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MAPPING THE LINKAGES BETWEEN

AGRICULTURE, FOOD SECURITY & NUTRITION

IN MALAWI

Edited by Noora-Lisa Aberman, Janice Meerman, and Todd Benson

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CHAPTER 2 : INDICATORS FOR EXAMINING LINKS BETWEEN AGRICULTURE, FOOD SECURITY, AND NUTRITION

Janice Meerman[a], Noora-Lisa Aberman[b], Jody Harris[b], and Karl Pauw[b]
[a] Independent consultant; [b] International Food Policy Research Institute

2.1—Introduction

How can the nutrition impact of agriculture programs be assessed? Depending on context, data may need to be collected on: production practices for food, livestock, and cash crops; post-farm gate value chain and other market-based activities; commodity prices; household food security; women's empowerment; and diet and nutrition outcomes. While not intended as an exhaustive review, this chapter provides a primer on some of the most commonly-used indicators for research, monitoring, and evaluation of these areas. The following sections discuss the commonly-used indicators for assessing:

- diet and nutrition outcomes;
- household food security;
- gender, household decisionmaking, and empowerment;
- agricultural production, productivity, and diversification; and
- food markets and prices.

In addition, this chapter also provides a brief overview of survey programs in Malawi that collect the data to construct these metrics. In so doing, the concept of the *agriculture and nutrition data disconnect* is introduced (Gillespie, Harris, and Kadiyala 2012). Given that assessing the agriculture–nutrition nexus requires reliable data sources for all the indicator areas listed above, the range of data types required is extremely wide and unlikely to be captured in a single survey. The data disconnect—whereby nutrition and health data tend to be collected in separate and non-comparable surveys to those used to collect data on food and agriculture—poses a major stumbling block to investigating agriculture–nutrition linkages in most countries.

2.2—Assessing diet and nutrition outcomes

Individual diets are the essential link between agriculture and nutrition; therefore, diet should be assessed in almost every piece of research or monitoring on how agricultural activities affect nutrition. Nutrition outcomes should also be assessed if the underlying logic of the design of an agricultural program or policy being monitored suggests that these outcomes are likely to be affected. Diet and nutrition outcomes are measured at the individual level, as they relate to what an individual consumes and the physical process of absorbing and utilizing nutrients. As such, the indicators discussed below are measures of individual diet diversity and anthropometry. These types of metrics are appropriate for assessing the utilization dimension of food security (see Chapter 1) where individual nutrition practices can truly be detected.

2.2.1—DIETARY RECALL

Twenty-four hour food recall surveys collect detailed information on the precise foods[3]—including amounts—eaten by an individual over the past day. Food composition tables are then used to assess the nutrients in these foods, thus providing an estimate of an individual's diet quality and the quantity of nutrients consumed (Jones, Ngure, Pelto, and Young 2013). While a gold-standard in dietary data collection methodology—used when a new concept is being tested—24-hour recall surveys are expensive and time-consuming to administer and nutrient analysis of the data may require locally-

[3] As opposed to aggregated food groups as with the individual diet diversity scores discussed later.

adapted food composition tables (Willett 2012). These constraints make 24-hour recall a prohibitive means to assess diets in many of the resource-poor settings where agriculture–nutrition programming and monitoring is being conducted.

2.2.2—INDIVIDUAL DIETARY DIVERSITY SCORES (IYCDDS, WDDS):

Eating a variety of foods helps ensure adequate intake of essential nutrients and promotes good health. Accordingly, individual dietary diversity measures are used as indicators of diet quality. Diet diversity scores for an individual are computed from information on the number of specific food groups from which the individual consumed food over a recent short period of time. These metrics have been repeatedly validated as having a robust and consistent positive statistical association with adequacy in individual micronutrient consumption. In other words, the higher the diet diversity score for an individual, the more likely that individual has a diet which meets his or her vitamin and mineral requirements (Ruel, Harris, and Cunningham 2013).

The populations from which indicators of individual diet diversity are most commonly collected are women of reproductive age, via the Women's Dietary Diversity Score (*WDDS*), and children under two years of age, via the Infant and Young Child Dietary Diversity Score (*IYCDDS*). The specific food groups used to calculate these two scores are not the same because the micronutrient requirements for women and small children are different. For the WDDS, there are nine food groups[4] (FANTA and FAO, 2014); while for the IYCDDS, there are seven food groups[5] (WHO 2007). Both the WDDS and the IYCDDS are calculated using data on foods eaten over the 24 hours prior to the interview.

Multi-stakeholder consultations and cross-country validation studies have identified cut-off points for both indicators to classify individuals as having low or minimum dietary diversity (FANTA and FAO 2014; WHO 2007, 2008). The IYCDDS requires a minimum of four of the food groups to be consumed to achieve minimum dietary diversity. The WDDS requires at least five of the designated food groups to be consumed.

Although they do not provide data on the frequency or amounts in which different foods were consumed, individual diet diversity scores can be constructed based on an easy-to-administer questionnaire (Kennedy, Ballard, and Dop 2010).

2.2.3—ANTHROPOMETRY

Anthropometry assesses the physical growth status of an individual relative to an international reference population. As a result, anthropometric statistics are typically reported as indices based on standard deviations from the mean of this reference population, or z-scores. In children, two of the most commonly used anthropometric indices are height-for-age (HAZ) and weight-for-height (WHZ) (WHO 2008).

Children whose height-for-age is less than two standard deviations below the median height of the reference population (HAZ<-2.0) are assumed to be stunted in their growth and suffering from chronic (long-term) undernutrition. In contrast, children with low weight-for-height (WHZ<-2.0) are assumed to be wasted and suffering from acute (recent and severe) undernutrition. Stunting prevalence can be high even in situations of relative food security, depending on the quality of diets consumed and the prevalence of infectious disease. Wasting in children is often seasonal due to food shortages and disease and carries a higher risk of death.

[4] The nine WDDS food groups are: starchy staples; dark green leafy vegetables; other vitamin A-rich fruits and vegetables; other fruits and vegetables; flesh foods (meat, fish, poultry, and liver or organ meats); eggs; beans and peas; dairy (milk, yogurt, and cheese); and nuts and seeds.

[5] The seven IYCDDS food groups are: grains, roots, and tubers; legumes and nuts; dairy; flesh foods; eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables.

In addition to these indicators, mid-upper arm circumference or MUAC, is also used to assess the nutritional status of children and, in some cases, adults. Body-mass-index (BMI) is a more commonly-used anthropometric indicator for adults and is used to detect both under- and over-nutrition.

Demographic and health surveys (DHS) are considered among the best sources of anthropometric data in many countries, including for Malawi. Four nationally-representative DHSs have been carried out in Malawi – in 1992, 2000, 2004, and 2010.

2.3—Assessing household food security

This section focuses on indicators that measure household food security, defined here as *access to food*. Access, in this context, is both physical and economic, including foods that a household grows for their own consumption and foods that a household purchases outside the home. Household access to food is typically used as an indicator of income and household calorie availability or lack thereof (Hoddinott and Yohannes 2002; Swindale and Bilinsky 2006).

While some of the most commonly-used household food security indicators look only at household access to different food groups, others go further, estimating per capita calorie and micronutrient availability based on international recommendations for individual requirements. However, as long as these estimates are based on household-level data that do not capture how food is divided between household members, they should not be considered representative of individual-level diets. The final category of indicator considered here is experiential. These metrics are based on indices which assess the severity of food insecurity based on common reactions to, and coping strategies for, not being able to access enough food.

2.3.1—HOUSEHOLD DIET DIVERSITY SCORE

As it is strongly associated with household calorie access and socioeconomic status, household-level dietary diversity is considered a proxy indicator for food access. It is best used to measure the quantity of foods that are being eaten by the household as a whole, thus providing information on what dietary options are *available* to individual household members, albeit without unpacking how those options may be exercised, as the allocation of food to individual members is not addressed during data collection (Hoddinott and Yohannes 2002; Kennedy et al. 2010). Household level diet diversity scores cannot be used to assess individual-level dietary intake or quality. Consequently, they cannot be used to predict individual-level nutrition outcomes.

The most commonly used indicator of household diet diversity is the household dietary diversity score or HDDS. Originally developed by the Food and Nutrition Technical Assistance Project (FANTA) to evaluate the food security and nutritional impact of USAID programs (Swindale and Bilinsky 2006), the HDDS is now used widely. It is calculated by summing equally-weighted response data on the consumption of 12 food groups[6]. These response data are gathered during an interview with the household head or other individual responsible for food preparation in the household. Nationally-representative household survey data such as Malawi's second and third Integrated Household Surveys (IHS2 and IHS3) commonly record any foods consumed in the last 7 days (although in other surveys the recall period may be the previous 24 hours). The response data are then summed to obtain a score (0 to 12) for the household as a whole.

It is important to note that, unlike the individual dietary diversity scores discussed above, the HDDS has no standard cut-offs for high or low diet diversity; however, higher numbers of food groups are associated with higher household access to calories (Hoddinott and Yohannes 2002; Kennedy et al. 2010).

[6] The 12 HDDS food groups are: cereal grain staples; roots and tubers; vegetables; fruits; meat; eggs; fish; pulses and nuts; dairy products; oils and fats; sugar; and condiments.

2.3.2—MICRONUTRIENT SENSITIVE HDDS AND HOUSEHOLD MICRONUTRIENT ACCESS

The micronutrient-sensitive HDDS or MsHDDS was created by IFPRI to increase understanding of which micronutrients were available to households through the foods that families reported eating (Verduzco-Gallo, Ecker and Pauw 2014). To date, the MsHDDS has only been applied in Malawi using the food consumption recall data from the IHS2 and IHS3 that asked the respondent, usually the household head, which and how much of 135 foods common in Malawi had been eaten by any members of the household that week.

Although based on the same idea as a conventional HDDS, the Malawi MsHDDS further subdivides the food groups used: the vegetable group is divided into dark green leafy vegetables, vitamin A-rich (red/orange/yellow) vegetables, and other vegetables; the group of fruits is divided into vitamin A-rich fruits and other fruits; and the group of meat is divided into red meat and white meat (mainly poultry). A total of 16 different food groups are used for the MsHDDS, rather than the 12 groups used for the HDDS.

IFPRI researchers then estimate per capita availability of key nutrients from all the foods the households reported eating, providing more detail on nutrients available to household members than is provided by the MsHDDS alone, which only provides a simple count of foods groups eaten. The calorie and micronutrient content of the foods eaten by household members was calculated based on the food recall data with food composition tables for Senegal and Kenya (the only available databases for sub-Saharan Africa (FAO 2010)) in order to convert the food quantities into their calorie and micronutrient contents (Ecker & Qaim 2011). These estimates of household access are then compared to age- and sex-specific nutritional requirement levels to estimate the prevalence of shortfalls in the micronutrients accessed by the household compared to what its members need as a whole to meet their nutritional requirements. Nutrient consumption threshold levels are based on individual requirement levels available from FAO, WHO, and UNU (2001) and from WHO and FAO (WHO and FAO 2004, 2006). We refer to this indicator as an estimate of *Household Micronutrient Access,* because it does not reflect actual micronutrient intake at an individual level but generates per capita estimates intakes based on household level data.

As with the HDDS, lack of information about intra-household food allocation is the primary reason why the MsHDDS and related estimates of per-capita micronutrient consumption should be viewed as a measure of household *access* to diverse foods and adequate micronutrients rather than of nutrient *intake*. Furthermore, while there are clear theoretical associations between these newly developed indicators—MsHDDS and the household micronutrient access indicator--and individual diet quality[7], these associations have not been empirically validated. Nonetheless, the MsHDDS adds a useful nutrition lens to a common food-security indicator, while the household micronutrient access indicator provides a rare example of nationally-representative food-based micronutrient access estimates. Further, the fact that the data for these indicators are found in the same dataset as socioeconomic and agricultural information reduces the data disconnect.

2.3.3—FOOD CONSUMPTION SCORE

Developed by the World Food Programme (WFP), the Food Consumption Score (FCS) is a composite score comprised of data on food groups and the frequency of consumption of those food groups. The typical recall period is usually 7 days (as opposed to the HDDS, which may be either 7 days or 24 hours) and data is collected on fewer food groups – eight, rather than 12. Each food group is weighted according to its nutritional value (for example, sugar and oil = 0.05, while meat, milk, and fish = 4.00) and the questionnaire collects information on how often each of the food groups were consumed by one or more family member over the past week. The FCS is intended to monitor changes is food-

[7] For instance, on average, individuals who belong to households which reported consuming relatively high quantities of vitamin-A rich fruits and vegetables are likely ingesting more beta-carotene than those who do not.

security status across large geographic areas such as regions or countries and is positively associated with per-capita calorie consumption (Jones et al. 2013; Lovon and Mathiassen 2014).

In addition, unlike the HDDS, the FCS uses standard cut-offs to categorize the quality and quantity of household food access as poor, borderline, or acceptable. While technical analysis of the sensitivity and cross-country comparability of these cut-offs is beyond the scope of this chapter, it is important to note that these cut-offs have been found to consistently underestimate the prevalence of poor or borderline energy consumption and that cross-country comparability is low (Lovon and Mathiassen 2014; Wiesmann, Bassett, Benson, and Hoddinott 2009).

2.3.4—HOUSEHOLD FOOD INSECURITY ACCESS SCALE AND COPING STRATEGIES INDEX

The Household Food Insecurity Access Scale (HFIAS) is based on the assumption that there is a set of predictable reactions to the experience of food insecurity that can be summarized and quantified (Carletto, Zezza, and Banerjee 2013). Based on the administration of nine questions to a household respondent, this measure has been incorporated into household surveys around the world and has been validated in Latin America and sub-Saharan Africa for reliability and validity in local contexts (Knueppel, Demment, and Kaiser 2010; Melgar-Quinonez et al. 2006). However, other validation studies suggest that this indicator's cross-cultural comparability may be weak, due largely to cultural and language issues which complicate interpretation of results across contexts (Swindale and Bilinsky 2006). In response to this criticism, the Household Hunger Scale (HHS) was created and has been cross-culturally validated, although its design only captures severe cases of food insecurity (Ballard, Coates, Swindale, and Deitchler 2011). The harmonized Latin American and Caribbean Food Security Scale (ELCSA) and the recently launched Food Insecurity Experience Scale (FIES) are examples of similar, experience-based food security scales (Cafiero, Melgar-Quiñonez, Ballard, and Kepple 2014).

As with the HFIAS, the Coping Strategies Index (CSI) takes an experiential approach to food-security analysis, assuming that there are several behavioral coping strategies used by households to manage food shortages. The CSI is comprised of a weighted average of the frequency and severity of a menu of these coping strategy behaviors, developed and assessed based on location-specific assessments and appraisal methods (Carletto, Zezza, and Banerjee 2013).

However, unlike household diet diversity indicators, the food insecurity scales and the CSI have been validated to predict food vulnerability (Carletto, Zezza, and Banerjee 2013). That is, these indicators can predict pending food insecurity as opposed to providing only an immediate snapshot of what foods households were accessing at the time of the survey.

2.4—Assessing gender, household decisionmaking, and empowerment

Women within a household are more likely than men to influence the nutrition outcomes of their family members due to their roles as primary caretakers and mothers. Consequently, agricultural interventions that include an emphasis on women's empowerment generally have proven to be more effective at improving nutrition than approaches that do not (Hawkes and Ruel 2007). Conversely, women's nutritional status and control over assets are important for improving agricultural productivity and investment (Meinzen-Dick et al. 2011). As such, measuring women's empowerment and decisionmaking power is considered an essential requirement for understanding the linkages between agriculture, food security, and nutrition (Quisumbing et al. 2014; van den Bold, Quisumbing, and Gillespie 2013).

Women's empowerment is best viewed as a process and thus is often assessed in terms of improvements in decisionmaking power over time. Proxies for decisionmaking power include women's income, education, and assets (Malapit and Quisumbing 2014). Assets can include physical assets, such as jewellery and livestock, or social assets, such as group membership. Direct indicators of empowerment and decisionmaking power include questions regarding how the earnings of the woman and her husband are spent, how much the woman earns relative to her husband, whether she owns or co-owns land or a house, and who makes decisions concerning the woman's health care, major purchases, and visits to family (Heckert and Fabic 2013). In the context of nationally-representative surveys, these questions are primarily asked to one female in each household.

The Women's Empowerment in Agriculture Index (WEAI)—developed by IFPRI and currently used in USAID's Feed the Future projects in Malawi and elsewhere—attempts to collate multiple angles of women's empowerment as it relates to productive realms of women's empowerment (IFPRI 2012). The WEAI is a composite empowerment score, comprised of standardized questions posed to the primary male and female decision makers across the following domains: input into agricultural production decisions; autonomy in production; ownership of assets; purchases, sale, or transfer of assets; access to and decisions on credit; control over the use of income; group membership, public speaking, and other leadership activities; existence of leisure time; and workload. To date, WEIA interviews provide one of the most comprehensive data sources for assessing women's empowerment and how it relates to agriculture, food security, and nutrition outcomes.

Some challenges arise in making use of the WEAI and related women's empowerment indicators, however. First, proxies of empowerment can be viewed as either drivers or indicators of empowerment, creating a chicken-or-egg effect that creates ambiguity in interpretation. Second, indicators must be adapted to—or validated for—the specific social and cultural context in which the interviews take place (Heckert and Fabic 2013). Finally, gender-disaggregated requirements limit the usefulness of some data sources. For instance, while many surveys, such as the IHS, document aspects of gendered farm decisionmaking and who within a household is involved in various economic activities of the household, this information is generally obtained from a single household respondent. The gold standard for gaining insights into the effects of gender on various household and individual outcomes, including nutrition, is to interview both men and women within each sample household of a survey. This is uncommon for agricultural surveys.

2.5—Assessing agricultural production, productivity and diversification

Unlike nutrition and food security indicators—many of which have been rigorously validated—metrics for assessing agricultural production, productivity, and diversification are often best considered as theoretical proxies. As such the discussion below differs somewhat from the sections above. More detail is provided regarding data sources and the theoretical underpinnings of these indicators, while less is provided regarding validation and construction.

2.5.1—AGRICULTURAL PRODUCTION: CROPS

The most commonly used agricultural indicators are those pertaining to production of crops or livestock. Because of the cereal-centric nature of agriculture and food preferences in Malawi and many other countries, crop production estimates typically receive more attention than livestock production estimates. Crop yields are usually defined as output per unit of land—typically metric tons per hectare. Estimates can be aggregated to district or national levels, or assessed at the household or farm level.

Crop production estimates are based on a sample of farmer interviews conducted in order to ascertain yields using a variety of methods with varying degrees of accuracy. The most common approach is to rely on government agricultural extension workers—typically from the Ministry of Agriculture or similar agency— to provide estimates of crop yields. These plot-level production statistics are then aggregated up to district or national level. In Malawi, the Agricultural Production Estimates Survey (APES) of the Ministry of Agriculture, Irrigation, and Water Development (MoAIWD) produces three rounds of crop estimates annually. While estimates from extension officers are perhaps the easiest way to collect yield data, they are also considered highly subject to measurement error, given that they usually rely on informal interviews with farmers and local communities (Jayne and Rashid, 2010, 2). Ministerial crop estimates also tend to be vulnerable to upward or downward revision for political reasons.

Alternatively, detailed, nationally-representative data on crop land allocation, crop production, and crop sales can be captured through household surveys, such as Malawi's IHS or the less-frequent and less-detailed National Census of Agriculture and Livestock (NACAL). In Malawi, these surveys are implemented by the National Statistical Office (NSO) and may be more accurate than the annual crop estimates both because of the more accurate methods used and because the likelihood of political interference is lower.

2.5.2—AGRICULTURAL PRODUCTION: LIVESTOCK

Both crop forecast surveys and household surveys often collect data on livestock ownership. In some cases, data collected by household surveys may be quite detailed, capturing information on current livestock ownership and stock changes due to new births, purchases, sales, theft, or consumption over a 12 month period. Specific indicators include whether or not a family owns any livestock, which and how many species they own, and type or amount of animal products (for example, milk, eggs, meat, honey) produced by the household.

One convenient way of quantifying ownership of a wide range of different livestock types in a standardized manner is to convert numbers to equivalent tropical livestock units (TLU). For example, relative to a cow of 250 kilogram (with TLU = 1.0) a sheep or goat weighing 30kg will have a TLU = 0.2. The exchange ratio is based on the concept of metabolic weight (that is, energy expenditure per unit of body weight per of unit time) and the fact that smaller animals produce more heat and consume more food per unit of body size.[8] This conversion can be done in Malawi with both the NACAL and the IHS datasets.

2.5.3—CROP DIVERSIFICATION

The term agricultural diversification broadly relates to the concept of allocating resources (inputs) across an increasing number of agriculture-related activities. The concept can be applied at the farm, district, or country level. Crop diversification, more narrowly, refers to the idea of not only increasing the number of crops (or varieties) that are grown, but also to how equitably land is allocated across those crops. Crop diversification is seen as an approach towards broad-based agricultural development and an important risk-management strategy for farm households, especially in a country like Malawi that relies heavily on a limited range of rain-fed food crops, yet faces significant weather challenges in the short run (Devereux 2007).

The most commonly used indicator of crude crop diversity, that is, how many crops or varieties are being grown, is a simple crop count. However a number of indices, including the Herfindahl–Hirschman Index (HHI) and the Simpson Index of Diversification (SID), are often used with or instead of these simple counts to assess not only the number of crops grown, but also the share of land allocated to each (Minot et al. 2006; Joshi et al. 2003). The SID, for example, equals zero under complete specialization indicating that all land is allocated to one crop. Theoretically, it approaches one under increased diversification indicating that a very large number of crops are being grown under equitable land allocation.

From a nutrition perspective, it is important to note that that studies in Kenya, Malawi, Uganda, and Rwanda have found that agricultural systems with greater agrobiodiversity are associated with greater dietary diversity at village and farm levels (Herforth, 2010; Remans et al., 2011). For the studies in Malawi, Uganda, and Rwanda, an indicator of biodiversity—functional diversity—was used to assess the association between the number of crops cultivated per farm and the diversity of nutrients available to household members (Remans et al. 2011).

2.5.4—AGRICULTURAL PRODUCTIVITY

The rate of production for given inputs is described as productivity. In a context like Malawi's where

[8] See http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Mixed1/TLU.htm.

land is scarce and productive inputs, like fertilizer, are expensive, productivity per unit of land, unit of labor, kilogram of fertilizer, or other input into agricultural production is often discussed. Raising productivity through adoption of improved farming techniques or technological innovation—such as small-scale irrigation or sustainable-intensification approaches—is seen as an important strategy for improving food availability. Increased productivity may also be associated with increased farm profits and household income, which in the presence of reliable food markets can improve access to food. Indicators of productivity generally are derived using the same agricultural production data sources as were highlighted earlier in this section.

2.6—Assessing market access, market participation, food prices, and seasonality

2.6.1—MARKET ACCESS AND PARTICIPATION

The degree to which households participate in or have access to markets is relevant to food security and nutrition outcomes. Households may engage either as sellers of their own produce, buyers of food available in local markets, or both. The latter typically includes farm households that sell produce with the intent to buy foods that they do not produce themselves. Because sales often take place via third-party traders who typically take agricultural commodities from areas of supply to areas of demand, households will not necessarily have access to markets where nutritious foods are sold.

Market access is often assessed in terms of a household's physical proximity to markets. Specific indicators include the distance to roads, traveling time to markets, and cost of transportation. Market participation is most simply defined as whether or not a farm household sells its crops and livestock products for money.

Household surveys often collect detailed information about market access and participation. For example, the agricultural questionnaire in Malawi's IHS captures information about the quantity and value of crop sales, including the place of sale (farm gate or local market) and the cost of transport to that place of sale.

These data can be combined with additional data collected by household surveys, including the quality of the local road network; access to or distance to daily (local) or weekly (regional) markets; access or distance to parastatal market depots (ADMARC); and presence of traders in the community. Taken together, this information can be used to paint a detailed picture about farm households' access to and participation in markets.

With respect to what foods households are buying, household surveys may also include questions about the source of foods that are reported eaten. Categories of sources typically include *own produce*, *gifts*, or *purchases*. Although data on where foods are purchased is not usually captured, the aforementioned information on availability and distance to markets permits inference of likely sources for purchased foods.

2.6.2—FOOD PRICES AND SEASONALITY

Food price volatility is most commonly measured by the coefficient of variation (CV), a standardized indicator of the degree to which a commodity's price in a particular market diverges from the mean regional or global price of that commodity. In this sense, the CV can be said to measure the price transmission of a particular commodity from international to domestic markets.

In addition to whether local food prices transmit or reflect regional and global prices, national and sub-national market characteristics are also relevant to households' access to food. These include the cost of transporting food to markets, usually measured by road infrastructure and fuel costs; the ratio of buyers and sellers to producers; whether markets are connected or isolated from each other in terms of geographical access and in terms of price alignment; and the presence or absence of government policies which intervene in the market, such as setting price ceilings or floors for specific foods or implementing export bans on particular commodities.

In contexts like that of Malawi, where high transport costs and few buyers and sellers relative to the number of producers cause markets to be very thin, prices are highly volatile.[9] This volatility often results in unpredictable and highly seasonal food prices which have significant implications for food security. Indicators of seasonality in food prices are typically constructed using household-level food consumption and food price data. In cases where seasonality has an adverse effect, the relationship between the food consumption and price levels will be inverse. This reflects a typical cycle of selling at a time when prices in the market are low, but when household cash needs are high, such as just after the harvest, then buying at times of high prices when household food stocks dwindle and the next harvest has not yet arrived. This vicious circle has been well documented in Malawi (Kaminski et al. 2014; Jayne et al. 2010).

2.7—Addressing the "Data Disconnect" – Opportunities for Malawi

As discussed throughout this chapter, indicators of food security and nutrition are the primary outcomes of interest when assessing the agriculture–nutrition nexus. However, as discussed earlier, household-level indicators stop short of estimating individual diet or nutrition outcomes, thus preventing assessment of the final frontier of utilization. In contrast, anthropometric indicators provide excellent estimates of how individuals are utilizing nutrients. Unfortunately, in so doing, they make it impossible to distinguish between what proportion of undernutrition is caused by health considerations such as infection and what is caused by food accessibility and subsequent dietary intake.

Given these limitations, it is individual diets in key population groups that should be considered the key outcome when assessing agriculture–nutrition linkages. The IYCDDS and WDDS are currently considered the best options for accurately measuring individual food intake in a non-invasive, inexpensive, and efficient way (Leroy, Ruel, Frongillo, Harris, and Ballard, forthcoming). Both indicators include cut-offs and use a standardized questionnaire (although adaptation to local contexts is required for the latter), thus facilitating inter-country implementation and comparability of results. Dietary recall is also a good option for measuring diets, but such surveys are more time consuming and costly. Anthropometric outcomes are best considered when examining health and sanitation dimensions, in addition to agriculture.

This clear analytical imperative to collect individual diet-quality information is significantly constrained by what is commonly referred to as the agriculture and nutrition data disconnect. This fracture occurs because of long-standing divides between agriculture and health in commonly-collected nationally-representative data sources. In Malawi, as in many other countries, agricultural data are usually not available in the same datasets as individual diet, women's empowerment, and nutrition outcome indicators. There are analytical approaches to overcome some of these constraints by bringing into a single analysis at a more general scale of analysis than the individual or household – an example of this using the results of the IHS3 with those of the DHS is shown in Text Box 2.1 following this chapter. Nonetheless, agriculture–nutrition analyses are consistently hamstrung by lack of appropriate, integrated data resources. While justifiable from a sectoral perspective, the disconnect results in there generally being no reliable data sources that provide information on diet and nutrition outcomes *as well as* agricultural production practices, market access, food prices, women's empowerment, and all the other indicator areas required to trace the full trajectory of a causal pathway from agriculture to nutrition outcomes for individuals.

That said, there are instruments that hold considerable potential for the systematic collection of data on standardized livelihood or agricultural production practices, food security, and, in some cases, nutrition (Carletto et al. 2013). In Malawi, many of these instruments already exist. Table 2.1 provides an overview of the country's key large-scale data sources that provide such complementary data in a systematic manner.

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[9] Only about one-in-six maize farmers sell any maize (Jayne et al. 2010).

Table 2.1—Data sources across nutrition pathways: Options in Malawi

Data sources	Domain: Food Systems/ Markets	Agriculture	Food security (availability & access)	Women's empowerment	Individual diets	Individual nutrition outcomes
Demographic and Health Survey (DHS)				– Empowerment – Decisionmaking	– WDDS, IYCDDS – Dietary recall	– Anthropometry
Integrated Household Survey (IHS)	– Seasonality – Market access – Food prices	– Crop & livestock production – Crop diversification	– HDDS – MsHDDS – HH Micro-nutrient Access			– Anthropometry [10]
Women's Empowerment in Agriculture (WEIA)			– Household Hunger Scale	– Empowerment – Decisionmaking	– WDDS	– Anthropometry (women)
Agricultural Production Estimates Survey (APES)		– Crop production				
Agricultural Market Estimates Survey (AMES)	– Market integration – Seasonality – Food prices					
National Census of Agriculture and Livestock (NACAL)	– Market access	– Crop & livestock production – Tropical livestock units				

Source: Authors compilation.

Of all the surveys listed in Table 2.1, the data collection instrument with the highest potential for assessing agriculture–nutrition linkages is the Integrated Household Survey series. These surveys cover multiple sectors – the last wave collected information on household food consumption, crops grown using rain-fed and *dimba* wetland cultivation, crop sales, livestock ownership and sales, child anthropometry, and food prices. The advantage of these surveys over APES and DHS data is that agricultural production data are easily merged with detailed consumption data (including from own produce or purchased foods) and child nutrition indicators at the household level, bridging the data disconnect and facilitating analysis of agriculture–nutrition linkages.

However, even while the IHS covers an impressively high number of relevant indicators, it still fails to collect data on individual diet patterns, the intermediary between agriculture and food and nutrition outcomes. Furthermore, the quality of IHS anthropometrics have been called into question as recent figures differ significantly from those in the DHS, the traditional source of nutrition indicators for the population of Malawi (Verduzco-Gallo, Ecker, and Pauw 2014).

While substantial retrofitting of the IHS is not practical, the addition of a simple measure of individual diet – such as the WDDS, which is especially valuable given its focus on women – and improvements to the quality of the anthropometric measurements would make the IHS a powerful tool for unpacking how agriculture in Malawi links to food security and nutrition outcomes. Such dietary diversity indicators can be constructed based on an easy-to-administer questionnaire that can be completed quickly by enumerators and at relatively low cost. Creating incentives to include this type of a module in the questionnaire for Malawi's IHS surveys could facilitate more thoughtful and robust research on the agriculture–nutrition nexus.

[10] As discussed above, the Integrated Household Survey, which is the primary household socioeconomic and agricultural data source for Malawi, does include anthropometrics, but the accuracy of these data is in question.

Box 2.1—Agricultural correlates of aggregate nutritional outcomes in Malawi: A district-level rank analysis

Todd Benson
International Food Policy Research Institute

Obtaining empirical evidence on the relative importance of agriculture for the nutritional status of individuals is difficult. Most datasets that shed light on nutrition outcomes provide limited information on agricultural livelihoods. Here we take advantage of the fact that the 2010 Demographic and Health Survey for Malawi (NSO & ICF Macro 2011) used comparable survey strata to that of the third Malawi Integrated Household Survey (NSO 2012), a survey conducted in 2010–2011 that collected extensive information on agricultural production. While the surveys sampled different households and individuals, the results of both are representative at the district level. Using a non-parametric rank correlation approach, we use district-level results from the surveys to examine whether there are any associations between the prevalence of stunted children (low height-for-age z-scores [HAZ]) and of thin women (Body Mass Index below 18.5 kg/m^2) in the districts of Malawi (see Figure 1.1) and selected district aggregate characteristics of agricultural production. We then extend our analysis to examine other possible non-agricultural determinants of nutritional status.

Our dataset consisted of 27 cases corresponding to the 27 districts of Malawi covered by the two surveys. This small set of cases limits the sorts of statistical analyses we can use. Moreover, our analysis is based on aggregate statistics. As nutritional status is a characteristic of individuals, information on how nutritional status varies within the population is lost when one uses aggregate statistics. Similar information is also lost on the distribution of the factors examined as potential determinants of those nutritional outcomes. As no assumptions can be made about the distribution of these variables within the population, we must use a non-parametric approach to gain insights from these district-level statistics.

Here we use a rank correlation analysis. This quantifies the degree of similarity between the rankings of two variables across cases in order to assess whether there is any significant relation between the variables. We examine whether the ranking of nutritional outcomes by district is similar to the ranking of any agricultural factors by district, either positively or negatively. Where association in the ranking is seen, this indicates the potential existence of a causal relationship between the agriculture and nutrition variables and may merit further study. Where the absolute value of the Kendall's statistic for rank correlations are between 0.1 and 0.3, we consider this association worthy of note, while associations with a coefficient above 0.3 are judged to merit even closer examination.

Potentially important agricultural and non-agricultural determinants of nutrition outcomes were identified for the analysis. Primarily using data from the two surveys, we computed district-level statistics for 10 potential agricultural determinants and about 20 potential non-agricultural determinants for the analysis. The non-agricultural determinants were categorized into several groups, including diet, gender, health, and welfare.

The rank correlation analysis results for the agricultural factors are shown in Table B2.1. Relatively limited associations are seen, suggesting that direct relationships between agricultural activities and nutritional outcomes in Malawi are relatively weak. Moreover, the strongest associations run counter to expectations— for example, more district residents engaging in cropping activities is associated with a greater prevalence of thin women. Of the other agriculture–nutrition associations considered, a few are encouraging, such as for livestock and tobacco. Greater average agricultural sales in a district also are associated with improved nutritional outcomes. However, unfavorable or no associations are observed with several other district-level agricultural factors, including for irrigation intensity, district maize yield levels, horticultural production, and the number of crops grown or sold by district households. These contrary or insignificant associations signal that the relationship between all dimensions of strengthened agricultural livelihoods and nutritional outcomes in Malawi will not always be positive or benign.

Table B2.1—Strength of rank correlations between potential agricultural determinants of nutrition outcomes and those outcomes, rank correlation coefficient, district-level aggregate data, Malawi, 2010

Variable	Stunted children	Thin women
Households engaged in crop production, %	0.13	**0.36**
Landholding size, ha/hh	*ns*	*ns*
Livestock ownership, TLU per hh	-0.14	*ns*
Irrigation prevalence, % hh	0.14	*ns*
Maize yield, kg/ha	*ns*	*ns*
Tobacco production prevalence, % hh	-0.15	-0.11
Horticulture production prevalence, % hh	*ns*	*ns*
Number of crops grown per hh	*ns*	*ns*
Number of agricultural products sold per hh	*ns*	*ns*
Per capita gross agricultural sales, MK thousands	-0.12	-0.13

Source: Author's analysis of DHS (NSO 2011) and IHS (NSO 2012) datasets.

Note: Kendall's rank correlation coefficients with an absolute value less than 0.1 are judged to indicate an insignificant association between the variables and are not reported. Coefficients with an absolute value greater than 0.3 are associations that are judged to merit closer examination, so are bolded.
ns = not significant.

Table B2.2 extends the rank correlation analysis to examine associations between district-level nutritional outcomes and potential non-agricultural determinants of those outcomes. For factors related to food access, districts with higher calorie consumption per capita and greater dietary diversity show lower levels of child stunting and thin women, while those in which a higher proportion of surveyed households reported inadequate food consumption tend to have higher levels of malnutrition.

Table B2.2—Strength of rank correlations between potential nonagricultural determinants of nutrition outcomes and those outcomes, rank correlation coefficient, district-level aggregate data, Malawi, 2010

Variable type	Variable	Stunted children	Thin women
Food access	Calorie consumption per capita/day	-0.12	**-0.30**
	Dietary diversity index (HDDS - 12 food groups)	-0.16	**-0.36**
	Households report inadequate food past month, %	0.18	*ns*
Gender; empowerment of women	Female head of household, % hh	0.17	**0.32**
	Married head of household, % hh	-0.19	-0.30
	Highest level of schooling - women aged 15-49, median years	-0.17	-0.27
	Difference between men & women in years schooling completed	0.13	0.19
	Married women who decide on purchases for daily needs, %	**-0.32**	-0.21
	Married women who do not participate in household decisions, %	0.17	0.13
Health & public health	Drinking water - improved source, % population	-0.23	0.17
	Improved household sanitation facilities, % population	*ns*	-0.11
	Member had an illness in previous 2 weeks, % hh	0.10	*ns*
Welfare	Per capita annual household non-farm income, MK thousands	-0.21	-0.18
	Per capita annual total real expenditure, MK thousands	-0.13	**-0.31**
	Individual poverty headcount, % below the poverty line	0.15	0.29

Source: Author's analysis of IHS (NSO 2012) and DHS (NSO and ICF Macro 2011) datasets and spatial data from Malawi.

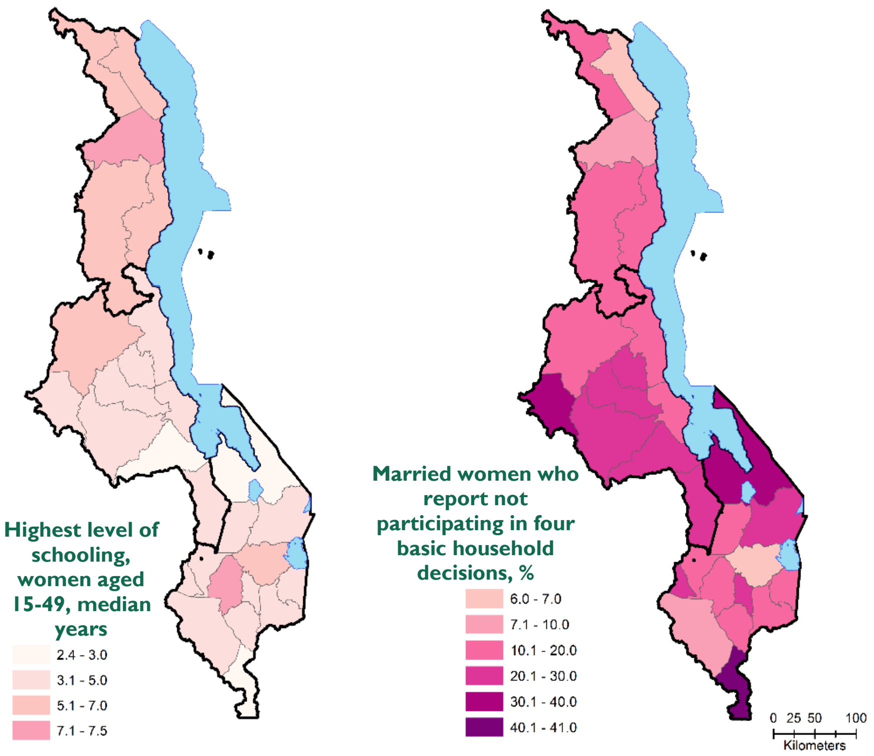
Note: Kendall's rank correlation coefficients with an absolute value less than 0.1 are judged to indicate an insignificant association between the variables and are not reported. Coefficients with an absolute value greater than 0.3 are associations that are judged to merit closer examination, so are bolded. Negative association (green bars) indicate improvements in nutritional status, while positive values (red bars) indicate deterioration.
ns = not significant.

The strongest positive associations with nutritional outcomes are for the gender variables. Higher average educational attainment levels for women are strongly associated with lower district averages for the nutritional indicators considered—a strongly beneficial relationship (Figure B2.1). Moreover, larger average differences between men and women in their educational attainment are associated with worse average nutritional outcomes at the district level. Similarly, women's participation in decisionmaking within the household demonstrates that greater women's empowerment in these decisions is associated with the reduced prevalence of stunted children and of thin women. In districts in which women are more often excluded from such decisions, average malnutrition levels are higher.

Health factors do not provide as strong associations with those outcomes as do the diet and gender variables considered, and the nature of some associations are counter to expectations. For example, better access to safe water are associated with lower child stunting levels, as expected, but also with a higher prevalence of thin women. In contrast, the associations observed for the variables in the welfare category are consistent with expectations—higher levels of nonfarm income and expenditures are associated with lower levels of malnutrition, while higher poverty levels are associated with increases in those levels.

While the principal motivation for this analysis was to gain additional understanding of how agricultural factors may contribute to nutritional outcomes, relatively limited associations were seen, suggesting that direct relationships between agricultural activities and nutritional outcomes in Malawi are relatively weak. Moreover, the nature of several of the associations examined run contrary to expectations, suggesting more complex relationships between strengthened agricultural livelihoods and nutritional outcomes in Malawi than we might expect. When we extended the analysis, non-agricultural potential determinants of nutritional status showed somewhat stronger associations—particularly for gender factors.

Figure B2.1— Women aged 15 to 49 years, median highest level of schooling attained and proportion reporting not participating in household decisions, by district, Malawi 2010



Source: Analysis of DHS data by M. Kedir, IFPRI.

The broader insight obtained from this study is that the pathways through which agriculture can lead to nutritional improvement in Malawi are indirect. A broader range of equally necessary determinants of improved nutrition must be in place if significant reductions in malnutrition are to be achieved. In considering these results, however, this analysis must be treated as exploratory. More detailed examinations of any associations of interest using individual and household-level data are required. Nonetheless, the district analysis presented here demonstrates that there are methods that can be used with somewhat coarse and seemingly incompatible data on nutrition status and its potential determinants to skirt around the agriculture and nutrition data disconnect discussed in Chapter 2 and build a better understanding of how agricultural activities can serve to improve nutrition in Malawi.

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