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Guidelines for Incorporating Dietary Diversity Metrics in Agriculture-Nutrition Surveys

Operational Manual for Using Dietary Diversity Indicators in Field Research

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PREFACE

This report is a product of the Center of Excellence (CoE), a multi-disciplinary team of scholars, policy analysts, and development practitioners based in New Delhi that offers cutting-edge research and capacity for implementing nutrition-sensitive agriculture in the Indian context. The CoE was established through the Technical Assistance and Research for Indian Nutrition and Agriculture (TARINA) project, a four-year grant awarded to the Tata-Cornell Institute for Agriculture and Nutrition (TCI) from the Bill & Melinda Gates Foundation to tackle malnutrition in India (see Box 1).

The CoE serves as a central repository of information and knowledge for building stronger linkages between agriculture and nutrition, as well as a hub for a network of national and international experts working in this space. It provides a mix of technical assistance, capacity development, and advocacy for the design and implementation of nutrition-sensitive agricultural projects, programs, and policies that ensure improved nutrition outcomes at scale.

The CoE plays a key role in translating lessons and evidence from TARINA, acquired through research and field-based implementation, into a collection of policy briefs, recommendations, and best practices for a wide range of stakeholders. While the CoE was founded under TARINA, it is envisaged to eventually evolve into an autonomous entity that is able to sustain itself well beyond the life of the grant through the provision of demand-driven technical assistance and expertise.

Box 1: About TARINA

Technical Assistance and Research for Indian Nutrition and Agriculture (TARINA) is a consortium that connects policy-focused academics with impact-focused implementation partners to promote a more nutrition-sensitive food system in India that enhances the availability and affordability of nutrient-rich foods for the rural poor.

Led by the TCI, TARINA links the research capacities of Cornell University, Emory University, the International Food Policy Research Institute (IFPRI), and the Tata Institute of Social Sciences (TISS) with the technical capacities of leading non-governmental organizations (NGOs) and development partners – BAIF Development Research Foundation, CARE India, Grameen Development Services (GDS), and Tata Trusts.

Through its leadership and expertise, the consortium aims to redirect agricultural policy away from staple grain fundamentalism toward a much broader food systems focus, which considers the need to build better connections between factors influencing agricultural production and nutrition. More specifically, it focuses on agricultural pathways for improving the rural poor's year-round access to affordable, diverse, and high-quality foods.

This is achieved through the project's three broad objectives to:

1. Provide technical assistance in redesigning agricultural projects to ensure nutrition outcomes at scale.
2. Provide assistance and evidence for policy reform that enhances diet quality at affordable prices.
3. Build capacity to design and implement nutrition-sensitive agricultural programs and policies.

TARINA was established with a US$13.4 million grant awarded to the TCI from the Bill & Melinda Gates Foundation. As the primary grantee, the TCI is the convening agency responsible for coordinating the TARINA consortium as well as providing oversight and ensuring accountability among partners. The project was launched on December 1st, 2015 and will run through November 2019 .

For more information about TARINA and to access additional information products, please visit the project's website:
www.tarina.cals.cornell.edu

INTRODUCTION

Dietary diversity metrics offer a timely, cost-effective, and logistically easy way of assessing household- or individual-level nutrition outcomes. With the recent emphasis on improved maternal and child nutrition outcomes (SDGs, agriculture-nutrition pathways), focusing on dietary diversity offers one way of identifying nutrition outcomes.

This becomes important for micronutrient deficiencies (like iron) that are often the result of inadequate dietary intakes. In India, high rates of anemia have been attributed to a diet that is heavily concentrated on starchy staples like rice and wheat relative to iron-rich foods like green leafy vegetables and meat, fish, or poultry products.

This note discusses key dietary diversity metrics that are currently in use and outlines how they can be developed/modified for incorporation in a larger household survey. We provide examples for each stage of development, implementation, and analysis of the various indicators. These examples are drawn from the research carried out as part of TCI's activities in India. Specifically, we draw on the experience of collecting and analyzing dietary data from two projects carried out in 2013-14:

1. Data was collected on women's dietary intake as part of a larger study focusing on women's empowerment and iron status in three different farming systems in the Chandrapur District of Maharashtra, India.

2. A dietary diversity module was developed as part of the Minimum Nutrition Dataset for Agricultural surveys (MNDA). It was field tested in Maharashtra and Hyderabad.

While the target audience for this note is development practitioners, the discussion herein will also be relevant to students, researchers, and others interested in the field of food security and nutrition.

REVIEW OF DIETARY DIVERSITY INDICATORS

In this section, we review three kinds of dietary diversity measures: count-based, frequency-based, and those based on weighted food records. The next section presents templates that can be used as a starting point to design each type of dietary diversity indicator.

1. Count-based measures

Two common count-based measures of dietary diversity are the Food Variety Score (FVS) and the Dietary Diversity Score (DDS). An FVS is a count of all foods consumed during a specified recall period. A DDS collapses the same foods by food group and then counts the number of food groups that were consumed during a given recall period.

One of the most widely used metrics is the FAO's dietary diversity score (FAO, 2011). It is a simple count of food groups consumed during the previous 24-hours. When computed at the level of an individual (IDDS), the score is considered to be a proxy for nutrient adequacy. Micronutrient adequacy, specifically in women (15-49 years old), is reflected in the Women's Dietary Diversity Score (WDDS). More recently, the FAO and FANTA have introduced the Minimum Dietary Diversity-Women (MDDW) indicator, which collapses the individual dietary diversity scores to a dichotomous score based on whether or not a given minimum number of food groups are consumed (FAO, 2014). FAO's DDS can also be computed at the level of the household (HDDS). In contrast to the IDDS, the HDDS reflects a household's economic access to food. The key differences in the components and computation of the dietary diversity scores discussed above is the total number of food groups considered and their treatment of foods consumed outside the household. These are discussed in Table 1.

TCI's work on developing a dietary diversity module as part of its focus on building a Minimum Nutrition Dataset for Agricultural surveys (MNDA) generates a dietary diversity score based on a 3-day recall. The module adds on information about food sources as well as food consumption outside the household (for the respondent as well as children). Separate measures have also been developed by WHO (2010) for measuring infant and young child feeding practices.

Box 2: The Minimum Dietary Diversity – Women indicator

The Minimum Dietary Diversity Indicator for Women (MDDW) was introduced by the FAO, USAID, and FANTA in 2015-16. It focuses on the dietary intake of women of reproductive age (15-49 years old) across ten key food groups over a 24-hour recall period. Intake of at least five of the ten food groups is considered to reflect a diet that provides an adequate intake of 11 key micronutrients. The MDDW is designed to be used as a population-level indicator, and its dichotomous nature targets easier communication of the state of a given population's diet quality at various policy and advocacy fora.

Since the MDDW is yet to be operationalized, it remains to be seen how effectively it reflects diet quality and influences policy decisions, as it is not without limitations. For one, the MDDW was designed using data from only 9 datasets – 6 from Africa, 2 from South Asia (Bangladesh), and 1 from South East Asia (Philippines) – each of varying sample sizes. This suggests that further use of this indicator in diverse settings is required to validate the results obtained from the 9 underlying datasets. The second limitation of the MDDW is due to the fact that the underlying Estimated Average Requirements (EARs) used to calculate the Mean Probability of Adequacy (MPA) for the 11 micronutrients are obtained from multiple sources like the WHO, Institute of Medicine (IOM), and the International Zinc Nutrition Consultative Group (IZiNCG). While the WHO sources are relevant to developing countries, the estimates for iron from the IOM are recommended for North American and Canadian populations. It is not clear how the MDDW accounts for variations in reference values for EARs between countries. To this end, it is likely that the underlying country-specific MPAs would influence the comparability of results from various locations. Third, for the proportion of women who have an MDDW score of 0, the indicator says nothing about the degree of inadequacy of specific micronutrients. And lastly, similar to other count-based measures, the MDDW too is constrained by a 24-hour recall period as well as seasonal fluctuations in food availability. To capture day-to-day variability in food consumption, it is suggested that the MDDW be implemented on multiple days, preferably 3 consecutive days at a stretch. Similarly, this exercise can be repeated during the main seasons (i.e. summer, winter, and monsoon) as well as at pre- and post-harvest seasons.

TABLE 1: COMPARISON OF FAO'S DIETARY DIVERSITY SCORES				
	HDDS	**IDDS**	**WDDS**	**MDDW**
Number of food groups	12	14	9	10
Consumption threshold	-	-	-	At least 5 out of 10
Aggregation (Range)	Simple count (0-12)	Simple count (0-14)	Simple count (0-9)	1 if threshold satisfied, 0 otherwise (1 or 0)
Consumption of	Any member of household	Individual	Individual	Individual
Foods prepared & consumed in/ outside home	Included	Included	Included	Included
Foods prepared & consumed outside home	Excluded	Included	Included	Included
Foods prepared outside & consumed at home	Included	Included	Included	Included
Reference	FAO (2011)	FAO (2008)	FAO (2011)	FAO (2014)

2. Frequency-based measures

Food frequency indicators (FAO, 2009) provide a count of how often, on average, different food items are consumed over a given recall period. Frequency-based measures of dietary diversity can be qualitative, semi-quantitative, or quantitative in design. When data is collected only on the frequency of intake for food/food groups of interest, the resulting indicator is considered to be qualitative in nature. The frequency of intake (qualitative) can be supplemented with information on portions consumed. When the portions used are standardized (cups, bowls, and spoons), we get a semi-quantitative food frequency questionnaire (FFQ). On the other hand, a quantitative FFQ is designed when the respondents themselves are allowed to estimate portions of food items consumed. Table 2 presents these differences between the various frequency-based measures of dietary diversity.

Frequency-based dietary indicators are able to pick up the variations in the

day-to-day consumption of an individual and offer a quick way to assessing intake over a longer timeframe. The qualitative measures in particular can be designed, and enumerators trained, in ways similar to those of count-based measures, since in both cases a single discrete response has to be recorded at the time of data collection. While the semi-quantitative and quantitative measures require more time to be invested in their design upfront, they also offer more details about dietary quality by going beyond food items (or food groups) and allow us to estimate actual nutrient intakes, if desired.

TABLE 2: COMPARISON OF FREQUENCY-BASED MEASURES OF DIETARY DIVERSITY

	Qualitative	Semi-quantitative	Quantitative
Frequency of intake	Yes	Yes	Yes
Portion(s) consumed	No	Yes	Yes
Use of standardized portion size(s)	No	Yes	No
Respondent-estimated portion size(s)	NO	No	Yes

3. Weighed food records

This method is based on the weighing of different foods that are prepared and consumed by the individual/household. Foods and individual ingredients are weighed before being cooked. Detailed records are typically collected anywhere from 1 to 7 days. The records can either be maintained by the respondent (in a diary) or by an enumerator who is present when the food is being prepared. The presence of an enumerator may, however, influence changes in consumption patterns.

DESIGNING A DIETARY DIVERSITY MODULE

In this section, we provide a step-by-step guide for designing and implementing a dietary diversity module. We focus on the following aspects of the design phase:

1. Choice of indicator
2. Initial considerations like recall period, type of recall, treatment of seasonality & non-typical days
3. Generating a contextually relevant list of commonly consumed foods
4. Implementing the dietary diversity module

For each of these considerations, we include examples from TCI's field projects and provide relevant templates that can be adapted to the needs of the project under consideration.

1. Deciding on the type of dietary diversity indicator to use

As indicated in Tables 1 and 2, dietary diversity indicators can typically be one of the following:

i. Weighed food method
ii. Count-based: Food variety score or dietary diversity score
iii. Frequency-based: Qualitative, semi-quantitative, or quantitative

Table 3 below compares the three types of dietary diversity measures discussed in the previous section, including the advantages and limitations of each. The decision on which indicator to use can depend on factors like the unit of interest (individual or household), duration of recall (short versus long-term), and the type of data needed (simple count versus frequency versus actual intakes). FAO's IDDS, WDDS, and MDDW are appropriate if the focus is on individual dietary diversity (the latter two especially for women). On the other hand, a food frequency tool would be more appropriate to capture day-to-day variations in diet over a relatively longer time period. If the project is focused on detailed, actual quantitative dietary intakes, then the weighted food records would be most appropriate.

TABLE 3: COMPARISON OF COMMONLY USED DIETARY DIVERSITY INDICATORS

	FVS	DDS	Frequency	Weighted
Based on	Count			
Advantage(s)	Quick to implement, Straigtforward to analyze	Quick to implement, Straigtforward to analyze	Long term, Quantitative	Detailed, accurate, quantitative
Limitation(s)	Short-term, No information on quantities	Short-term, No information on quantities	Complex to design and analyze	Complex to design and analyze

It is suggested that, if possible, a mix of dietary tools be used. For instance, a combination of individual-level, 24-hour dietary diversity scores and a 30-day food frequency (qualitative or semi-quantitative) would capture both a short-term and long-term pattern of food consumption. Box 3 discusses the rationale for incorporating multiple dietary measures in TCI's project on women's empowerment and iron deficiency in Chandrapur, India.

Box 3: Deciding which dietary diversity measures to use

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India

The following individual-level dietary diversity tools were incorporated in this household survey:

1. 24-hour dietary diversity score
2. 30-day semi-quantitative food frequency

A combination of these two measures provided a snapshot of the average food groups consumed in any given day as well as a longer-term sense of dietary patterns that were expected to cover the day-to-day variations in food intake.

2. Initial considerations

Before designing the dietary diversity module, it is recommended that the following issues be decided upon, based on the objectives of the research project.

a. Seasonality:

It is possible that at the field site under consideration, the availability of different food items depends on the season(s) in which they are grown. Such seasonality can either influence food that is grown by households for self-consumption as well as influence availability of foods in local markets. This variation in availability is expected to contribute to variation in the food consumption pattern of households and/or individuals. Additionally, the pre- and post-harvest agricultural season can also influence households' access to foods, especially if they are purchased from the markets. Households are expected to have a relatively greater disposable income in the post-harvest season as compared to the lean season. To capture such effects of seasonality, it is recommended that the timing and frequency of dietary recall be aligned with the project objectives. Box 4 discusses how the project timeline was based around seasonality considerations in TCI's Chandrapur project.

Box 4: Accounting for seasonal variations in consumption

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India

Seasonality was an important consideration for designing the dietary diversity module. Since the survey was across three different farming systems, a farming calendar was developed to identify a period of 2-3 months that would reflect either a post-harvest or lean season situation for all farming systems. The project eventually zeroed in on the period January–March for the survey. Within those three months, the survey was phased in such a way as to capture the post-harvest context in different farming systems. For instance, it began with the food-cropping households, since rice is harvested by December. It then progressed to the landless households and covered the cash-cropping households at the very end (since cotton is mostly harvested through the month of January/early February). Budgetary and time considerations are important when deciding whether or not to have multiple rounds of dietary recalls.

b. Recall period:

Dietary recalls have been based on a whole host of recall periods, ranging from 24-hours to longer. FAO's tools rely on a 24-hour recall, as it is least prone to errors of omission by the respondent. However, 24-hour recalls do not capture the day-to-day variation in consumption. For this, a 3 to 7 day recall is often used. Longer timeframes (15-30 days) can be used; however, they become more useful from the point of view of frequency of intake as opposed to a count of food groups, since recall can be prone to errors for a longer timeframe. Box 5 discusses various kinds of recall periods incorporated in TCI's women's empowerment and MNDA projects.

Box 5: Considerations around recall periods

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India

1. Recall period: The survey incorporated both a 24-hour dietary recall as well as a 30-day, semi-quantitative food frequency recall. This gave a picture of both a short-term and long-term dietary intake for women.
2. Type of recall: For both the 24-hour DDS and 30-day, semi-quantitative FFQ, an 'enumerator-driven response' recall was administered to women in each of the survey households.

TCI research on dietary diversity as part of the MNDA in India

1. Recall period: The dietary diversity module used a 3-day recall period. The module collected dietary intake information for each of the three days preceding the survey day.
2. Type of recall: An 'open- ended response' recall was administered to women in each of the survey households. Enumerators did not use a pre-prepared list of food items, but rather probed the respondents to recall and list all the foods they consumed based on the time of day (upon rising, mid-morning, afternoon, late afternoon, etc.).

c. Type of recall:

Two types of recalls can be considered in the design of a dietary diversity module. The first is an 'open-ended response' recall, which is respondent-driven and involves asking the respondent for a list of foods he/she consumed over a given recall period. While the enumerator may prompt them from time to time, the responses are determined largely by the ability of the respondent to recall all the foods he/she consumed. The respondent is more involved in such a response and might not feel inclined to mention food(s) that they in fact did not

consume. A second option is an 'enumerator-driven response' recall wherein the enumerator lists each food item one by one, and the respondent answers whether or not (and/or how frequently) he/she consumed it. This option places less burden on the respondent; however, it is possible that the list of foods might not be comprehensive, in which case an omission bias is possible. It also carries the risk of the respondent saying 'yes' to various food items by virtue of them being mentioned by the enumerator, but were in fact not consumed by the respondent.

d. Treatment of 'non-typical' days:

Responses to food consumption can vary during 'non-typical' days and therefore bias the results on dietary diversity. Such days can include holidays/festivals/fasts and so on. These are days that are usually characterized by a diet that differs from what would be consumed on a normal/typical day. If the recall period includes a non-typical day, it is recommended that consumption for that day not be recorded. Instead, consumption of the day before that can be considered if it was a normal day. It is also recommended that information on such region-wide, non-typical days be gathered well in advance to determine the best time to implement the dietary diversity module. This is because very often, in the case of such days, most (if not all) respondents in a given region would observe such days – a fact that can influence the quality of data collected. Some considerations around how non-typical days can be accounted for are discussed in Box 6 below.

Box 6: Treatment of non-typical days

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India
The household survey in Chandrapur had to work around two kinds of non-typical days.

1. The first were festivals that influenced the start and end of the household survey in general. For example, the survey was scheduled to begin after the festival of 'makar sakranti' and end by the start of the 'holi' festival. Celebrations for both these festivals last anywhere between 1–2 weeks.
2. The second kind of non-typical days were days when women were fasting. In this case, dietary recall was done for the day preceding the non-typical day.

TCI research on dietary diversity as part of the MNDA in India
The dietary diversity module in the MNDA accounted for three kinds of non-typical days:

1. Market day
2. Special day (festival/wedding and so on)
3. Fasting day

3. Generating a list of food items consumed

The next step to designing a dietary diversity module involves generating a comprehensive list of foods that are commonly consumed at the field site. Given the context-specific nature of consumption, it is recommended that adequate time be given to this step. There are several ways that such lists can be generated. A starting point can be lists prepared by national/state-level nutrition institutes and/or universities. These can be complemented by in-depth interviews of key informants (for example, women who prepare food in the household). As a pre-testing step, the list that has been prepared can be administered to a focus group and/or some individual households in communities near the actual field site. Relying on multiple methods allows a triangulation of results to ensure that the maximum possible relevant foods are included. This is discussed in Box 7 below. If the project is focused on a specific micronutrient (for example, iron or vitamin A), then efforts should be made to learn as much as possible about local foods rich in that micronutrient that are available and/or consumed at the field site. For instance, if the focus is on iron deficiency or anemia, then an explicit focus on green leafy vegetables and meat (including organ meat), fish, and poultry products is recommended.

Box 7: Using count-based & frequency-based measures in household surveys

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India

Since the survey covered three different farming systems and included two different types of dietary diversity indicators, preliminary research efforts to develop a comprehensive list of food items focused on the following aspects:

1. Foods available at the time of, and in the 2 months leading up to, the survey
2. Foods available in one/some of the farming systems and not others
3. Local names of foods, and if they differed by farming system
4. A conscious focus on iron-rich foods in the region, and if respondents were able to distinguish meat from 'organ meat' (they were not able to).

With that in mind, the project staff relied on the following sources for dietary data:

1. In-depth interviews with women (in each farming system) – Women were questioned about typical food consumption, foods they were purchasing at the time from local village markets, what kinds of foods (if any) were being grown in home/kitchen gardens, if any specific food crops (e.g. wheat, gram, lentils like pigeon-pea for Chandrapur) had recently been harvested (or would be harvested by the time the actual survey was implemented). While the villages for in-depth interviews were selected randomly, the households in each were selected purposefully so as to get a breadth of households – large versus small farmers, landless households. Such interviews took longer than food group discussions (see below), but allowed the respondent to give detailed responses in an environment she was familiar with and comfortable to speak in. In-depth interviews were carried out until a saturation of responses was reached. The villages that were visited for such preliminary interviews were eventually not considered when sampling for the actual survey.
2. Focus group discussions (FGDs) – In the same villages as above, FGDs were also conducted to understand common dietary intake patterns. These provided a greater range of responses (and affirmations/contradictions) in a shorter timeframe than the in-depth interviews. These were typically arranged through the village Aanganwadi or ASHA workers.

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3. Expertise of collaborators – TCI's collaborators at the Mahatma Gandhi Institute of Medical Science (MGIMS, Wardha) had an impressive record of conducting community medicine related field research in the region. Their insight into the seasonality of food availability, proper training of field staff and logistics of arranging field interviews was key to planning the field activities.
4. National Institute of Nutrition (NIN) – The NIN in India has publications on food consumption and nutrient composition of foods in India. These were used to cross-check the list of foods generated from the village visits and then used to determine nutrient intake at the data analysis stage.

4. Implementation of a dietary diversity module

Typically, in household surveys the enumerator would administer the dietary diversity module to the target respondent (for individual-level dietary diversity) or to the person who is primarily responsible for preparation of food in the household (for household-level dietary diversity). For each food item that the enumerator lists, the respondent will indicate whether or not he/she consumed it (and how frequently/in which portion size, if applicable). The key to the success of such an exercise is adequate training of field staff. Given the often lengthy nature of dietary diversity modules, enumerators are likely to skip food items or pose their question(s) in a leading way. An emphasis needs to be placed on the importance of avoiding leading questions ('did you eat ----?' as opposed to 'you ate ----didn't you?'). At the same time, the responses received are also prone to several omissions. It is possible that the respondent is unable to recall his/her consumption activities accurately. In this case, the enumerator may prompt them with time/activity cues to garner an appropriate response. At the same time, respondents can also suffer from response fatigue and might need to be nudged or encouraged by the enumerators to complete the module. Table 4 below presents commonly used templates for count-based and frequency-based indicators of dietary diversity.

TABLE 4: SOME COMMON TEMPLATES FOR COUNT-BASED AND FREQUENCY-BASED DIETARY DIVERSITY MODULES

Indicator	Typical question	Response options		
Count-based	Did you (or someone in your household) consume <food item> in the <recall period>	Yes No	Qualitative	Semi-Quantitative*
Frequency-based	In the last <recall period> how frequently would you say you (or someone in your household) consumed <food item>?	Never One day of the week 2-4 days of the week 5-6 days of the week 7 days of the week Once a month 2 times a month 3 times a month 4 times a month 5-6 times a month 7-8 times a month		
	Which portion size** <show standardized units> would you say corresponds most closely to your consumption of <food item>?	Standardized portion A Standardized portion B Standardized portion C Standardized portion D		
	How many such portions for <food item> do you consume in a day?	Minimum – maximum		

*Note: *Quantitative food frequency: if respondent-determined portion sizes noted instead of standardized units.*
***Standardized portion sizes are available for cups and bowls. Typically a set of 4 bowls has volumes ranging from 50-200 ml.*

COMPUTATION OF DIETARY DIVERSITY INDICATORS

In this section, we discuss how each type of dietary diversity indicator can be computed.

1. Count-based indicators

An FVS is a simple count of all food items consumed by the individual (or household) for the given recall period. Each food item is given a score of 1 if the food item is consumed and a score of 0 if it is not. The IDDS is similarly a simple count of all food groups consumed. Each food group is given a score of 1 if at least one food item within that food group has been consumed. If no food item within the food group has been consumed, it gets a score of 0. While the HDDS too is a simple count of food groups consumed, it gives a score of 1 to a food group as long as any member of the household consumes it. In the case of the MDDW, a threshold of 5 out of 10 food groups is applied for dietary intake of women. If the aggregate dietary diversity score is equal to, or greater than, 5, then the MDDW=1. If the DDS < 5, then the MDDW=0. MDDW scores of 1 and 0 indicate adequate and inadequate micronutrient intake, respectively.

Table 5 below shows how the scoring for such count-based measures is undertaken. The example provided assumes two food groups only: cereals and dairy products. The cereals food group includes rice and wheat, while milk is the only item included in the dairy products food group. The FVS is a simple count of all the food items consumed in the relevant recall period. The DDS first clubs all food items by their corresponding food group. Each food group corresponds to a score of 1 (or 0) if at least one food item in it has (or has not) been consumed. The list of food groups and food items within each food group would be more detailed for an actual dietary diversity module.

TABLE 5: COMPUTATION OF COUNT-BASED MEASURES (ASSUMING 2 FOOD GROUPS: CEREALS, DAIRY PRODUCTS)			
	Response	**Food Variety score**	**Dietary Diversity score**
Did you (or someone in your household) consume RICE in the <recall period>	Yes No	1	1 (Food group: cereals)
Did you (or someone in your household) consume WHEAT in the <recall period>	Yes No	1	
Did you (or someone in your household) consume MILK in the <recall period>	Yes No	1	1 (Food group: Dairy)
Total score		FVS= 3	DDS= 2
Note: Each food item that is (or is not) consumed in the relevant recall period corresponds to a score of 1 (or 0). The FVS is a sum of scores for all food items. The DDS clubs foods belonging to the same food group together and is a sum of the food groups consumed.			

2. Frequency-based indicators

The **qualitative** food frequency measure is computed in two steps. First, an average frequency of consumption for each food item is generated. For this, each response option for frequency of consumption is standardized to a specific number of days. One way to do this is to consider the average number of days. For instance, 2-4 days a week becomes 3 days a week, where 3 is the average of 2 and 4 days. The number of days per week can then be extended to the actual recall period. For instance, for a recall period of one month, an average of 3 days per week would translate to 3x4 = 12 days per month. If the purpose of the FFQ is to analyze frequency of consumption of all/specific food items, then the computation ends here and averages can be compared as such. A second step, however, is involved if consumption frequency is looked at for different food groups. In this case, the average frequency of consumption for a food group can be obtained as follows:

- If the food group has just one food item, then the frequency of consumption for the food group is the same as that for the food item.
- If the food group has two (or more) food items and at least one of those is consumed all days of the recall period, then the frequency of consumption of the food group is the same as the total number of days in the recall period.
- If the food group has two (or more) food items and none of those is consumed on

all days of the recall period, then the frequency of consumption of the food group is the sum of individual frequencies subject to a maximum that equals the maximum number of days in the recall period.

The **semi-quantitative** food frequency measure for each food item or food group is computed as the product of the average frequency of consumption (for the recall period), portion size (per meal), and total number of such portions consumed in a given day. The portion sizes here are based on standardized measures. If they were to be replaced by respondent-determined portion sizes consumed, we would get the quantitative food frequency measure. Table 6 below discusses how the various frequency-based measures of dietary diversity are computed. It does this for two food items – rice and milk – that belong to two different food groups – cereals and dairy, respectively. The recall period is assumed to be of one month (30 days).

TABLE 6: COMPUTATION OF FREQUENCY-BASED MEASURES (ASSUMING 2 FOOD ITEMS, 2 FOOD GROUP AND 30-DAY RECALL)

Responses	**In the last 30 days how frequently did you (or someone in your household) consume RICE?**	**In the last 30 days how frequently did you (or someone in your household) consume MILK?**
	2-4 days of the week	4 times a month
Standardized portion size	100 mg	25 ml
Units of standardized portions consumed daily	2	1
Computation		
Days per month	12*	4
Qualitative Frequency	12	4
*Semi-quantitative*** frequency*	2400** mg	100** ml

*Note: * 3 days per week, 4 weeks per month. ** Product of days per month, total portions per day, and each portion size. For rice, this equals 12x100x2 = 2400 mg per 30 days and for milk this equals 4x25x1 = 100 ml per 30 days. ***Quantitative food frequency measures can be computed by replacing standardized measures with respondent-determined portion sizes.*

Based on Table 6, the quantity consumed can be combined with food composition tables to generate 30-day estimates for intake of specific nutrients and/or calories. This is discussed for iron intakes from rice in Table 7 below.

3. Weight-based indicators

Detailed weighed food records can be analyzed using nutrient composition tables that contain information on the presence of various macro and micronutrients in different foods. It is recommended that country-specific nutrient composition tables be used for this purpose. For instance, in India the Indian Council of Medical Research publishes revised editions of the food composition tables (FCTs). The actual nutrient intake is obtained as a product of the quantity consumed of a given food item and the nutrient availability per 100 grams of that food item. Table 7 discusses the estimation of iron intakes from rice for a 30-day recall using iron content values from the latest FCTs for India.

TABLE 7: COMPUTATION OF NUTRIENT INTAKES (THIS EXAMPLE: IRON INTAKES FROM RICE)

Calculation of iron intake from rice	
30-day intake of rice (from Table 6)	2400 mg
30-day intake of rice (in grams)	2.4 grams
Iron content (mg) in 100 grams of rice*	1.0
30-day iron intake from rice	2.4 x 1 = 2.4 mg
**Food composition tables.*	

INTERPRETATION OF DIETARY DIVERSITY INDICATORS

This section suggests some commonly used ways to interpret results from dietary diversity indicators.

1. Aggregate scores

Aggregate count- and frequency-based scores can be grouped into low, medium, and high as a starting point for descriptive statistics. While FAO does suggest such categories for the DDS, in general there are no standardized cut-offs for determining the thresholds for such categories. It is recommended that these thresholds be determined by the data that is actually available. For instance, the aggregate scores can be divided by way of quartiles (four categories) or tertiles (three categories), depending on their distribution. Additionally, the nutrient intakes from weighed food records can be compared to recommended daily values. Averages of aggregate scores can be compared across parameters like gender, region, age group, caste group, and so on. Box 8 discusses how this was done for TCI's project in Chandrapur.

Box 8: Analysis: Comparison across interest groups

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India

In Maharashtra, results from the 24-hour DDS and the 30-day, semi-quantitative FFQ were used to compare 24-hour intake, 30-day frequency of intake as well as estimates of total iron intakes between the three farming systems:

1. Landless
2. Food-cropping households
3. Cash-cropping households

2. Disaggregation of total scores

Count- and frequency-based scores can be disaggregated by the types of constituent food groups, i.e. the proportion of individuals (or households) consuming each food group. This gives us a glimpse into how consumption patterns differ even if overall scores are the same or similar. Weighed food records can

be disaggregated by individual nutrients of interest. Box 9 discusses how women's dietary diversity scores were disaggregated and compared between three different farming systems as part of TCI's project on women's empowerment and iron deficiency in Chandrapur, India.

Box 9: Analysis: Disaggregation by food group

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India

Individual dietary diversity scores were disaggregated by individual food groups for the three farming systems under consideration (landless, food-cropping, and cash-cropping households). As a first step, disaggregated food group consumption within each farming system was analyzed. This allowed us to identify:

1. Proportion of women consuming each food group within each farming system
2. Average frequency of intake for each food group within each farming system

This was followed by a comparison of consumption of each food group between the three farming systems. Such a comparison allowed us to identify the food groups for which consumption is significantly different between farming systems. A similar analysis was also carried out for frequency of intake of different food groups as well.

SUGGESTED SUPPLEMENTARY DATA (OPTIONAL)

This section suggests additional data that may optionally be incorporated in household surveys to supplement the information gathered on dietary diversity. It allows for an incorporation of factors that can influence a household's and/or individual's ability to access and afford a nutritious diet.

1. Household composition

Household or individual dietary diversity can be a function of various household characteristics like family size, education level of household head, number of children, and the number of elderly. To this effect, data on the following variables can be collected:

- Number of individuals in the household
- Number of children and elderly in the household (can be disaggregated by age-group) or household dependency ratio (i.e. the ratio of elderly above 65 yrs. and children 0-14 yrs. to the household members who are 15-64 yrs.)
- Education level of household head
- Education level of index woman

2. Agricultural diversity

For most rural households engaged in agriculture, access to a diverse diet can be determined by crops cultivated, use of crops (consumed/sold), presence of livestock and home gardens, to name a few. Accordingly, the following variables on agriculture and allied activities can be incorporated in the survey:

- Total number of crops cultivated
- Total number of food crops cultivated
- Proportion of crops used for own-consumption
- Is there a home garden/kitchen garden present?
- Does the household own any livestock?
- Are any dairy products from livestock used for household consumption?
- Are any livestock used for household consumption?

3. Food access indicators

Household or individual dietary diversity can be a function of the ability of the household to access diverse foods. In addition to own-production (discussed above), this access can also be determined by the ability to purchase foods

from local markets. Food purchases additionally can be influenced by household income. In order to account for these factors, the following variables are suggested:

- Distance to market
- Time to market
- Household food expenditures
- Household non-food expenditures
- Market-Level Dietary Diversity (Pingali et al., 2014)
- Value of sale of crop(s)
- Participation in non-farm employment
- Number of sources of household income

TCI's MNDA project also focuses on different sources of food that are accessed by households. These are discussed in Box 10 below.

Box 10: Food access indicators

TCI research on dietary diversity as part of the MNDA in India
For each food item reported by the respondent, the enumerator also notes down the source of that food item. This provides some information on the extent to which households are able to access foods from different sources. The following food sources are considered by the MNDA:

1. Public distribution system (PDS)
2. Local vendors and shops
3. Own farm/foraged
4. Market
5. Prepared food
6. Other (from government program/given as gift/offered as payment)

4. Age and anthropometry

Information on individual height and weight can be used to develop BMI scores for adults and indicators of stunting (low height for age)/wasting (low weight for height)/underweight (low weight for age) for children.

Box 11: Dietary diversity scores and BMI

TCI research on dietary diversity as part of the MNDA in India
The MNDA research calculated adult BMI levels and classifies individuals as underweight (BMI < 18), normal (18.5-24.9) or overweight (BMI > 25). It then plots the BMI score for each BMI category against the dietary diversity scores for individuals in that BMI category. Such a graph can indicate how BMI levels differ as dietary diversity scores increase/decrease.

5. Micronutrient outcomes

Based on the specific field context and logistics (budget and time, amongst others), data may be collected on specific micronutrient deficiencies. When compared to dietary diversity intakes, it can provide some insight into the actual absorption of nutrients in the body (bioavailability).

Box 12: Dietary diversity scores and iron deficiency

TCI research on women's iron deficiency in Chandrapur (Maharashtra), India
Data on multiple biochemical assays was collected to assess the prevalence of iron deficiency for women in three different farming systems in Chandrapur. Prevalence of iron deficiency was compared to individual dietary diversity scores (and 30-day frequency of intake). The dietary diversity scores were disaggregated by food group for each farming system. This allowed us to identify the food groups for which consumption was significantly different between farming systems, and to assess whether or not these food groups were important for iron outcomes (as reflected by rates of iron deficiency in each farming system).

SUGGESTED READING LIST

Peer-reviewed literature

The following is a list of recent studies that have used the dietary diversity indicators discussed in this document. FAO's guidelines for the indicators are referenced at the end of this document.

Arimond et al. 2010. *Simple Food Group Diversity Indicators Predict Micronutrient Adequacy of Women's Diets in 5 Diverse, Resource-Poor Settings*. The Journal of Nutrition. Available at http://jn.nutrition.org/content/140/11/2059S.full.pdf

Savy et al. 2005. *Use of variety/diversity scores for diet quality measurement: relation with nutritional status of women in a rural area in Burkina Faso*. European Journal of Clinical Nutrition. Available at http://www.nature.com/ejcn/journal/v59/n5/pdf/1602135a.pdf

Herbert et al. 1999. *Development and testing of a quantitative food frequency questionnaire for use in Gujarat, India*. Public Health Nutrition. Available at http://journals.cambridge.org/download.php?file=%2FPHN%2FPHN2_01%2FS1368980099000051a.pdf&code=894c9948c5eecba60e7fa9d615b280fd

Wiesmann et al. 2009. *Validation of the World Food Programme's Food Consumption Score and Alternative Indicators of Household Food Security*. IFPRI discussion paper 00870. Available at https://www.ifpri.org/publication/validation-world-food-programmes-food-consumption-score-and-alternative-indicators

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FAO. 2016. *Minimum Dietary Diversity for Women. A guide to measurement*. FAO & FANTA. Available at http://www.fao.org/3/a-i5486e.pdf (accessed May 1st, 2016).

Pingali, P. and Ricketts, K. 2014. *Mainstreaming nutrition metrics in household surveys-toward a multidisciplinary convergence of data systems*. Annals of the New York Academy of Sciences.

FAO. 2014. *Introducing the minimum dietary diversity – women (MDD-W) global dietary diversity indicator for women*. FAO & FANTA, available at http://www.fsnnetwork.org/sites/default/files/minimum_dietary_diversity_-_women_mdd-w_sept_2014.pdf (accessed September 12, 2014).

FAO. 2011. *Guidelines for measuring individual and household dietary diversity*. Rome, Italy.

FAO. 2008. *Guidelines for measuring individual and household dietary diversity*, Version 4. Rome, Italy.

FAO. 2008. *Methods to monitor the human right to adequate food*. Volume II, Annex 3. Rome, Italy.

APPENDIX

1. FAO Women's Dietary Diversity Score template with food groups

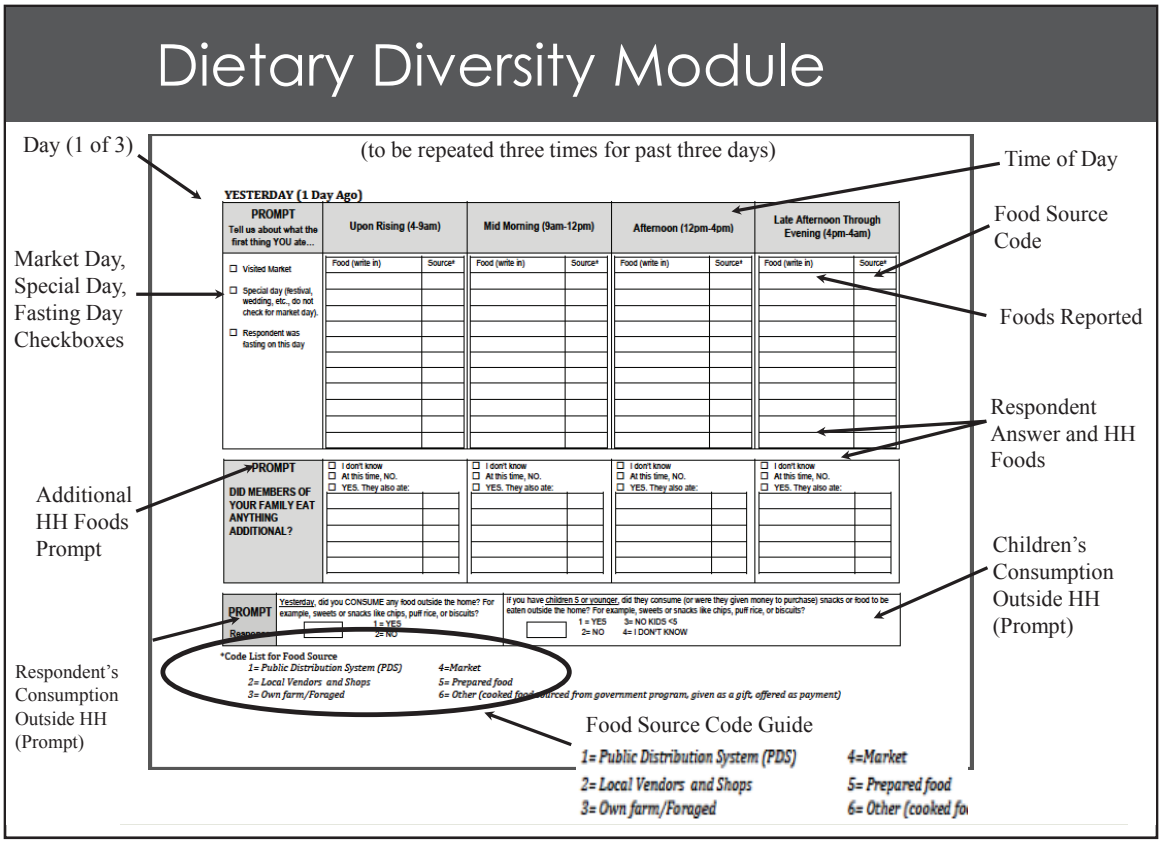
The following template is borrowed from the FAO's latest guidelines on the MDDW (FAO, 2016).

	Food categories	Description/examples to be adapted Consult **Appendix 2** and replace the example foods below with items commonly consumed in the survey area(s).	Consumed Yes = 1 No= 0
A	**Foods made from grains**	*Porridge, bread, rice, pasta/noodles or other foods made from grains*	___yes (1) ___no (0)
B	**White roots and tubers and plantains**	*White potatoes, white yams, manioc/cassava/yucca, cocoyam, taro or any other foods made from white-fleshed roots or tubers, or plantains*	___yes (1) ___no (0)
C	**Pulses (beans, peas and lentils)**	*Mature beans or peas (fresh or dried seed), lentils or bean/pea products, including hummus, tofu and tempeh*	___yes (1) ___no (0)
D	**Nuts and seeds**	*Any tree nut, groundnut/peanut or certain seeds, or nut/seed "butters" or pastes*	___yes (1) ___no (0)
E	**Milk and milk products**	*Milk, cheese, yoghurt or other milk products but NOT including butter, ice cream, cream or sour cream*	___yes (1) ___no (0)
F	**Organ meat**	*Liver, kidney, heart or other organ meats or blood-based foods, including from wild game*	___yes (1) ___no (0)
G	**Meat and poultry**	*Beef, pork, lamb, goat, rabbit, wild game meat, chicken, duck or other bird*	___yes (1) ___no (0)
H	**Fish and seafood**	*Fresh or dried fish, shellfish or seafood*	___yes (1) ___no (0)
I	**Eggs**	*Eggs from poultry or any other bird*	___yes (1) ___no (0)
J	**Dark green leafy vegetables**	*List examples of any medium-to-dark green leafy vegetables, including wild/foraged leaves*	___yes (1) ___no (0)
K	**Vitamin A-rich vegetables, roots and tubers**	*Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside (see **Appendix 2** for other less-common vitamin A-rich vegetables)*	___yes (1) ___no (0)
L	**Vitamin A-rich fruits**	*Ripe mango, ripe papaya (see **Appendix 2** for other less-common vitamin A-rich fruits)*	___yes (1) ___no (0)
M	**Other vegetables**	*List examples of any other vegetables*	___yes (1) ___no (0)
N	**Other fruits**	*List examples of any other fruits*	___yes (1) ___no (0)

TABLE 8: MINIMUM DIETARY DIVERSITY–WOMEN (MDDW) INDICATOR FOOD GROUPS	
All starchy staples	Eggs
Beans and peas	Vitamin A rich dark green leafy vegetables
Nuts and seeds	Other Vitamin A rich vegetables and fruits
Dairy	Other vegetables
Flesh foods	Other fruits
Source: http://www.fantaproject.org/sites/default/files/resources/WDDP-Meeting-Report-Oct2014.pdf	

2. TCI MNDA dietary diversity module

This template can be used to estimate individual- or household-level dietary diversity for a 3-day recall.



3. TCI Chandrapur semi-quantitative food frequency questionnaire

The semi-quantitative food frequency questionnaire developed for TCI's survey in Maharashtra is described below. The template combines both a 30-day frequency as well as a 24-hour recall to estimate the MDDW. Please note the following:

1. Food items for different groups are mentioned according to their local names in Marathi.
2. The quantities/portion sizes are based on standardized cups/bowls. These are described in the next section of this Appendix.
3. Meat consumption is calculated as per capita, since respondents were unable to estimate portion size for pieces of meat.
4. Consumption of fruits was considered in whole units.

S.No	**Food type**	**In the past one month, on an average, how frequently did you eat _____?** Response options: Never –go to next item One day of the week 2-4 days of the week 5-6 days of the week 7 days of the week Once a month 2 times a month 3 times a month 4 times a month 5-6 times a month 7-8 times a month	**Portion/ measure/ number of pieces commonly consumed <u>at one time</u>**	**Total Number of portions consumed in <u>whole day</u>**	**Did you consume yesterday?**
1	Roti/ Chapatti		Small Small to medium Medium Medium to large Large	<drop down list from 1 to 20>	Yes -1, No -2
2	Bhakri (sorghum bread)		Small Small to medium Medium Medium to large Large	<drop down list from 1 to 20>	Yes -1, No-2

3	Puranpoli		Small Small to medium Medium Medium to large Large	<drop down list from 1 to 20>	
4	Puri		Small Small to medium Medium Medium to large Large	<drop down list from 1 to 20>	Yes -1, No -2
5	Bhat (rice)		A full A half B full B half	<drop down list from 1 to 20>	Yes -1, No-2
6	Dal/varan (lentil)		Full A Full B/Half A Half B/Full D Full C Half C Half D	<drop down list from 1 to 20>	Drop down list of <No, pigeon-pea, green gram, red gram, black gram, chickpea, lakori>
7	Besan		Full A Full B/Half A Half B/Full D Full C Half C Half D		
8	Beans (phalli/ shenga) of different kinds		Full A Full B/Half A Half B/Full D Full C Half C Half D	<drop down list from 1 to 20>	Drop down list of <No, chowli, barbate, popat, vaal, gavar, shevga, other>
9	'Saag' (green leafy veg)		Full A Full B/Half A Half B/Full D Full C Half C Half D	<drop down list from 1 to 20>	Drop down list of <No, chouvlai, spinach, fenugreek, chana leaves, radish leaves, shepu, other>

10	Other vegetables Drop down list of other veg – read each one by one and record responses for relevant ones.		Full A Full B/Half A Half B/Full D Full C Half C Half D	<drop down list from 1 to 20>	Drop down list of <No, cauliflower, cabbage, eggplant, okra, potato, tomato, onion, carrot, pumpkin, bitter gourd, bottle gourd, other>
11	Tea		Full A Half A Full B Half B	<drop down list from 1 to 20>	Yes-1, No-2
12	Fruits Drop down list of fruits – read each one by one and record responses for relevant ones.		N/A	<drop down list from 1 to 20>	Drop down list of <No, Amla, apple, bana, mango, orange, papaya, custard apple, fruits, sweet lime, guava, pomegranate, pineapple, singhada, ber, watermelon, other>
13	Eggs		Show units from 1-10 with intervals of 0.5	<drop down list from 1 to 20>	Yes-1, No-2
14	Khichdi (rice, lentil mix)		A full A half B full B half	<drop down list from 1 to 20>	Yes-1, No-2
15	Kadhi		Full A Full B/Half A Half B/Full D Full C Half C Half D	<drop down list from 1 to 20>	Yes-1, No-2
16	Milk		Full A Half A Full B Half B	<drop down list from 1 to 20>	Yes-1, No-2

17	Curd		Full A Full B/Half A Half B/Full D Full C Half C Half D		<drop down list from 1 to 20>	Yes-1, No-2
18	Buttermilk		Full A Full B/Half A Half B/Full D Full C Half C Half D		<drop down list from 1 to 20>	Yes-1, No-2
19	Cottage cheese		Full A Full B/Half A Half B/Full D Full C Half C Half D		<drop down list from 1 to 20>	Yes-1, No-2
20	Bread		slice		<drop down list from 1 to 20>	Yes-1, No-2
21	Non-veg <give drop down options – ask for each item one by one and record response for each item>		(Amount prepared in household) 1 pao .5 kg 3 pao 1 kg 1.5 kg 2 kg More than 2 kg	How many pieces do you usually eat? 1 2 3 4 5 6 7 8	<drop down list from 1 to 20>	Drop down list of <No, chicken, goat, fish, prawn, other>
22	Snacks from market like samosa, bhajiya etc.		0 1 2 3 4 5 <pieces/units>		<drop down list from 1 to 20>	Yes -1 No -2
23	Sweets like laddoo, jalebi, kheer, shengdana chikki, tilgul, modak etc.		0 1 2 3 4 5 <pieces/units>		<drop down list from 1 to 20>	Yes -1 No -2

24	Dry fruits like almonds, raisins, cashewnuts, dry coconut				Yes -1 No -2

4. Standardized portion sizes

Standardized bowls were used to estimate quantities consumed of food items in the template above. These come as a set of marked plastic bowls for a range of quantities from 50-200 ml typically. Additionally, common cup-portions were used for consumption of food items # 11 and 16.