Sheets. We highlight here three sources of information that have some overlap with the FBS. They each use similar methodologies, but none are comprehensive, and the first has been discontinued.

The Organization for Economic Cooperation and Development used to publish Food Consumption Statistics (the final publication was in 1991). Its variables included production, stock changes, imports, exports, total utilization, feed, seed, total processing, food processing, industrial processing, waste, statistical difference, food (gross), extraction rate, food (net), per capita consumption, and calories, fat, and protein consumption per person per day. The data was largely supplied by responses to the OECD annual questionnaires and EUROSTAT data; the OECD Secretariat completed and corrected data where necessary. Data was annual and covers approximately 70 different food commodities for 22 countries. An admirable feature of this publication was its by-country documentation on what was included under various commodities, reference periods, and comparability of data over time.

A simplified version of the FBS are the South African Development Coalition's (SADC) food balance sheets for its member nations. These annual sheets cover maize, rice, wheat, sorghum/millet, and cassava. Two main purposes of these data are to assess any surplus or deficit in food supply and to be a tool for planners and policy makers in avoiding shortages and famine. Subsistence production is included as an important part of the data. Data sources include country governments and famine early warning systems, which gather data via sample surveys, crop field measurements, yield sub-plots, and farmer interviews. Variables include opening stocks, gross harvest, desired state grain reserves (SGR) carryover stocks, gross domestic requirements, imports, exports, forecasted closing stock or current stock, domestic shortfall/surplus, and import gap. The consumption figure (gross domestic requirements) encompasses food, feed, seed, losses, and other uses. While not as detailed in categories as the FBS, the SADC food balance sheets are a straightforward presentation of supply data. Not breaking down consumption into its various components has the advantages of thinking of supply of a commodity as something that can be manipulated and diverted into different areas and of being a simpler statistics. However, it may be argued that there exists the disadvantage of not knowing how much of supply is practically available for human consumption.

The United States Department of Agriculture maintains and frequently updates its Production, Supply, and Distribution (PS&D) database which contains data for 62 commodities for approximately 200 countries and regions and includes annual data on area harvested, yield, production, imports, exports, total domestic consumption, ending stocks, feed, and domestic consumption. These are all reported for local marketing years. The data come from attaches in embassies, Foreign Agriculture Service commodity analysts, USDA/ERS country and commodity analysts, and country statistics. Keeping data of countries and commodities of relevance to U.S. trade is a main purpose of this database. For this and other logistical reasons, subsistence farming and crops or countries not significant to U.S. trade are not included (USDA/ERS Production and Supply Database).

Appendix B. FBS in Relation to the Early Warning System Data Requirements and Presentation

The FBS data helps to predict shortfalls in a country's food availability. To further outline how this may be done, let us consider FAO's Global Information and Early Warning System on Food and Agriculture (GIEWS). GIEWS' efforts in promoting food security include assessing the availability of food and the amount of food necessary to meet basic requirements and making projections of these figures for the next year. In doing so, GIEWS creates a projected food deficit or surplus for a particular country of interest. These deficits indicate the severity of the food availability problem on a national level, and when data is available, for more localized, within-country regions.

Because its aim is to warn of potential food crises, GIEWS is concerned with projections of future food supply and utilization in addition to current and past figures that may be found in the FBS. From Table B1, we can see that the FBS and GIEWS have essentially the same supply and utilization components. Besides that the GIEWS data contain future projections, there exist additional differences in the natures of GIEWS and FBS data. GIEWS data are given by marketing year, while FBS years are calendar years. In at-risk countries, food crises may be tied to the timing of one or more particular crop cycles, making marketing years for those crops an intuitive horizon for presentation and analysis. Since the FBS are meant to be compared across countries and to include all food commodities with different seasonal schedules, no marketing year for a single crop in a single country would be appropriate to compare with total food availability for all other countries.

Looking to anticipate food crises, GIEWS requires multiple sources of data, both official and unofficial, at local and provincial levels that include meteorological and pest data, evidence of malnutrition and coping strategies, and prices and household food production, among other variables. Though the FBS and GIEWS may share information or have information from common sources, the FBS do not require the scope and detail of data utilized by the GIEWS for early warning. GIEWS' methodology for estimating the projected food deficit uses the same process used by the FBS to estimate food availability. Using time series data, GIEWS creates projections for quantities of commodities, mainly cereals, that will be produced, imported commercially, imported as food aid, exported, drawn from stocks, used for seed, used for feed, lost after harvest, and other uses. GIEWS staff also estimate how much food is necessary either to maintain current consumption patterns or to provide a given fraction of the nation's daily calorie requirement.

Table B1, taken from a recent report on North Korea, shows how a country's deficit or surplus may be calculated. Domestic Availability is composed of domestic production and stocks; food requirements, feed use, seed requirements, other uses, and post harvest losses comprise Total Utilization. Domestic Availability subtracted from Total Utilization yields the Import Requirement, how much food must be imported in order to meet utilization needs or how much food can be exported while still meeting utilization needs. GIEWS further estimates how much food the country will be able to import commercially and subtracts this from the Import requirement to arrive at the Uncovered Deficit. We can see that though the accounting

procedure is similar to that of the FBS, the GIEWS asks a different question. Availability and utilization are the two sides of the equation. Here, however, the difference is that the equation may not balance in the sense that it is unknown if food-needs will be met in the next year. The FBS are an accounting of actual food, where it has come from, and how it was utilized. The GIEWS accounting procedure uses predictions of how much food will be needed in the future, how much will be available from domestic sources in the future, how much the country will be able to purchase as imports in the future, and then asks if there will be enough food to meet the country's needs.

Table B1. Democratic People's Republic of Korea: Cereal Balance Sheet for 2001/02 (Nov/Oct)

	('000 metric tonnes)
Domestic Availability	3544
Stock Draw-down	-
Domestic Production	3544
Total Utilization	5011
Food use	3929
Feed use	300
Seed requirements	144
Other uses and post harvest losses	638
Import Requirement	1467
Commercial import capacity	100
Uncovered Deficit	1367
Of which emergency food aid pledged	331

Note: the above figures are projections.

Source: GIEWS. *Special report: FAO/WFP crop and food supply assessment mission to the Democratic People's Republic of Korea. 26 October 2001.*

Appendix C. Economic Issues and the FBS

The FBS illustrate the movement of food commodities in an economy, documenting the components of supply and utilization and commodities' ultimate availability as food. Lying behind this organized balance are prices, incomes, poverty, and multivariate supply and demand functions which lead to transactions whose final outcomes are seen in the balance sheets. Though we are hesitant to suggest that the FAO incorporate these underlying factors into the FBS, clearly a more complete understanding of the movements behind the quantities can serve to improve our understanding of food markets and why some persons have inadequate access to food. Here we briefly propose how measurements of prices and incomes could contribute to a more meaningful FBS that is better able to measure food security.

Each number in the FBS represents a balance of supply and demand. For example, a given quantity of maize reported in the FBS was produced at a price (opportunity cost) at which consumers would purchase it and producers would sell it. In each transaction, there are quantities of demand and supply, which are determined by prices of goods and incomes among other factors. An increase in the price of a food commodity may cause an increase in its production, a decrease in its consumption, and depending on relative prices, an increase or decrease in imports. An increase in income can cause increases in production or imports of a commodity via the income effect or decreases in production or imports if people switch to higher quality foods. All the results of these transactions can be seen in the FBS, but not the prices and incomes which led to the transactions.

FBS data on food availability are commonly used in the construction of indices of undernutrition. Since Sen's axiomatic approach to the measurement of poverty, there have been a number of modifications, added axioms, and evaluations of the resulting indices of poverty and undernutrition. However, the majority of these have stressed the three components of (1) the number of the poor, (2) the severity of the poverty measured as an income gap, and (3) income inequality. Some argue that inequality and poverty are being confused in the construction of these indices (Hagenaars). This argument raises an obvious, but little discussed point in the literature: An index of poverty is not the same as a picture of poverty. The purpose of an index is to measure the importance of poverty as a problem in a population. A picture of poverty shows what it looks like as a distribution of income or welfare for the population.

In our exercise to demonstrate the significance of prices and incomes on food security, we think more in terms of a picture than an index. We define the poverty line, f, as the amount of money (or other resources) that buys a household's minimum caloric intake (this can be extended to individuals or expanded to included protein and other nutrients) and assume that there is a significant qualitative difference in the well-being of persons or households above this poverty line and below. Households with incomes below f are considered poor.

Suppose the price of a staple food were to increase so now the poverty line higher at is f'. If there is no corresponding increase in income for the poor, then their numbers and income gaps increase. Most poverty indices would reflect this in an increase. Additionally, food security in that time period would fall, since fewer people would have access to their caloric requirements.

Changes in price over time might allow us to derive a distribution of the probability that a household's purchased caloric intake would be sufficient.

To alter the income distribution with the aim of improving access to food, there are two things that may be changed: the central tendency of the distribution or its spread. First, suppose a policy could be enacted which simply redistributes income so all households have the same income while total income and prices do not change. This shifts up income of the poor and increases access to food and thus food security.

From the above exercises, we can appreciate that food prices as well as the shape of the income distribution provide key information in determining a population's access to food. For any of the price or income changes described above, the data in the FBS would show the end equilibrium results in markets of production, imports/exports, storage, processing, food, etc. Were these FBS results to be combined with price and income data, equilibria and a sense of supply and demand in each of these markets could be constructed. Then the workings and interactions of these markets would be better understood.

Appendix D. Discussion of the FBS Presentation and Format

This appendix will familiarize the reader with the workings of Food Balance Sheets by presenting an abbreviated version of a balance sheet. We also refer the reader to the sheets themselves, "Handbook for the Preparation of Food Balance Sheets", and "Food Balance Sheets: Applications and Uses", all published by the FAO.

Table D1 shows part of the balance sheet for the Democratic People's Republic of Korea (DPRK) for the calendar year 1999. Immediately we see the separation of commodity supply and utilization, the two sides of the balance equation. Domestic supply is the sum of domestic production, net imports, and draw down of stocks (a positive entry means that the commodity has been taken out of the stock and made available for consumption. This supply may be used as feed for livestock, seed for future crops, processing into other food commodities listed in the balance sheet, or food for human consumption. Additionally it may be wasted or used for other purposes not listed such as consumption by tourists.

Two main purposes of the FBS are to assess how much food is available for human consumption and to sketch the path of food commodities from field or port to market. We now perform a basic exercise, which demonstrates these two points. Consider rice and begin at the left of the sheet. The DPRK produced 1,563 thousand metric tons of rice and imported 256 thousand metric tons of rice. They made no exports and did not use any stocks. This results in a total domestic supply of rice of 1,819 thousand metric tons. To arrive at how much of this rice was available for human consumption, we subtract the quantities used for feed, seed, processing, waste, and other. That is, 1,667 thousand metric tons of rice was available for human food consumption.

The Food Balance Sheet follows primary food commodities through processing into other important commodities. Approximately 19 thousand tons of barley were processed into beer in

DPRK in 1999. This is a 2 to 3 step process in which the barley is first turned into barley malt and then either directly into beer or into malt extract and then to beer. The FAO uses conversion factors to calculate how many tons of a processed food product (beer) result from a given weight of a primary product (barley). Whenever possible these factors are specific to the country and species of commodity. For DPRK the average conversion factor for the period 1992-1996 (1999 factors were unavailable) of barley into barley malt was 80 percent and for all countries the average rate of conversion of barley malt into beer was 65 percent (FAO, "Technical Conversion Factors for Agricultural Commodities").

Per capita supplies of food, calories, protein and fat are on the right of Table D1. The per capita food supply estimate is derived simply by dividing the national amount of food by the population and then converting into kilograms. Nutritional conversion factors (again, specific to the country and food when possible) convert the weight of the food into energy and nutrient amounts supplied, and these amounts are then re-scaled to daily per capita figures.

The FBS use a comprehensive set of categories of foods (e.g. cereals, starchy roots, oil crops vegetables, fruits, alcoholic beverages, meat, animal fats, and fish and seafood) under which specific commodities (e.g. wheat, cassava) are listed. Additionally, the FBS aggregate these categories into vegetable and animal products and ultimately to a Grand Total for nutrient supplies. This structure allows users to see the source of calories, fat, and protein in the national diet and which commodities contribute most importantly to the national diet. Note however, that the FBS show available food, not food actually eaten, so the "national diet" is better thought of as the average diet the country could make available to its citizens. In Table D1, we see that the DPRK's diet is highly vegetable based and that rice provides most of the calories and about one fifth of the protein in the national diet.

Table D1: Abbreviated Food Balance Sheet

Democratic People's Republic of Korea, 1999
Population: 22,110,000
(all commodity figures in 1000 metric tonnes)

	Domestic Supply					Domestic Utilization						Per Capita Supply			
Products	Production	Imports	Exports	Stock Change	Total	Feed	Seed	Processing	Waste	Other	Food	kg/year	calories/day	protein/day (g)	fat/day (g)
Grand Total													2100	61.6	31.5
Vegetable Products													1969	52.5	21.7
Animal Products													130	9.1	9.8
Cereals – excluding beer	3207	1198	37	1	4441	172	116	331	280	281	3261	147.5	1299	28.2	6.1
Wheat	189	528	0		717	20	28		39		629	28.5	210	6	0.8
Rice (milled equivalent)	1563	256	0	0	1819	4	45		104		1667	75.4	737	12.9	1.6
Barley (excluding beer)	106	6	0		112	0	11	19	6		76	3.4	22	0.6	0.1
Maize	1235	406	37	0	1678	120	22	312	127	281	815	36.8	302	7.9	3.4
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.															
.															
Alcoholic Beverages	332	4			336						336	15.2	91	0.1	
Barley, Beer	99	4			103						103	4.6	5	0.1	
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Source: FAOSTAT, Food Balance Sheet database, retrieved 5 January 2002