Food and Agriculture Organization of the United Nations

Bioversity International

GUIDELINES ON ASSESSING BIODIVERSE FOODS IN DIETARY INTAKE SURVEYS

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FOREWORD

Current foods systems are facing mounting challenges to provide growing populations with safe, diverse and nutritionally adequate foods because of resource constraints, environmental degradation as well as the continual narrowing of the food base and the loss of biodiversity. Biodiversity is intricately intertwined with food security and nutrition, for it is critical to the availability of nutrients needed to support health and well-being, as well as to the sustainability of the natural resource base upon which food systems rely.

Nutrition is at the heart of the sustainable development agenda. As a follow up to the Second International Conference on Nutrition (ICN2)[1], in April 2016, the UN General Assembly proclaimed a Decade of Action on Nutrition for the period 2016-2025, and endorsed the Rome Declaration on Nutrition and the accompanying Framework for Action. Recommendation 10 of the Framework for Action called for the promotion of "the diversification of crops including underutilized traditional crops… applying sustainable food production and natural resource management practices."

In order to mainstream biodiversity and to improve nutrition at national and local levels, a thorough understanding of the contribution of food biodiversity to healthy diets and sustainable food systems is needed. The Commission on Genetic Resources for Food and Agriculture (CGRFA)'s Voluntary Guidelines for Mainstreaming Biodiversity into Policies, Programmes and National and Regional Plans of Action on Nutrition recognizes that the limited availability of data on use and consumption of biodiverse foods acts as a major bottleneck in determining the importance of biodiverse foods to food security and nutrition[2].

Dietary assessment surveys provide information on the nutrient adequacy of diets, but few are designed to capture the consumption of foods with taxonomical details below the level of 'species'. Thus, their usefulness for understanding food biodiversity in diets and the nutritional contribution of biodiverse foods is limited. Fortunately, there is potential for many of these instruments to be adapted to capture this information, and thus to provide better information to agriculture practices and programmes, nutrition programmes and research, and the policy spheres surrounding agriculture, nutrition and health.

[1] The Second International Conference on Nutrition was held in Rome on 19–21 November 2014. Full report available at www.fao.org/3/a-i4436e.pdf

[2] The 15th regular session of the Commission on Genetic Resources for Food and Agriculture (CGRFA) was held in Rome on 19-23 January 2015. Full report available at: http://www.fao.org/3/a-mm660e.pdf

The Food and Agriculture Organization of the United Nations, in collaboration with Bioversity International, is pleased to publish these scientific guidelines on collecting information on food biodiversity through dietary surveys, in order to assist researchers and practitioners to generate more reliable data and to implement best practices in this regard. Experts on biodiversity, ethnobotany, nutrition and public health have contributed to and reviewed these guidelines. We take this opportunity to thank them for their time and efforts.

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ABOUT THIS DOCUMENT

These guidelines were developed through an FAO Technical Meeting on the collection of information on food biodiversity and food processing in food consumption surveys. The meeting was held 21-22 September 2013, in conjunction with the 20th International Congress on Nutrition in Granada, Spain. *The Guidelines on the Collection of Information on Food Processing through Food Consumption Surveys* (FAO, 2015) were also published as a result of this meeting.

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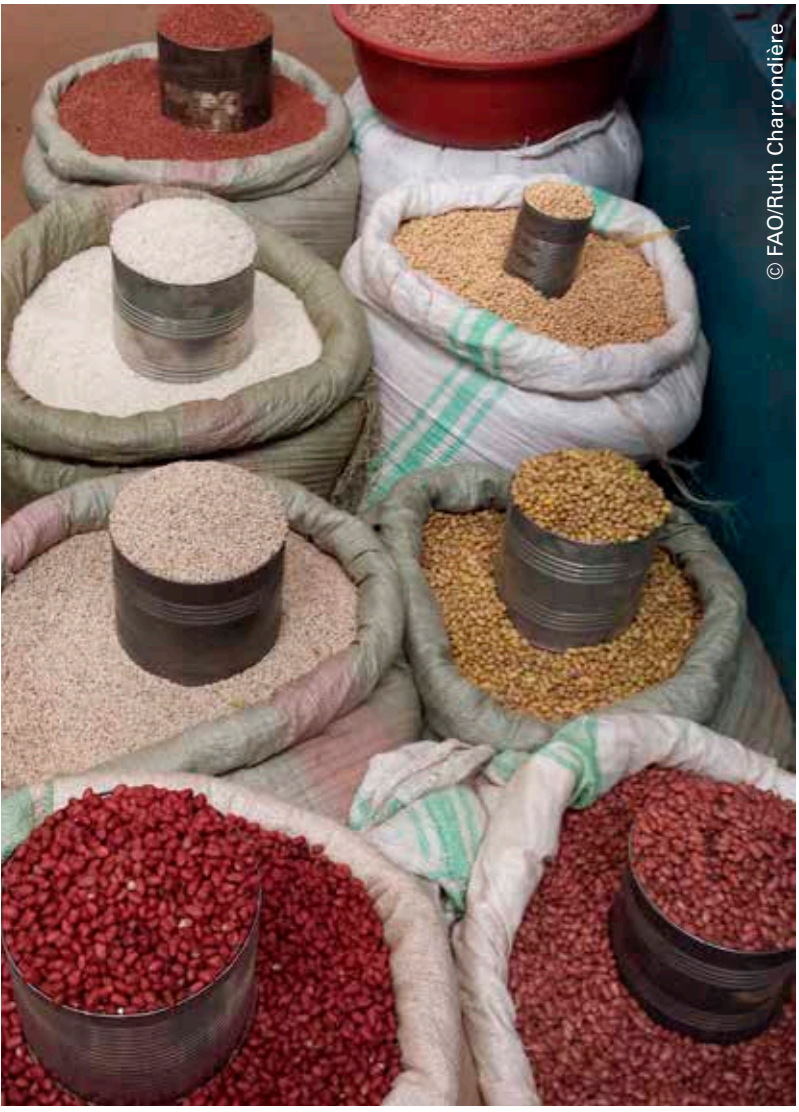
LIST OF ABBREVIATIONS AND ACRONYMS

BioFoodComp	Food composition Database for Biodiversity
CBD	Convention on Biological Diversity
CGRFA	Commission on Genetic Resources for Food and Agriculture
CIP	International Potato Center
DDQ	Dietary Diversity Questionnaire
FAO	Food and Agriculture Organization of the United Nations
FFQ	Food Frequency Questionnaire
INFOODS	International Network of Food Data Systems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1. INTRODUCTION

Despite improvements in recent decades in health care, increased food production and better access to markets, childhood stunting and other forms of malnutrition continue to be prevalent. In 2013, 161 million children under 5 were stunted, 43% of whom were living in Asia and 38% in Africa (UNICEF-WHO-World Bank, 2015). In 2011, anaemia affected 32 million pregnant women and 496 million non-pregnant women worldwide, with a prevalence of 38% and 29% respectively (WHO, 2015). At the same time, 1.9 billion adults and 42 million children under five were overweight or obese, and 2.8 million people die from obesity related conditions annually (WHO, 2015a).

The relation between agriculture and food systems (how food is produced, packaged, distributed and consumed) and nutritional problems is high on the policy agenda. Food availability, accessibility and quality are essential for good nutrition. What people eat, how diets are changing, the impact of these changes on nutritional status and on the environment are key questions which need to be studied at the global level as well as in more specific agro-ecological contexts and landscapes. There is emerging global consensus that the growing incidence of chronic disease related to poor nutrition and simplified, energy-dense diets is linked in part to massive shifts in agricultural food systems that have resulted in neglect of locally available nutrient-rich foods, and a decline in their use (Herforth and Ahmed, 2015).

Biodiversity is defined by the Convention on Biological Diversity (CBD) as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Within that, agrobiodiversity encompasses all of the components of biological diversity relevant to food and agriculture, including agricultural ecosystems. Food biodiversity refers to the diversity of plants, animals and other organisms that are used for food.[3]

The Voluntary Guidelines for mainstreaming biodiversity into policies, programmes and national and regional plans of action on nutrition, endorsed at the 15th regular session of the Commission on Genetic Resources for Food and Agriculture (CGRFA) in 2015, recognize that more data on composition and intake, for example on wild and underutilized species and animal breeds, are needed to determine the importance of food biodiversity in food security and nutrition. The Guidelines highlight the need for more research and more practice in the integration of biodiversity into dietary assessment (FAO, CGRFA 2016). Measuring what and how people eat using dietary assessment tools is a common practice that comes with many challenges, and incorporating considerations of food biodiversity into dietary assessment creates an additional layer of complexity.

[3] Defined by the Convention on Biological Diversity. **Annex 1** provides further definitions on biodiversity related terms and taxonomy.

It is essential to have a good understanding of the amount of biodiversity that is available within a given food system and how it can serve nutrition, health and agriculture. Only then can biodiversity be incorporated (and mainstreamed) into policies and programmes, in order to guide consumers, producers, manufacturers, policymakers and others in the identification and promotion of a healthy, nutritious, safe and sustainable diet and food supply. For different food systems, the complexity of an assessment would vary depending on ecosystem diversity. Thus it is advisable to start with small-scale assessments, and expand as different methodologies are tested and refined, and greater understanding is achieved in the subject area. To this end, clear guidance is necessary for professionals.

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2. PREVIOUS WORK

FAO and Bioversity International have been working together with partners to increase the scientific knowledge base on the nutritional benefits of food biodiversity. This work is part of efforts to reverse the current global trend toward a narrowing of the food base and a loss of biodiversity, and to raise awareness of the food security and nutrition benefits which can be achieved through more attention to the benefits of food biodiversity (FAO, 2012b). One of the challenges faced in improving the knowledge base is the scarcity of data on the composition and consumption of foods at a level of detail sufficient for inclusion in the Nutrition Indicators for Biodiversity (1. Food composition, and 2. Food Consumption): that is, referring to foods identified at below-species taxonomic level (variety/breed/market type level) as well as wild and underutilized foods identified at species level (Box 1). There is in fact a huge gap in the availability of composition and consumption data for foods identified at below-species taxonomic level as well as on wild and underutilized foods identified at species level.

In order to motivate the scientific community to generate, collect, compile and disseminate more data on biodiversity in foods, and to be able to track progress, FAO and Bioversity International led two expert consultations to define indicators for the measurement of food biodiversity. The first of these was held on food composition in 2007 [4], and the second, in June 2009, aimed to develop indicators for food consumption[5]. The definitions of the proposed nutrition indicators for biodiversity are shown in Box 1.

The indicators for consumption should be derived or estimated by reviewing modified dietary intake instruments and survey reports. The consultation recognized that guidance is needed on how to adapt existing dietary intake tools in order to capture food biodiversity. It was recommended that FAO, in collaboration with other biodiversity experts, develop guidelines for adapting dietary assessment instruments that measure individual dietary intakes to incorporate ways of registering foods consumed in sufficient taxonomic detail. This led to the FAO technical meeting in Granada, which resulted in the development of these guidelines, and the term 'biodiverse foods' (Box 1).

[4] The report is available online at http://www.fao.org/docrep/010/a1582e/a1582e00.htm.

[5] The report is available online at http://www.fao.org/docrep/014/i1951e/i1951e00.htm.

BOX 1 - DEFINITIONS OF "NUTRITION INDICATORS FOR BIODIVERSITY" AND "BIODIVERSE FOODS" FOR FOOD COMPOSITION AND FOOD CONSUMPTION

(FAO 2008; FAO 2011)

Food Composition (Indicator 1):

1. ***Count of the number of foods with a sufficiently detailed description to identify genus, species, subspecies and variety/cultivar/breed, and with at least one value for a nutrient or a bioactive component. Exceptions are wild and underutilized foods, which are acceptable when described at genus/species level and/or with local name.***

Food Consumption (Indicator 2):

1. ***Count of foods reported in food consumption surveys described at the level of genus, species, subspecies and variety/cultivar/breed. Exceptions are wild and underutilized foods, which are acceptable when described at genus/species level and/or with local name.***

2. ***Secondary Indicator: Count of the number of food consumption and similar surveys taking biodiversity into consideration in their design and/or reporting, with at least one reported food meeting the criterion for the Indicator 2.***

For the purpose of this document, "*biodiverse foods*" are defined as the foods identified at an appropriate level with sufficient taxonomical detail, and which contribute to the above indicators. These include:

- Foods described at the level of variety/cultivar/breed, with different plant/animal parts or stages of maturation for the same animal/plant species to be counted separately.
- Food described by 'market type'. As respondents are not always able to mention the specific variety/cultivar/breed, but are able to define the food consumed below species level using 'market type' information, it was decided during the 2013 Granada FAO technical meeting that market types would be considered as sufficient detail for below-species level.
- Wild foods identified at species level.
- Underutilized foods (FAO, 2008, 2010) identified at species level.

Note:

Please refer to **Annex 1** for definitions of the terms variety, cultivar, breed and market group/type.

Please refer to **Annex 2** for a more refined set of inclusion criteria valid for both Indicators, adapted from the Expert Consultation on Nutrition Indicators for Biodiversity – 2. Food Consumption (FAO, 2010).

Since the launch of "Indicator 1" in 2008 on food composition, reporting for the Nutrition Indicators for Biodiversity on Food Composition is being done on an annual basis. FAO and the International Network of Food Data Systems (INFOODS) actively collect, compile and publish analytical data on the food composition of biodiverse foods identified at appropriate taxonomic levels in the FAO/INFOODS Food Composition Database for Biodiversity (BioFoodComp 3.0)[6]. Results suggest an increase in the availability of data at appropriate taxonomic levels for biodiverse foods, but there is still a need for investigation of a wider spectrum of foods and components, as well as an increase in the publication of data in national and regional composition tables/databases (FAO/INFOODS, 2013).

2.1 FOOD CONSUMPTION DATA ON BIODIVERSITY

Reporting for the Nutrition Indicators for Biodiversity on Food Consumption is carried out every two years[7]. It is important to note that even when food intake is reported for biodiverse foods identified at taxonomic levels appropriate for inclusion in the Nutrition Indicators for Biodiversity, nutrient and non-nutrient food composition values may not be available for all of them. So far, most nutrient intake estimates have been calculated at the species level, but rarely at the subspecies level. However, progress is being made in this field and the amount of data available is gradually increasing, although the survey design and tools for capturing the consumption of biodiverse foods need to be improved (FAO/INFOODS 2013).

[6] INFOODs Database at http://www.fao.org/infoods/infoods/tables-and-databases/faoinfoods-databases/en/.

[7] Previous reports can be found at http://www.fao.org/infoods/infoods/food-biodiversity/en/.


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3. PURPOSE OF THE GUIDELINES

FAO produced these guidelines in collaboration with Bioversity International with the aim of facilitating the work of researchers who wish to capture biodiversity aspects (appropriate levels of taxonomic identification of foods) in commonly used dietary surveys, including 24-hour recall, food records, food frequency questionnaires (FFQ) and dietary diversity surveys. For the sake of simplicity, these guidelines focus on plant foods, which is where the expertise of Bioversity International lies, but similar principles could be applied to animal foods, insects, fish and other aquatic species, with the support of appropriate experts. The guidelines are intended as a practical tool, and describe the preparatory steps involved in assessing and documenting local foods, with appropriate levels of detail in taxonomic identification. This is followed by suggestions on how to adapt dietary assessment instruments to collect information on biodiverse foods.

The benefits of increasing the level of taxonomic detail on biodiverse foods in all dietary surveys include:

- promoting the incorporation of specific varieties, cultivars and breeds of plants and animals as well as wild, neglected and underutilized species used as food into relevant nutrition activities, such as food composition, food-based dietary guidelines, nutrition education and nutrition policy development;
- increasing potential to generate knowledge on nutrient composition and data on intake of varieties in order to understand the impact of biodiversity on food security and nutrition;
- enabling the reporting of food consumption by ecosystem and/or geographical area;
- communicating to food composition database compilers what specific varieties/cultivars/breeds/market types lack or require compositional data;
- improving nutrient intake estimations in all dietary surveys.

The information collected with the adapted tools will help answer questions in research studies and assess programme interventions which aim to measure food biodiversity below the species level. Some potential questions include:

- How does on-farm agricultural biodiversity contribute to household and individual food consumption?
- To what extent do programmes aimed at conserving biodiverse foods achieve measurable changes in food intake?
- What is the nutrient contribution of different varieties/breeds in terms of intakes of macro- and micronutrients, and are any differences in intakes of macro- and micronutrients seen when information is collected at this level of detail?

The intended users are professionals in nutrition, dietetics, agriculture, health and social science, as well as other researchers wishing to capture dietary data on foods identified at below-species taxonomic level (or at species level in the case of wild/underutilized foods).

3.1 WHAT GAPS DO THESE GUIDELINES FILL?

These guidelines

- provide an overview of the tasks to be undertaken in order to assess the availability of food biodiversity and identify biodiverse foods with sufficient taxonomic detail for incorporation into dietary intake surveys;
- provide an understanding on how to adapt dietary assessment tools to capture biodiverse foods at national, regional and community levels.

The principles described here can serve as a basis for discussion on expanding existing guidelines for the adaptation of tools such as Household Consumption and Expenditure Surveys, designed to measure household food consumption, which are not addressed in detail here (FAO 2012a).

3.2 WHAT DO THE GUIDELINES NOT ENCOMPASS?

These guidelines do not cover:

- how to plan or implement a dietary survey, nutrition project or interventions that aim to incorporate traditional food, agroecology or other aspects of agrobiodiversity;
- how to conduct dietary assessment surveys, using e.g. the 24-hour recall, diet history or food frequency questionnaire, as there are already many guidelines available on this topic;
- general guidance on generating, collecting and analysing food composition data;
- guidance on ethnobotanical research;
- details on how to approach communities, obtain their consent and agreement to participate in the study and establish a relationship of trust;
- information on sample size calculation. This is connected to the research question to be answered and a statistician should be consulted before beginning data collection.

Please refer to **Annex 3** for further resources on these topics.


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4. PREPARATION FOR TOOL ADAPTATION

It is important to note that extensive preparatory work is required before beginning to adapt any existing dietary intake tool to collect information on biodiverse foods. There are a series of steps to undertake in order to gather the information, which will be used to later adapt the dietary assessment questionnaire, and develop enumerator aids such as photo books and descriptions of each biodiverse food of interest. This section will provide a description of each step, and **Annex 3** suggests additional reference materials which may be consulted to assist with these preliminary steps.

4.1 PRELIMINARY STEPS TO COLLECT INFORMATION NEEDED TO CAPTURE BIODIVERSE FOODS IN DIETARY ASSESSMENT TOOLS

BOX 2 - SNAPSHOT AND OBJECTIVES OF STEPS INVOLVED

1. ***Create a multi-disciplinary team. The team should include experts in ethnobotany, taxonomy, dietary assessment and others.***
   - Objective: to include input and obtain support from experts from relevant scientific fields and individuals with local knowledge.
2. ***Perform a literature review (including the grey literature).***
   - Objectives:
     - 1) to learn about the extent to which locally available biodiverse foods have already been documented with sufficient taxonomical detail in the population of interest;
     - 2) to gain a better understanding of the nutritional problems faced by the community in which you will work;
     - 3) to assess the availability of and gather food composition data available for all foods in the area;
     - 4) to understand food consumption patterns in the area.
3. ***Define the foods and/or food groups for investigation at the subspecies level.***
   - Objective: To identify which biodiverse foods to include in the dietary intake tool.

4. Conduct an assessment of food biodiversity within the food system at the appropriate level of taxonomic detail.

- Objective: To obtain a clear picture of the availability of food varieties/cultivars /breeds/market types through market and field surveys, key informant interviews and focus group discussions, complemented by sample collection and photographs for correct identification and reference.

5. Verification, harmonization and finalization of the sub-species food list for the dietary assessment tool.

- Objective: To ensure correct identification of the subspecies scientific names and genus/species level information for wild and underutilized foods to be included in the dietary assessment tool.

4.2 STEP 1: CREATE A MULTI-DISCIPLINARY TEAM

The nature of the work involved in collecting information for these preliminary steps requires consideration of a number of different scientific disciplines, and for this reason requires the involvement of specialists in taxonomy, ethnobotany, nutrition and quantitative and qualitative research techniques, as well as knowledgeable experts from the local communities.

The type of expertise needed may vary depending on the foods or food groups being considered. For example, a botanist can ensure correct identification of fruit or vegetable cultivars and varieties but a fisheries expert would be required if one of the goals was to include details on aquatic species. More than one taxonomic expert may be needed depending on the number of plant/animal species/subspecies to be included in the dietary assessment tool.

Table 1 - Potential team members needed to document biodiverse foods within the considered food system

DISCIPLINE	RESPONSIBILITIES
Local Leaders	Introduce team to the community, mobilize community to participate in the study, safeguard local knowledge.
Ethnobotanist (botany) and other taxonomic experts, as needed. (A different expert, e.g. zoologist, will be needed if the research involves investigating non-plant foods such as animals, fish, other aquatic species, insects or fungi.)	- Ensure correct identification of variety/cultivar/breed market type (or species level identification for those foods considered to be wild or underutilized) and collect samples as required, together with information on season, edible parts and uses. - Collect specimens for national and international reference collections where voucher specimens are kept in an internationally recognized herbarium or museum. - Contact plant, animal and fish breeders in the localities to obtain specific information from them. - Interview women or other persons with primary responsibility for collecting plants from the wild to compile their local knowledge of edible wild foods.
Anthropologist	Document background on community history and cultural knowledge of local foods, including beliefs concerning medicinal and/or nutritional properties of different foods, their uses and seasonality
Nutritionist/Dietitian	Gain an understanding of the available food biodiversity in order to be able to adapt the dietary assessment tool to incorporate biodiverse foods and develop appropriate training tools and probing questions for use during survey training and data collection.
Food composition expert	Assess the availability of food composition information at the subspecies level on the biodiverse foods in the identified area. Gather, compile and analyse food composition data of interest. In case of missing data, determine whether further data are needed and how they can be generated.
Photographer	Take photographs for use in focus group discussions and for use as training and data collection aids.

Data collection assistants	Carry out market surveys, focus group discussions and key informant interviews under the guidance of the ethnobiologist, food composition and nutrition experts.
Community stakeholders	Provide information on available food biodiversity, seasonality, use, local knowledge and beliefs of the properties of different foods.
Local translators	Assist with documentation of local names and uses for foods. The name of the same food or variety/cultivar can vary in different communities or among different ethnicities (or speakers of different tribal languages). Names of parts of plants and animals used for food (e.g. leaf, root, seed, stomach, liver, eyes) and cultural knowledge on the food uses may also vary by community and ethnicity.

The precise composition of the team which will undertake the fieldwork can be reviewed before beginning Step 4. While assembling the team, it would also be helpful to identify individuals with local knowledge to be consulted during the planning stage of the programme.

4.3 STEP 2: PERFORM A LITERATURE REVIEW

A literature review may have four main objectives:

- to learn about the extent to which foods available in the food system to be studied have already been documented at a sufficient level of taxonomic detail in the population of interest;
- to gain a better understanding of the nutritional problems faced by the community in which you will work;
- to assess the availability of food composition data in the area, and gather these data at the required taxonomic level;
- to understand food consumption patterns in the area.

All four of these aspects can help prioritize foods for in-depth food biodiversity research.

Most national level data collection systems such as food balance sheets and even dietary intake surveys do not provide the level of detail needed when trying to gather information on food biodiversity. However, consulting this type of document can be a useful first step in understanding general food availability, national trends in consumption and dietary patterns.

As mentioned above, one objective of the literature review would be to identify and gather existing data on food composition of biodiverse foods. The food composition expert will search for and compile compositional data on biodiverse foods from multiple sources, including:

- national or regional food composition tables and databases;
- the FAO/INFOODS database;
- peer reviewed journals or previously completed interviews and surveys which investigate knowledge of wild and underutilized edible plants, animals and insects.

Available food composition data can be used to facilitate the decision in Step 3 about which food/food groups to include or investigate, and can be matched with the taxonomical information obtained from ethnobotanical studies at the level of interest of step 4, according to FAO/INFOODS guidelines on food matching (FAO, 2012). The purpose of having these data is:

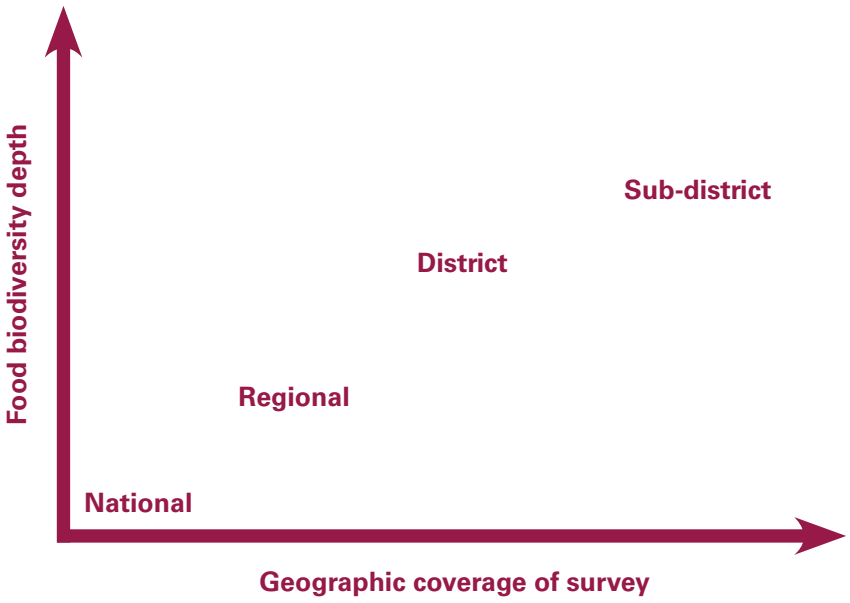
- to understand which biodiverse foods have a known nutrient composition;
- to understand the contribution of food biodiversity to nutrient intakes;
- to explore variability in nutrient content (e.g. major macronutrients, vitamins and minerals) between varieties that represent common market classes, breeding lines and native and wild species, and their influence on nutrient intake estimations.

In addition to consulting published sources such as the national databases and the BioFoodComp database, it can also be very useful to consult grey literature, such as reports and studies of international and national agriculture and food security research organizations, Non-Governmental Organizations (NGOs) and master's or Ph.D. theses. Searching for sources of grey literature can be time-consuming as not all of this type of information can be found on the internet. It may be necessary to contact resource persons and to visit laboratories, archives and universities in order to locate these valuable sources of information. When utilizing food composition data from grey literature, it is important to exercise caution and conduct thorough quality checks on the data.

4.4 STEP 3: DEFINE THE FOODS AND/OR FOOD GROUPS FOR INVESTIGATION AT SUBSPECIES LEVEL

In many areas there are hundreds of foods at subspecies level, and it will be necessary to prioritize food groups and/or food items of interest according to time and resource constraints and the level of survey coverage (national, regional, district). As illustrated in Figure 1, a trade-off exists between the geographic coverage of the survey and the amount of food biodiversity that can be measured. When incorporating food biodiversity into a national-level survey covering a wide range of agro-ecological zones, ethnic groups and languages, it may only be possible to collect subspecies information for one or two species. As the geographic coverage of the survey decreases, a greater depth of collection on food biodiversity becomes more feasible.

Figure 1 - *Relationship between food biodiversity investigation and survey scope*



Priority could be given to the major staple food, such as rice, or to certain food groups (e.g. fruits and vegetables) or specific nutrients of interest (e.g. vitamin A-rich foods). A review of the purpose and objectives of the research or food security and nutrition programme will help to determine the extent of information on biodiverse foods that needs to be included in the dietary intake tool. The team should develop a priority list based on a set of criteria related to the objectives of the survey.

Some preliminary questions[8] to discuss as a team may include the following.

Study design:

- What are the objectives of the study? Is it relevant for this study to collect information on food biodiversity?
- Do additional questions need to be added on the consumption of biodiverse foods if certain foods are not available during the intended timeframe of the study because of seasonality?
- What are the foods/food groups or key nutrients which are of primary interest for the study?
- What financial and human resources are available?
- Will the inclusion of biodiversity change any study parameters (e.g. season, sampling subjects)? For example, would oversampling a particular population that consumes biodiverse foods be required?

Assessing consumption patterns for biodiverse foods (these questions need to be considered in depth in Step 4):

- What are the available biodiverse foods? Which are the major ones produced?
- What is the extent of use of biodiverse foods by the study population?
- Which foods are most commonly consumed? In which season is their peak consumption? Does this season fall into the study period?
- Are foods from the wild consumed? If so, which ones? Are their taxonomic names known or only local names? In which region and season are they consumed and by whom?
- Are there any traditions or beliefs about any of the biodiverse foods of interest?

Survey adaptation:

- Which biodiverse foods are most likely to be recognized by the study population?
- What identification aids are needed?

The likelihood that a respondent will be able to identify a food item at subspecies level should also be kept in mind during this and subsequent steps. The following criteria may help determine this likelihood:

- Differences in size, colour or shape between variety/cultivar/breed/market types. For example, different varieties within the same species may have a different colour (e.g. apples), shape (e.g. eggplants) or size (e.g. banana). Differences in colour can be external (skin, peel) or internal (for example, the internal flesh of the same fruit can range in colour from light yellow to deep orange).

[8] Questions adapted from Medical Research Council webpage, Choosing a dietary assessment or physical activity assessment method http://dapa-toolkit.mrc.ac.uk/choosing-a-method/.

- Detectable differences in taste between the variety/cultivar/breed/market type. For example, some varieties of pepper may be spicier than others, and some varieties of banana sweeter.
- Depth of knowledge of respondents. This can depend upon the areas to be surveyed and the livelihood of the respondent. In general, persons in rural areas involved in agriculture as part of their livelihood will be more familiar with the varieties they cultivate and consume compared with those living in urban areas.

At market level, the variety/cultivar/breed/market type can be identified. For example, in some markets the name of the variety is recorded for the consumer and/or marked on the package.

Based on the information collected as outlined in Box 3, the team can develop a set of criteria for selecting the biodiverse foods to be included in the dietary assessment tool (Table 2).

BOX 3 - EXAMPLES OF ADDITIONAL POSSIBILITIES FOR PRIORITIZATION

- If the research is focused on assessing foods rich in vitamin A, the dietary intake instrument should be designed to explore the diversity of foods within the local food system with the potential to contribute to vitamin A intake.
- In the case of a community nutrition programme designed to increase intakes of fruits and vegetables, the preliminary steps and the adaptation of the dietary intake instrument would be focused on biodiverse fruits and vegetables available in the market, home grown or gathered in the wild.
- In the case of food security and nutrition programmes, the team should review the planned interventions or activities and determine which agricultural products (including for example vegetables, fruit, small livestock or fish) the project might be able to influence, either directly, through increased home production and consumption, or indirectly, through improved market access and lower prices. The agricultural products most susceptible to influence by the project can be highlighted as priorities.
- Lastly, some governments have developed lists of preferred species for further scientific research. Where such lists exist, they can help the team decide on priorities.

Table 2 - Potential inclusion criteria for biodiverse foods:

CRITERION	INCLUDE FOODS
1) Scientific Name	with scientific names that can be matched with local names, to avoid double counting
2) Nutrient composition data	with nutrient composition data
3) Variation in nutrient composition	with significant differences in nutrient composition of essential macro- and micronutrients (e.g. thiamin, riboflavin, niacin, folate, vitamin B-6, B-12, A, C, calcium, iron and zinc) at the level of varieties, cultivars and breeds
4) Ease of identification	that are recognizable/known to the enumerators and consumers in the study area (see step 5)
5) Consumption patterns	frequently consumed in amounts that have a significant impact on nutrient intake (e.g. at least "weekly")
6) Seasonality	consumed within the study period
7) Multi-ingredient foods not broken down into ingredients; processed and/or brand name foods	for which it is possible to contact the manufacturer to obtain the information, and the information is available
8) Number of varieties / cultivars / breeds to include per study	for which total number of varieties per food/food group and per survey is less than [x] (see note below)

For Item 5, a FFQ of infrequently consumed biodiverse foods could be used, together with a 24-hour recall questionnaire. Investigators may elect to exclude infrequently consumed food items in order to reduce the burden on participants and enumerators, although this may mean that food biodiversity is not fully captured (Kolahdooz *et al.*, 2014).

For item 8, determine the foods (or varieties, or cultivars) to be included in the survey so that no category contains more than [x] options. This number will depend on the scope of the survey (as shown in figure 1, the wider the scope the more options become available), on the capacity of the respondents and enumerators to distinguish between similar foods, and on the need to keep the questionnaire within reasonable size so that it does not becomes too burdensome to administer.

4.5 STEP 4: CONDUCT AN ASSESSMENT OF FOOD BIODIVERSITY WITHIN THE FOOD SYSTEM AT THE APPROPRIATE LEVEL OF TAXONOMIC DETAIL.

(often done in parallel with step 3)

After deciding on the list of priority biodiverse food items/food groups, the team will need to assess the food system for biodiverse foods and make a comprehensive list of all prioritized foods within the geographic range of the survey. Gathering information on the available food biodiversity for the study population is a mandatory step to undertake prior to being able to adapt a dietary intake instrument. This information can be gathered through market and seed company inventories, field surveys, key informant interviews and focus group discussions combined with collection trips with key informants to collect samples for correct taxonomic identification and constitution of a reference collection. For plant foods, seed companies can generally provide commonly consumed or popular variety/cultivar/market type names with pictures and sometimes even market share data.

To assess available food biodiversity, the project/research area should be divided into agro-ecological zones which can be classified according to agricultural potential, rainfall, climate, population density and market access (Musinguzi, unpublished), and food biodiversity should be assessed for each zone. Within the agro-ecological zone, seasonality must always be considered, as food availability can change dramatically by season. This means that food biodiversity assessments may need to be repeated at different periods during one year (e.g. dry and wet season; lean season and harvest season etc.), or seasonality needs to be considered in questionnaire design.

Ethnicity and local language should be taken into account during all interviews or discussions. The team should try to find out about the different ethnic or cultural groups living in the area to be surveyed, and whether there is more than one local language. People living in the same area with different ethnic or cultural backgrounds use different vernacular names in different local languages for the same variety. Their knowledge and use of biodiverse foods are also heavily influenced by food traditions, cultural heritage and personal preferences and perceptions. In rural areas, where different cultural groups sometimes inhabit geographically distinct areas, one might consider organizing a community food biodiversity assessment per major ethnic or cultural group (for an example on wild food plants, see Termote *et al.*, 2011). Migration patterns or seasonal shifts in populations should also be considered in any assessment. The preliminary questions suggested in Step 3 can be very helpful during this assessment.

The final food list in the dietary assessment tool will need to combine all the foods and varieties of interest and all the different local names used in the whole study or project zone for each food of interest.

The assessment of biodiverse foods should be conducted with a trained ethnobiologist or botanist, and with the help of other taxonomic experts, according to project needs (see step 1)[9]. Once samples are collected and interviews are done, samples need to be correctly identified using key flora and fauna reference books available for the region or through comparison with samples available in local or national collections, preferably herbaria. Nearly all countries have herbaria, mostly housed at the national botanic gardens or in local universities with a biology (botany) department. When samples are correctly identified, all samples should be prepared for storage in the reference collection of an internationally recognized herbarium within the country where the research/project is executed, and each sample given a unique reference number. Doubles of samples may also be stored in places specialized in the flora/fauna of the country/region of interest. In the study conducted by Termote *et al.* (2011) on wild edible plants in the Democratic Republic of Congo, the team deposited one reference collection in the herbarium of the University of Kisangani in-country and the doubles in the National herbarium of Brussels (BR) specialized in the flora of Central Africa. All subsequent publications dealing with these species/varieties, using local or scientific names, should refer to these unique reference numbers (voucher specimens) and the acronym of the herbarium where they are stored.

Correct identifications of species/varieties/cultivars/breeds and constitution of reference collections for future verification and use are of the utmost importance when assessing food biodiversity (see also Nesbitt *et al.*, 2010). Attention to this step is essential in order to make the research objectively verifiable and reliable. It is beyond the scope of these guidelines to illustrate best practices for organizing ethnobotanical studies in the field, collecting and processing samples and analysing data, but links to further resources can be found in **Annex 3**.

[9] Ethnobotanists are generally trained on interview techniques to elicit local knowledge on plant uses as well as on performing plot inventories and collecting reference samples of biodiverse foods. They are generalists in terms of species/varieties identifications and will send samples to specialized taxonomists if they are not able themselves to identify the samples unambiguously.

An example of a detailed data collection form (adapted from Fanzo *et al.*, 2011) is shown in **Annex 4**. It can be used to gather information on samples collected for species/subspecies identification. When possible, flowers, fruits and even roots of smaller plants should be included in the sample, and specific characteristics such as colours and odours should be documented in order to facilitate correct identification. To identify taxonomic names, several resources are available (see **Annex 3**).

Different techniques are necessary to obtain a full picture of the marketed, cultivated, reared and wild food biodiversity. Market surveys conducted during different seasons can be one means of assessing the amount of biodiversity available for purchase. This information should be supplemented with key informant interviews, community focus groups, field and plot surveys and observations to derive a complete overview of locally available and consumed biodiverse foods. Table 3 provides examples of different types of information sources and tools which can be used to assess available food biodiversity.

Photo documentation is very useful during this and subsequent steps. Photographs of all foods of interest can be taken systematically to help in the correct identification of biodiverse foods. The photos can be assembled into a photo book to be used as a training aid for enumerators and as a memory aid for respondents during the data collection phase. As specimens of animals and insects are more difficult to collect and preserve, photographs can be used systematically both for initial identification and during survey data collection. Each photograph or reference sample taken for the purpose of identification, as well as for collection, should include (adapted from Fanzo *et al.*, 2011):

- the specimen type and date;
- the local name(s) for each variety;
- the location (GPS coordinates), seasonality, and habitat;
- details about the different parts of the plant which are eaten, such as the stems, leaves, roots, seeds, and fruit;
- a brief description with specific characteristics of the food item to distinguish between varieties (for example in China some varieties of red pepper are the same size, shape and colour, but can be distinguished by taste, as some are very hot and others sweet).

For fruits and vegetables, the plant should be photographed in its whole raw state, as well as cut in half to demonstrate the colour of the inner flesh, with a ruler or other standardized measurement marker placed beside it to indicate the size of the food.

Table 3 - Information to be collected and tools which can be used to assess food biodiversity 10 11

INFORMATION NEEDED	POTENTIAL SOURCES OF INFORMATION/TOOLS	METHODS
AVAILABILITY		
What is the availability of food biodiversity in the market place of each predefined agro-ecological zone?	Market survey[10]	- Record the number of cultivars per species of interest found for sale in different markets in the area. - Record, collect and verify with experts the local names for the cultivars and note down any variation in names, for example between ethnic groups. - Record the prices and availability of the different cultivars, and if relevant, note seasonal variations. - Systematically photograph all foods (and varieties/breeds) of interest, and record any distinguishing characteristics, if relevant. - If relevant (for taxonomic or dietary assessment) a sample of the plant, animal or insect can be obtained.
What is the availability of food biodiversity in the field of each predefined agro-ecological zone?	Field survey, using an ethno-biological inventory and key informant interviews, inclusive of all ethnic groups in the area. Note: for cultivated varieties, where seed companies have well-registered varieties and cultivars that are marketed as such, their own data may suffice.	- Record the number of cultivars per species of interest found in the plot/field. - Record, collect and verify with local experts the local name of the cultivar. - Take systematic photographs of each cultivar. - If relevant (for taxonomic or nutritional assessment) a sample of the cultivar can be obtained.
What is the availability of foods gathered from the wild in each predefined agro-ecological zone?	Community survey, using an ethno-biological inventory, key informant interviews and focus groups, inclusive of all ethnic groups in the area.	- Develop a questionnaire guide about available sources of food biodiversity in the study population for key informants and groups of knowledgeable community members. - Include questions to find out what the local seasons are and how they are named ("rainy season occurs from x to x month"; "dry season", "harvest season" and so on).[11] - Organize collection trips with key informants to obtain samples for identification and reference storage.

[10] If of interest, price information can also be included in the market assessment.

[11] The interviews and discussions can also help inform patterns of seasonality and endangered or disappearing resources. For example, key informants in South East Asia are able to describe disappearance of aquatic food resources.

INFORMATION NEEDED	POTENTIAL SOURCES OF INFORMATION/ TOOLS	METHODS
FOOD USES AND APPRECIATION		
Which parts of the plant (leaves, roots, stems, fruit, seeds) or animal (head, liver, heart, blood) are consumed? This information has important implications for nutrition.	Questions about plant/animal parts used, preparation, processing and transformation techniques, seasonality, abundance, etc. to be added to the questionnaires or interview guidelines for key informant interviews and/or focus group discussions during market, field and community surveys.	
Taste appreciation is an important consideration if the goal of the assessment is to plan interventions to increase utilization of specific foods/ food varieties.	Questions about perceptions and appreciation of local, wild and other foods to be added to the questionnaires or interview guidelines for key informants and focus group discussions during market, field and community surveys.	Ask about the taste and texture appreciation and perceptions of each biodiverse food.
Commonly consumed local dishes and their utilization of specific biodiverse foods. This information can help enumerators probe for missing biodiverse food ingredients.	Questions about common dishes consumed, their preparations and key ingredients etc. to be added to the questionnaires or interview guidelines for key informant interviews and/or focus group discussion with those responsible for food preparation	- Ask about the dishes that are commonly consumed and ingredients to understand the use of biodiverse foods and their quantities - Record name and take photos of dishes for identification - Collect recipes where available - Compile a list for use with dietary surveys

(Source: Kuhnlein et al., 2009; FAO 2015)

Additionally, a simple food propensity questionnaire[12] conducted with the aid of the photo documentation could be used to obtain information on dietary intake patterns and current level of use of biodiverse foods, and allow researchers to understand who the consumers are of a certain commodity at the taxonomic level of interest. It could also be useful for deciding which infrequently consumed foods to exclude for the study in Step 3.

[12] A food propensity questionnaire is a FFQ that collects information on frequency or "yes/no" responses on the consumption of particular foods, but not portion size (Subar *et al.*, 2006).

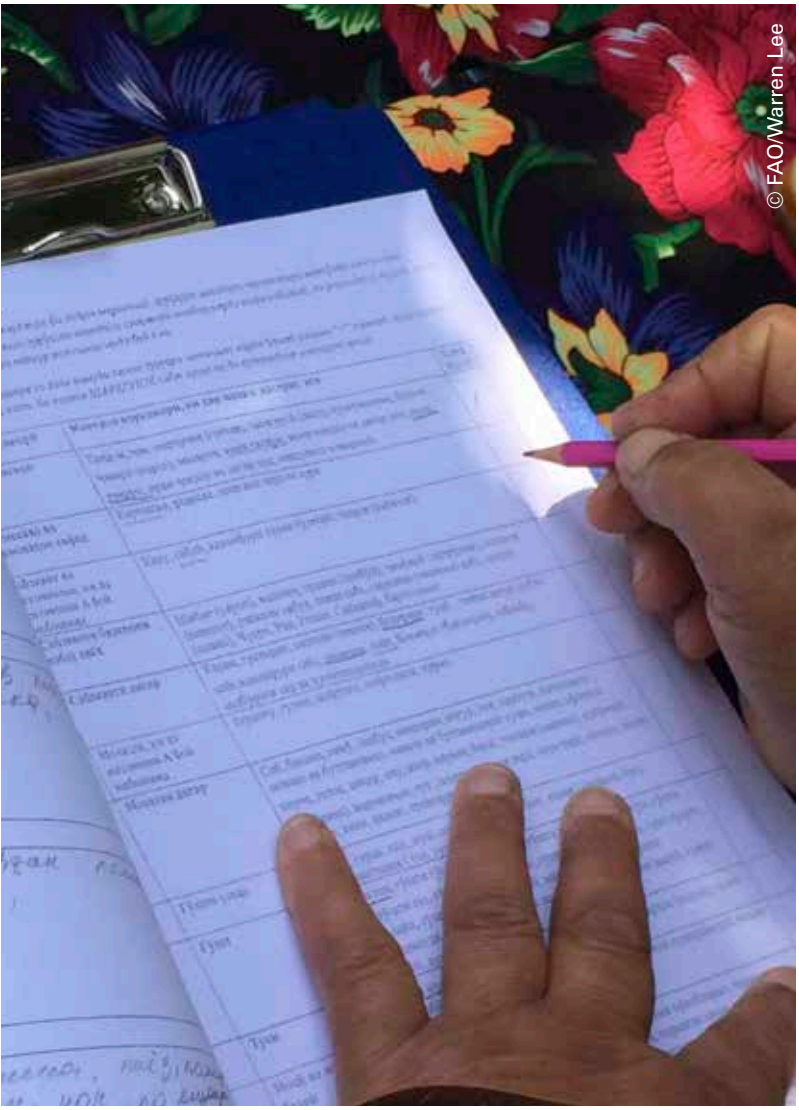
4.6 VERIFICATION, HARMONIZATION AND FINALIZATION OF SUBSPECIES FOOD LIST FOR USE IN DIETARY ASSESSMENT TOOL

Before beginning to adapt a dietary assessment tool, the multi-disciplinary team should discuss and finalize the food list and descriptions of each food of interest, with the appropriate level of taxonomic detail to be included in the dietary assessment tool. These lists can then be incorporated into the actual survey tool, if appropriate, as for example in a 24-hour recall, FFQ or dietary diversity questionnaire (DDQ).

Musinguzi *et al.*, 2012 recommend holding a harmonization meeting in which all of the food lists generated from village-level focus groups are compared by a knowledgeable group of experts. This meeting is meant to identify any overlap or duplication in classification of the varieties/cultivars/breeds/market types or wild/underutilized foods. All local names, sometimes with wide variations in spelling, but identify the same biodiverse food, should be recorded for use in the dietary assessment tool food lists. Similar meeting can be held at a township or even regional level, as needed.

At this point, focus groups with the key respondent for the survey (for example women of reproductive age or person with primary responsibility for food preparation) should be conducted to ensure that persons in the target audience are able to correctly identify the foods of interest at the required level of detail using local names. If necessary, photographs of each variety can be displayed to ensure the correct identification.

Different types of memory aides and probing questions will need to be developed for the different dietary assessment tools discussed in the next section. When the survey relies on trained enumerators for data collection, these enumerators will need to be specifically trained in the use of memory aids to stimulate the memory of the respondent and probing questions to verify that the information provided is sufficiently detailed to identify the variety/breed.



5. SELECTING AND ADAPTING A DIETARY INTAKE INSTRUMENT

5.1 SELECTING THE DIETARY INTAKE INSTRUMENT(S)

The guide focuses on dietary intake instruments that measure intake at the individual level. They are chosen mainly based on their ratings for potential for adaptation in the report of the Expert Consultation on Nutrition indicators for Biodiversity: 2. Food Consumption. This table has been included here in **Annex 5** for reference of the justifications for these ratings.

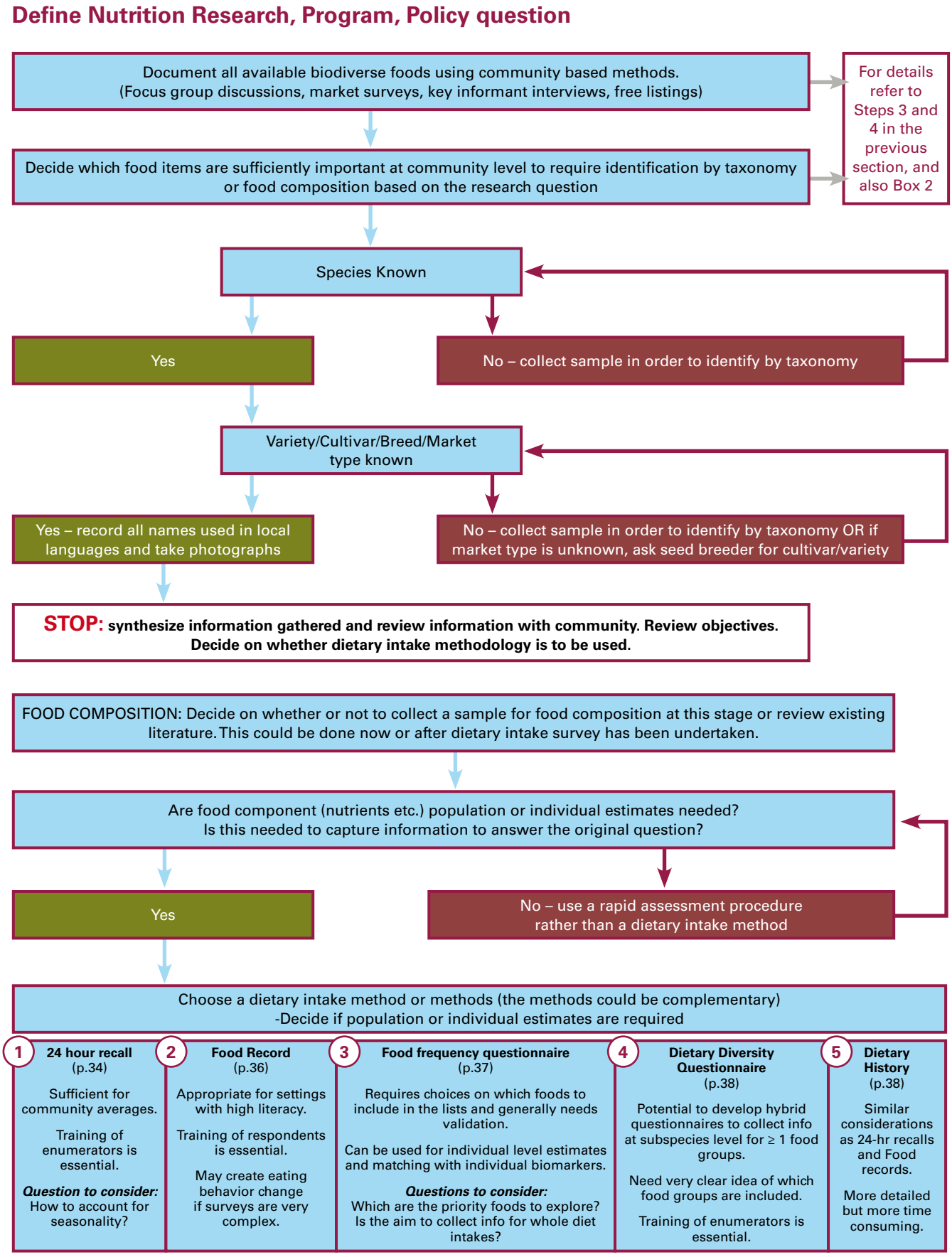
Open-ended instruments rather those that are closed or predefined were all rated as having medium to high potential adaptability for capturing biodiverse foods at the level of individual intakes. This is because open ended instruments used to assess dietary intakes can be adapted to accommodate high levels of specificity such as local name of the variety/cultivar/breed, description of the preparation method as well as description of the part of the plant or animal (root, leaf, seed, fruit, head, liver, eyes) consumed. Additionally, the instruments can include probing questions and additional spaces for recording details on food biodiversity. Examples of probing questions can be found in the section below on adapting the dietary intake instrument.

Among the open-ended tools listed that were rated, the 24-hour or repeated recall was rated as having high potential for adaptation, followed by food records and food frequency questionnaires, which received ratings of medium to high potential for adaptation (FAO, 2010). Instruments that received low to medium ratings, such as the household budget survey or duplicate portion method are not detailed in these guidelines. Despite its medium rating, the dietary diversity questionnaire is viewed as a suitable method, as a free recall can be conducted at the beginning of a DDQ, and a section on biodiversity can be added (FAO, 2011).

The validity and reproducibility of the chosen dietary assessment tool should be tested prior to using it for research purposes. The user should not assume that a 24-hour recall or FFQ would yield valid and reproducible data irrespective of the setting (Willett, 2013; Patterson *et al.*, 2004; Gibson, 2005). Depending on the setting, methodologies mentioned could be used in combination to maximize their effectiveness.

The Dietary Assessment: A resource guide to method selection and application in low resource settings (FAO, 2017, forthcoming) provides further information on the selection of dietary assessment method, methodological issues and capacity consideration of the interviewers and data analysis.

Figure 2 - *Decision Tree to guide the collection of dietary intake information related to biodiverse foods*



BOX 4 - SPECIAL CONSIDERATIONS WHEN MEASURING FOOD BIODIVERSITY

Seasonality

Seasonality has a great influence on both the foods available within the food system at different periods during the year AND the consumption patterns of the population.

Research by Islam *et al*. 2011 on food consumption patterns during the seasonal periods of food shortage in Bangladesh, known as *monga*, documented increased reliance on wild plants during these periods. Key informants reported a much greater reliance on wild vegetables, roots and grains during these seasonal periods of food shortage. If the objective of the research is to document the extent to which food biodiversity contributes to nutrient intakes then it is paramount to measure dietary intakes during periods such as the seasonal time of food shortages, in which reliance on wild/indigenous foods is at its peak. However, food intakes in other seasons would be useful to calculate their contributions to usual intake, i.e. year-round average intake.

Even in areas where most of the food is purchased, there can be large seasonal variations at the species and to a lesser extent subspecies level of foods available for purchase (André and Rodrigues, 2012).

Wild and underutilized foods

In conventional dietary assessments, consumption of wild and underutilized foods are often underreported. For example research in Bangladesh was conducted during a period when a jujube, a fruit collected from the wild was in season. Many children were observed eating this fruit without the knowledge of the primary respondent, who was generally the mother of the household, thus it was not recorded (Kennedy *et al*., 2005). The importance of capturing consumption of wild and underutilized foods will need to be emphasized during enumerator training and in probing questions developed for data collection.

The following considerations are particularly relevant for developed countries.

Urban areas

Much of the research documenting the ability of respondents to identify the variety/cultivar/breed of food consumed has been conducted in rural areas (Kennedy *et al.*, 2010; Musinguzi, unpublished; Englberger *et al.*, 2005). Rural respondents are much more likely to be the primary producers of the food consumed and therefore have first-hand knowledge of the varieties they grow and eat. They are also much more likely to have a greater level of knowledge and access to locally available wild/underutilized foods. The ability of urban consumers to correctly identify food consumed at subspecies level remains largely unknown, particularly when they are not closely connected to the production of the food they consume (e.g. street food and other foods prepared out of the home). Preliminary research would need to be conducted with urban consumers before deciding to modify a dietary intake tool for the purpose of measuring food biodiversity. A study conducted in an urban area in Brazil, using commonly consumed market groups of banana and lettuce, found that over two-thirds of consumers were able to identify the market group of banana or lettuce consumed during 24-hour recalls conducted by trained enumerators and supplemented with visual aids (Bastos, 2015, personal communication).

Out of home consumption

Consumption of food outside the home is very common, particularly in urban, but increasingly also in rural areas. The more removed the respondent is from the source of the food moving down the chain from own production/procurement of the food, to purchase from a market/store but prepared at home, to consumed on the street/fast-food/restaurant; the more likely the chance of obtaining no response or an incorrect response when requesting information on biodiversity in foods.

Researchers working in urban areas or areas where out of home food consumption is common should thoroughly pre-test the data collection tool(s) using all of the memory aids developed to enhance data collection in order to confirm whether or not it is possible to assess food intakes at the level needed.

5.2 ADAPTING THE DIETARY INTAKE INSTRUMENT

The following three steps are universally applicable for the adaptation of dietary assessment tools to include food biodiversity:

1. ***Modification and adaptation of the questionnaire forms to be used for data collection.***
2. ***Development of training aids for enumerators (and respondents where self-recording is used)***
   - **a.** Complete list of all biodiverse foods to be collected.
   - **b.** Photo book for each specific food item to be identified at variety/cultivar/breed or market type. Refer to Preparation for Tool Adaptation: Step 4, for more details on preparing photo documentation.
   - **c.** A coding list of species level and sub coding for variety/cultivar/breed as provided in the example later in this section.
   - **d.** Probing questions (see examples below) and memory aides to be used by enumerators or to assist respondents in recalling consumption of biodiverse foods and providing sufficient detail for proper identification.
   - **e.** To allow for correct coding for food composition values, the enumerator/respondent should be prompted in the modified dietary survey to record relevant information on food preparation and/or processing practices, because these may affect the food composition values[13].
3. ***Training enumerators or respondents on how to administer the questionnaire, including using probing questions and photographs for identification of food biodiversity and how to record the desired information on the questionnaire form.***

Examples of probing questions that can be included in the dietary intake instruments: (These will need to be pre-tested with focus groups or key-informant interviews)

- Do you eat foods that are wild, gathered or hunted? Can you name them?
- Can you name any specific foods that you only eat at this time of the year?
- For fruits/vegetables with peel/shell – what colour is the peel/shell/ flesh?
- Do you eat all parts of [the food]? If not, what part(s) is usually eaten, and why?
- Does [the food] have another variety/cultivar/breed/market type? If yes, do you eat it? How do you tell the difference?

[13] For example, if a potato were boiled, much of the potato's B and C vitamins would be leached into the water. Should the liquid be consumed, the nutrient intake would remain the same (i.e. if the potato and water are being turned into potato soup), but not if it is discarded. Cooking time and/or methods may also vary for different biodiverse foods at the subspecies level.

Additional markers which can be added to the dietary intake tool

In addition to recording information on the names of the biodiverse foods of interest consumed, some researchers have found it meaningful to request additional information such as the source of food, e.g. if the food was purchased, produced at home or gathered from the wild or if the food was imported or local. Table 4 provides some examples from previous studies. If decided to collect this type of additional information, a clear definition of 'local', 'wild', 'traditional', etc. in the frame of the research or project will need to be provided.

Table 4 - Examples of additional characteristics of food consumed that can be included in the questionnaire

ADDITIONAL CHARACTERISTIC	ASSESSMENT TOOL USED	STUDY REFERENCE
Food type: Local or imported food	24-hour recall 7 day food frequency	Englberger *et al.*, 2010.
Crop variety code: Modern/high yielding Locally improved Traditional/wild Unknown	24-hour recall	Kennedy *et al.*, 2005.
Market/Imported or Traditional/Locally produced food	24 -hour recall Food Frequency Questionnaires (FFQ)	Kuhnlein, H.V., Erasmus, B. and Spigelski, D. 2009.

Additionally, to help improve the chosen instrument(s) and inform future assessments, researchers should make note of any "grey areas" where researchers are not able to obtain complete information, and the reason, if known, and any confusion or disagreements among interviewees on common names of defined species/cultivars/varieties/market type and how these were resolved.

5.3 24-HOUR RECALL

The 24-hour recall is one method used to collect information on foods and beverages consumed by an individual or household over the previous 24 hours. The survey methodology is enhanced greatly by the ability of trained survey enumerators, who guide the respondent through a recall of all food and beverages consumed during the previous 24-hour period. Thorough training will be critical if the survey aims to assess intakes of foods identified at the subspecies level accurately. As the face-to-face interview allows participants and researchers to discuss foods and food types, it is probably the best tool to capture cultivar-specific information while allowing the enumerator to cross-check accuracy, either through inquiry with other household members or by direct observation of food items available in the household or surrounding area.

The first pass of the multiple pass technique begins with the enumerator asking the respondent to recall all the foods and drinks consumed throughout the previous day, in a chronological sequence (Gibson and Ferguson, 2008). The second pass is a crucial step in the adapted 24-hour recall. It is here that the enumerator should go over each of the foods and drinks consumed and probe for additional information, such as the cultivar, variety, market type or breed, as relevant, and record all this information on the 24-hour recall form.

Adaptation of the questionnaire form is relatively simple. **Annex 6** provides an example of modifications to the 24-hour recall form in order to record biodiverse foods. The questionnaire form was adapted by adding two additional columns, one to record the name of the variety and another for a numeric code (if used) for the variety mentioned (see example from Bangladesh below).

Recall interviews can be administered to any target adult within the household. When the target member is a child, the primary caregiver should be the respondent, though older children can be asked to supplement the information provided by the caregiver, particularly in the case of out-of-home food consumption. Ideally, interviews should take place in the household, where respondents feel at ease. Research has also shown that more accurate results are obtained when other family members present in the household are allowed to help the respondent remember the types and amounts of foods and beverages consumed (Gibson and Ferguson, 2008). Both of these points are important for researchers wishing to measure biodiversity in foods. Should the respondent have difficulty remembering the name of a cultivar, variety, market type, breed or wild food name, other family members can be enlisted for help. The respondent can also be asked if a sample of the foods of interest consumed the previous day is available within the household, and if so, the enumerator can verify the information.

Data collection guides and tools

In research in Bangladesh (Kennedy *et al.*, 2005) using the 24-hour dietary recall tool, enumerators were given the following type of table during survey training and data collection as an aid in recording information on the questionnaire form. After recording the name of the

species ("banana" in the example below), enumerators asked respondents if they could name the cultivar, and if so, the appropriate code was entered in the data collection form. When the respondent was not able to name the cultivar, "unknown" was entered.

Table 5 - Example of subspecies food list and food codes

GENERIC FOOD NAME	LOCAL NAME OF CULTIVAR	SPECIES FOOD CODE	CULTIVAR CODE	PHOTOGRAPH #
Banana	Sagar kala	1	1	B1
	Meher sagar	1	2	B2
	Sabri kala	1	3	B3
	Kabri kala	1	4	B4

(Source: Kennedy et al., 2005)

To assist with accurate identification of foods at subspecies level, each survey enumerator team should be provided with a set of colour photographs or actual samples of each food of interest. If the number of biodiverse foods of interest is large, then photographs may be a more practical tool than actual food samples.

Training enumerators

Collecting information at subspecies level requires enumerators to become familiar with a more specific form of data collection than normally undertaken in dietary assessment surveys. The number of days allocated to enumerator training will probably need to be increased, to allow enumerators time to practice using the more detailed food list and the probing questions, and also to learn how to identify the foods at variety/cultivar/breed/market type level. Enumerators will need to practice using the photo book and food code lists in order be able to identify the differences between the variety/cultivar/breed/market type and to elicit accurate responses from participants.

As with all surveys, a pre-test is necessary to identify problems in the questionnaire, and to clarify any questions related to completion of the data collection tool or survey procedures. When collection of biodiversity in foods is one of the goals, it is essential that enumerators are very familiar with each variety/cultivar/breed/market type to be recorded. The pre-test should also check that respondents can correctly name the varieties or wild foods consumed. If a large number of respondents cannot identify the foods at the requested level of detail, it may be necessary to refine the procedures and/or memory aids before beginning the survey.

5.4 THE FOOD RECORD METHOD

The food record is a detailed listing of all food and drinks consumed by an individual on one or more days. Food intake is most commonly recorded by the subject at the time when foods are eaten. Therefore this method is most appropriate in areas of higher literacy. In situations of low literacy the food record can be completed by an observer, or by a trained research assistant in the home, although this is generally not done because of time constraints, expense and the burden placed both on the respondent and enumerator.

Portion sizes of the foods consumed are either weighed (both in raw and then cooked form) or estimated by the consumer (or observer) in household measures. One concern with this method is that persons alter their eating habits as a result of being asked to record them (Willett, 1998). Counter-measures include stressing the importance of the study and asking subjects to try to avoid changing their normal food habits. Asking subjects to keep detailed records of food consumed during the day may itself create changes in behaviour because of the burden of recording dishes with numerous ingredients (Willet, 1998). It is important to keep this in mind if subjects are asked to complete food records of increasing complexity, including, for example, not only food consumed but also details on the variety/cultivar/breed/market type.

The food record is very versatile, and columns to describe foods at the required level of taxonomic detail can be inserted into the food record form as shown in **Annex 7**.

Data collection guides and tools

A photo book which provides the names of locally available biodiverse foods of interest can be provided to each study participant to assist them with recording information correctly. In addition a set of probing questions can be included to help respondents remember different aspects of their intake.

Training respondents

One consideration to be borne in mind with this method as compared with the 24-hour recall is that all respondents will need to be trained to use the data collection guides and tools. Adequate training of all respondents could be costly, as well as imposing an additional burden on respondents. However, if respondents are generally familiar with local names of biodiverse foods, as documented in some previous studies (Kennedy *et al.*, 2005; Termote *et al.*, 2012), they may find it no more burdensome to provide additional details on biodiversity than to record the brand name of the product. As a food record is a prospective method, participants can be prompted during training to notice these details and differences when gathering or purchasing their foods. Hence, the participants may be able to provide more details on the variety/cultivar/breed/market type than in other types of surveys.

An additional option would be to have the record reviewed by a trained professional together with the participant. This would enable ambiguities to be clarified and missing information supplied through additional probing. The additional time, cost and burden to the respondent should be considered when deciding on this option.

As described above, all tools, including the photo book, other memory aides and probing questions need to be pretested to identify problems and clarify any questions related to completion of the data collection tool.

The final step when using this tool is to review the record with the respondent.

5.5 THE FOOD FREQUENCY QUESTIONNAIRE

In addition to reporting on the foods consumed, the Food Frequency Questionnaire (FFQ) is designed to elicit information on the frequency of use of each food item. Literature on FFQs can be consulted for options and decision making related to the frequency responses. An example of an FFQ used during research in Africa is provided as **Annex 8**. For populations with lower educational levels the layout of the questionnaire as shown in **Annex 9** could improve comprehension. Likewise, an open-ended frequency list has in some cases resulted in less loss of information (Willett, 1998).

Data collection guides and tools

The considerations above concerning data collection guides and tools for the 24-hour recall and the food record questionnaire apply equally to FFQs. However, an additional step is required in which the respondent estimates the frequency of consumption of the foods of interest. A detailed set of instructions should be prepared to assist respondents in recalling all required information (see **Annex 8**).

Training respondents

Pre-testing the questionnaire is generally facilitated by a trained enumerator who helps the respondent answer the questions and makes observations on any difficulties or misinterpretations encountered. The instruction manual should be reviewed together with the respondents to ensure that instructions are understood and to clarify any questions respondents may have on how to record information on the form.

5.6 THE DIETARY DIVERSITY QUESTIONNAIRE

Dietary diversity questionnaires (DDQs) are used to measure the number of food groups consumed by households (FAO, 2011), or by individuals including women of reproductive age (FAO and FHI 360, 2016) and children aged 6–23 months (FANTA, 2006). Assessment of dietary diversity has very flexible application across age and gender groups. The tool could be adapted to allow the collection of information at subspecies level for one or more food groups.

At the time these guidelines were drafted, there were no known studies that had adapted a DDQ to measure the availability of food biodiversity. Any research or programme wishing to modify a DDQ for this purpose would need a very clear idea of which food groups to include in the adaptation as it would be very burdensome to try to incorporate this level of detail for all food groups currently used in a DDQ. **Annex 10** provides an example of a DDQ with a few suggested adaptations.

Data collection guides and tools

The considerations above concerning data collection guides and tools for the 24-hour recall and the food record questionnaire apply equally to DDQs.

Training enumerators

As for the 24-hour recall, enumerators would need to receive training including how to use probing questions, as well as the use of the list of commonly consumed dishes and the photo book, on how to facilitate the completion of the biodiversity section of the questionnaire accurately.

5.7 DIETARY HISTORY

The dietary history method (Gibson, 2005), which can also be used as an open-ended instrument, requires the same kind of adaptations as food records and the 24-hour recall (probing questions, recording of variety/cultivar/breed/market type, elaboration of data collection guides and tools, and training for enumerators). It has the potential to collect more detailed information over a longer period, but the process is more time consuming compared with the methods above. It is therefore not described in detail here.

5.8 USING TECHNOLOGY TO COLLECT INFORMATION WITH ADAPTED DIETARY SURVEYS

Computer assisted interviewing can be used with both 24-hour recall and FFQs (Kirkpatrick *et al.*, 2014; Wong *et al.*, 2008). Low-cost portable devices (laptops, tablets, mobile phones etc.) are making this increasingly feasible in both developed and developing countries. These devices are also useful for image-assisted recording (images, voice records and videos) for the food record (Timon *et al.*, 2015) or dietary history methods (Beasley *et al.*, 2009). Some advantages of computer assisted interviewing are as follows.

- It allows branched questions and structures, which can improve efficiency and standardization.
- Fewer trained interviewers are needed, as the structure is built in.
- Images or videos can be embedded into the surveys to assist with respondents' identification of biodiversity in foods, or added by respondents to document foods consumed or preparation methods. This allows experts to identify foods and estimate portion sizes more accurately, and to spot any 'hidden foods' or condiments used. Participants should be given guidance on photographing foods to illustrate size, pertinent characteristics etc.
- Applications can allow for real time data collection to minimize memory bias – this is particularly applicable for urban areas in developed countries where smartphones are common, while in rural and low resource settings it may be more difficult.
- Time can be saved during data entry, as information is entered directly into a database during the data collection phase.

However, if the data are collected remotely through self-reporting, it will not be possible for the enumerator to ask additional probing questions or provide cues face-to-face to assist with the process. As a result, some pertinent details on biodiverse foods may be missed.

6. POST ASSESSMENT

6.1 ANALYSING AND REPORTING FOOD CONSUMPTION DATA INCLUDING BIODIVERSE FOODS

To obtain an overall picture of food biodiversity, consumption frequency of different cultivars of a given species could be aggregated by households, as illustrated by this example on eggplant consumption from a study conducted in Bangladesh.

Table 6 - Cultivars of eggplant consumed by households in Saturia region of Bangladesh

SCIENTIFIC NAME	LOCAL NAME OF CULTIVAR	GERMOPLASM	# HOUSEHOLD TIMES CONSUMED
Solanum melongena	Begun Deshi	Traditional	185
	Iron Begun	Modern	29
	Gol/Shobus	Modern	2
	Gol/Begun	Locally improved	1
	Kajoli	Modern	1
	Unknown	Unknown	38
	Total		**256**

(Source: Kennedy et al., 2005)

Food composition data of the foods recorded in the dietary surveys could be examined with a focus on key macro- and micronutrients. Average daily intakes can be compared with the daily recommended intakes established for the corresponding demographic (Kuhnlein *et al.*, 2006). This would allow researchers to understand whether current diets of the study population adequately meet nutritional needs, as well as provide insight into the nutrient contribution of specific biodiverse foods, and on whether the consumption of specific variety/cultivar/breed/market type should be encouraged.

Consumption data could also be compared with data on nutrition status, if this is available, such as data on the prevalence of stunting, wasting and iron deficiency anaemia from Demographic Health Surveys or SMART surveys at the level closest to that of the study (i.e. regional/provincial/district). As demonstrated by previous studies in Thailand and Peru, simple physical health indicators, as well as weight and height measurements can be taken directly from study participants in parallel with the dietary assessments, using standard anthropometric methods.

Using appropriate statistical methods, these comparisons could further the understanding of the ways in which nutrient intake from biodiverse foods are associated with the nutrient status of the study population. This understanding could in turn inform the direction of future assessments and clarify the potential of specific biodiverse foods in nutrition interventions (Kuhnlein *et al.*, 2006).

If there are previously unknown/unreported biodiverse foods identified during the survey, they should be recorded following the procedure outlined in Step 4 above, under the guidance of an ethnobiologist and/or a taxonomic expert. If the food(s) is of high relevance to the study and food composition data are not available, the team will need to decide whether there is capacity to collect samples to generate data, and/or submit the food for nutrient analysis at a laboratory. For a study in the Peruvian Andes, different varieties of native potatoes recorded in FFQs and food recalls were sent to the International Potato Center (CIP) for analysis on vitamin C, iron and zinc content. These nutrients were chosen in connection to CIP's focus on the two minerals in their biofortification programme, as well as their emphasis on promoting native potatoes with higher contents of the minerals (Creed-Kanashiro, 2016, personal communication).

Consumption of species or cultivars found to be nutritionally unique during the food composition analysis portion of the study should be recorded in order to assess how these unique sets of nutrients contribute to the nutritional status of the study population. Consumption counts of specific foods can be submitted for cataloguing to the FAO Biofoodcomp Database.

As more studies that measure food biodiversity using adapted dietary assessment surveys are conducted, a further step would involve collecting these examples and drafting a more detailed, step-by-step manual for practitioners based on the examples and the current guidelines.

7. AREAS TO BE STRENGTHENED AND NEXT STEPS

In tropical areas where the food lists are typically extensive and availability of food composition data is low, developing a list of biodiverse foods in relation to specific nutrients and/or nutrient deficiencies would help researchers prioritize foods for further research. Scientific approaches could be explored to develop innovative methods for estimating the nutrient values of newly identified foods.

In developed countries, and particularly in urban areas where there is higher consumption of purchased, prepared and processed foods, there are few existing studies and a lack of knowledge on food biodiversity. This gap presents an opportunity for further research. When dealing with consumption of purchased, prepared and processed foods, it is important to reference the *Guidelines on the Collection of Information on Food Processing through Food Consumption Surveys* as this provides key recommendations in this regard (FAO 2015a).

Given the multiple uncertainties that exist in using adapted dietary assessment surveys to measure food biodiversity, further case studies that build upon previous research should be conducted. These examples should then be collected and used in drafting a more detailed, step-by-step manual for practitioners based on the current guidelines.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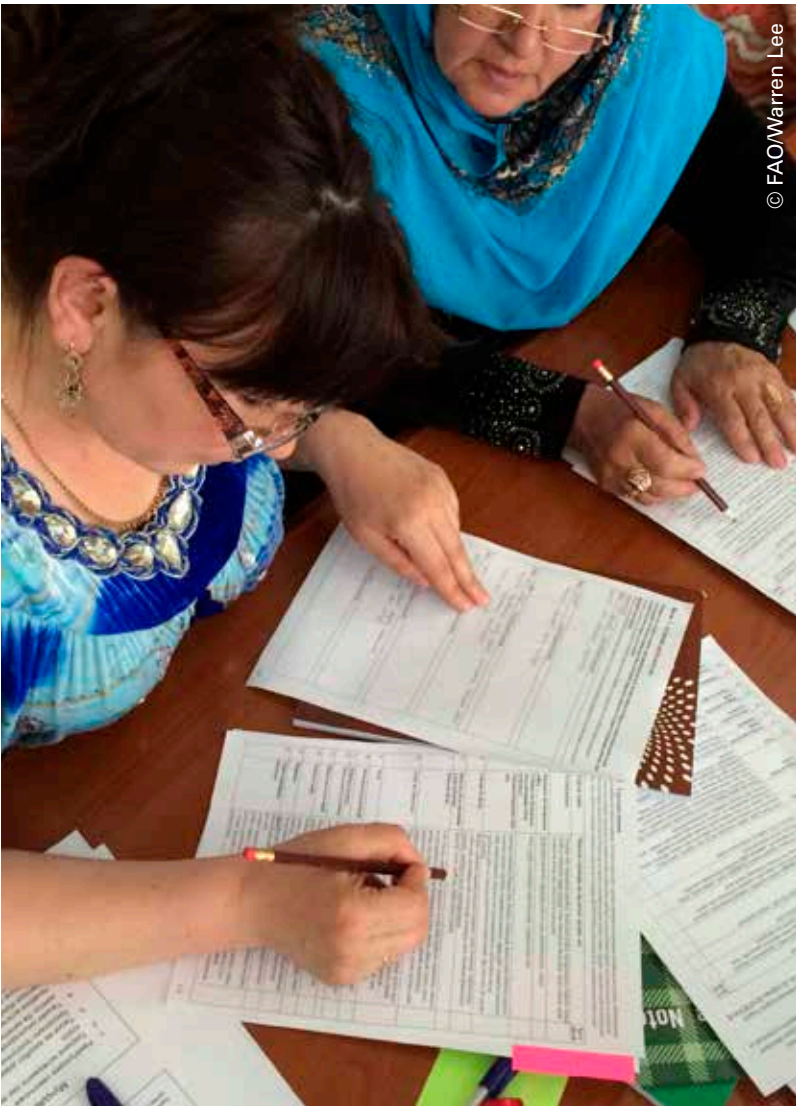
8. CONCLUSION

These guidelines mark a starting point in providing information on how to collect food biodiversity information in dietary intake surveys. They are an important first step in addressing the critical and urgent need to understand dietary intake patterns and the current level of use of food biodiversity better. Furthering this understanding will help inform the design of agriculture and nutrition programmes as well as advocate for the realignment of agriculture policy to enhance nutritional status of populations by promoting the use of the full range of available food biodiversity.

Information on food consumption goes hand in hand with information on food composition and both are essential building blocks for nutrition science. Rather than debate which element should come first in research, we hope these guidelines stimulate joint efforts to gain a better understanding of consumption and composition of food biodiversity, and stimulate users to foster collaboration in filling information gaps and building upon findings.

There is a substantial amount of learning still to be documented, particularly when applying these methods to larger scale surveys. The most difficult part of the journey has already started, and readers are encouraged to take the next step to generate best practices and lessons learned on the use of food biodiversity for the benefit of today as well as tomorrow.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ANNEXES

ANNEX 1: DEFINITION OF TERMS AND TAXONOMY RELATED TO FOOD BIODIVERSITY[14]

Glossary of Terms:

Agrobiodiversity: The variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fibre, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems.

Biodiversity: the variability among living organisms from all sources, including terrestrial, marine and other ecosystems and the ecological complexes of which they are a part; it covers diversity within species, between species and of ecosystems; synonyms: biological diversity, ecological diversity.

Biodiverse foods: level of description of food by genus, species, subspecies and variety/cultivar/breed/market type, or genus/species and or local name of wild and underutilized foods

Breed: i) a subspecific group of animal species, within a single zoological taxon of the lowest known rank, with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species; ii) a group of domestic livestock for which geographical and/or cultural separation from similar groups has led to acceptance of its separate identity.

Cultivar: (from cultivated + variety) (abbrv.: cv.) a category of plants that is below the level of a subspecies taxonomically and equivalent taxonomically to variety, and is found only in cultivation i.e. a product of breeding programmes through seed companies and research institutes, and cultivated by farmers; it is an international term denoting certain cultivated plants that are clearly distinguishable from others by stated characteristics and that retain their distinguishing characteristics when reproduced under specific conditions. The naming of a cultivar should conform to the International Code of Nomenclature for Cultivated Plants (the ICNCP).

[14] These terms and definitions are adapted from the Report of the Expert Consultation on nutrition Indicators for Biodiversity: 2. Food Consumption (FAO, 2010)

Food biodiversity: the diversity of plants, animals and other organisms used for food, covering the genetic resources within species, between species and provided by ecosystems.

Genus: a group of closely related species whose perceived relationship is typically based on physical resemblance, now often supplemented with DNA sequence data. A species is assigned a two-part italicized name in Latin, the genus being listed first (with its letter capitalized) and the species second; the name of the species is the whole binomial, not just the second term, for example apple belongs to the species *Malus domestica.*

Market group/type: Market groups/types for fruit and vegetables reflect consumer preferences and intended end uses of the product (e.g. household use or industrial processing for canning, pickling, juice, sauce).

The purpose of grouping commercial varieties of fruit and vegetables in these guidelines is to define simple categories that consumers will easily recognize. For vegetables and fruit, categories would be mainly based on appearance in the market. Traits to define groups might include size, shape, colour, and texture (shininess, smooth, rough, etc.). For example, US consumers recognize large tomato (beef steak), small tomato (cherry tomato) or cooking types (Roma, San Marzano). For each market group there may be a few or many varieties sharing these traits. Varieties are changing every few years depending on presence of seed companies, breeding programmes, consumer preferences, and market demands.

Species: below the level of genus, species is a class of potentially interbreeding individuals that are reproductively isolated from other such groups having many characteristics in common; species classifications are subject to review and change as new genomic and other scientific evidence is considered; by convention, a species is assigned a two-part italicized name in Latin, the genus being listed first (with its leading letter capitalized) and the species second. The name of the species is the whole binomial, not just the second term: for example, apple belongs to the species *Malus domestica.* Species is sometimes abbreviated to "spec." or "sp." singular.

Subspecies: populations of organisms sharing certain characteristics that are not present in other populations of the same species; the taxonomic naming convention is to append "ssp" or "subspec" and the Latin name in italic to the species name, for example *Prunus domestica* L. ssp domestica.

Underutilized species: for the purpose of these guidelines, underutilized species are defined as species with underexploited potential for contributing to food security, health and nutrition, income generation and environmental services (GFU, 2007). However, underutilized species is not a well-defined term and it depends on the geographical, social, economic and temporal aspects and includes a wide range of wild, traditional, indigenous and local foods.

Variety: a naturally occurring subdivision of a plant species, within a single botanical taxon of the lowest known rank, with distinct morphological characteristics and given a Latin name according to the rules of the International Code of Nomenclature; a taxonomic variety is known by the first validly published name applied to it, so that nomenclature tends to be stable; the taxonomic naming convention is to append "var" and the Latin name in italic to the species name, for example *Malus angustifolia* (Ait) Michx. var. *angustifolia* – southern crabapple; a variety will have an appearance distinct from other varieties, but will hybridize freely with other varieties if brought into contact. Varieties are usually geographically separate from one another to plant breeders, at least in countries that are signatories to the International Convention for the Protection of New Varieties of Plants (UPOV Convention). "Variety" or "plant variety" is a legal term; in zoological nomenclature, the only officially regulated rank below that of species is subspecies; forms and morphs are used instead of varieties if needed, but are unregulated by the International Commission on Zoological Nomenclature. In bacteriological nomenclature, "variety" and "subspecies" are used interchangeably.

Wild foods: the definition is adapted from the first *State of the World's Plant Genetic Resources for Food and Agriculture report* (FAO, 1997): wild plants, animals and insects that are not cultivated or reared in captivity are part of the minor crops and underutilized species, and include roots and tubers, vegetables and leafy vegetables, fruits, insects, amphibians, reptiles, birds and mammals gathered for food.

Taxonomy

As a preliminary orientation on taxonomy, the table below provides information on taxonomic nomenclature and examples of cultivar and breed specific identification. For many cultivated species (e.g. rice, banana, apple, tomato), it is possible to determine the name of the cultivar or market type. As the taxonomic identification is difficult to obtain at the species level for uncultivated, underutilized or wild species, these can be reported at level of species.

Table 1 - Schema of Taxonomic Names

SCIENTIFIC NAME	PLANT EXAMPLE	PLANT EXAMPLE	FISH EXAMPLE	ANIMAL EXAMPLE
Family	*Rosaceae* – Rose family	*Poaceae* – Grass family	Pleuronectidae	Bovidae Caprinae
Genus	*Prunus* L. – plum	*Triticum* L. – wheat	Platichthys	Ovis
Species	Prunus domestica L. – European plum	Triticum aestivum L. – common wheat	Platichthys flesus (Linnaeus, 1758)	Ovis aries – sheep
Subspecies	Prunus domestica L. subsp. domestica			(rarely used)
Breed	'Cacak's Beauty'	'Pioneer 2163'	1840 – European flounder	Suffolk

(Source: Kennedy et al., 2005)

For wild and underutilized foods, often there will be no information available on variety/cultivar/breed/market type. Obtaining genus/species level identifications for wild and underutilized foods is useful and obtaining information on intakes of wild and underutilized foods is important, even if only genus/species level information is available. Obtaining a more detailed description of species-specific food intakes is useful (e.g. describing the fish species such as salmon, tilapia and catfish) for both agro-biodiversity and nutrition research.

ANNEX 2: CRITERIA FOR THE INCLUSION OR EXCLUSION OF FOODS FOR NUTRITION INDICATORS FOR BIODIVERSITY (INDICATOR 1 AND 2)

FOODS INCLUDED	FOODS NOT INCLUDED

- Foods at variety/cultivar/breed level for common and imported foods (e.g. rice, banana, potato), preferably with scientific name.
- For those foods contributing to the indicators:
  - different parts of plants (e.g. leaf, root, flower, stem, fruit) and animal (e.g. all muscle cuts contribute only once but all organs count separately);
  - different stages (e.g. egg, larva and young/adult animal);
  - only raw foods; except if just the cooked form of this food is available;
  - Colour and/or shape describing the variety, cultivar or breed (e.g. pear, brown- skinned (*Pyrus* sp.) or snake gourd (*Trichosanthes cucumerina*).
- Foods with the number of cultivars /varieties /breeds per species even if not described by taxonomic or local name (e.g. *Musa* spp. – 4 varieties).
- Common foods which are taxonomically speaking varieties with additional cultivar name. (e.g. *Brassica oleracea* var. capitata 'January King').
- Ingredients of recipes, processed foods or botanical supplements/extracts (including beverages), if they meet criteria.
- Genetically-modified foods.
- Wild and/or underutilized foods only described at genus/species level and/or with local name (e.g. "grasshopper"). The underutilized foods must be recorded on the 'list of underutilized species contributing to the nutritional indicators for biodiversity'.
- A local name in addition to an English/ Spanish/French or taxonomic name if it is indicative for a variety/cultivar/breed (e.g. in brackets after the English/Spanish/French name).
	- Common or imported foods (e.g. rice, banana, potato) described only at species level, even if other specifications are given, such as:
	  - region
	  - country
	  - season
	  - colour as part of the food name (e.g. green beans) or as indication of processing (e.g. white or brown rice);
	  - shape (e.g. medium-size carrot)
	  - species name is followed by author (e.g. L. or Linn. [for Linnaeus], Mill.), which should not be confused with the variety/ cultivar/breed name.
	  - Foods with unspecific name, e.g. "wild green leaves", "reef fish", "bush meat".
	- Common foods which are taxonomically speaking varieties when described without an additional cultivar name (e.g. *Brassica oleracea* var. *capitata*).
	- Processed foods or recipes.
	- Supplements, and plant or animal extracts (as powders, capsules, etc.) if not meeting the criteria.
	- Fortified foods.
	- Common or imported foods described only with local name, or in addition to English, Spanish, or French name seeming to be the translation of the food (i.e. not indicative of variety/cultivar/breed).

(Adapted from Table 2 of the report of the 'Expert consultation on nutrition indicators for biodiversity 2: Food Consumption' http://www.fao.org/docrep/014/i1951e/i1951e00.htm. FAO, 2010).

ANNEX 3: FURTHER READING AND ADDITIONAL SOURCES OF INFORMATION

The following list of links supplements the content of the guidelines. The list is by no means exhaustive, but aims to provide further material of interest to readers for their information. Readers are also encouraged to perform their own searches of the literature for more specific information related to their needs.

Dietary assessment methodology

Cade, J., Thompson, R., Burley, V. & Warm, D. 2002. Development, validation and utilisation of food-frequency questionnaires – a review. *Public Health Nutrition,* 5 (4): pp. 567–87.

Coates, J., Colaiezzi, B., Fiedler, J., Wirth, J., Lividini, K., & Rogers, B. 2012. *Applying Dietary Assessment Methods for Food Fortification and Other Nutrition Programmes.* Global Alliance for Improved Nutrition (GAIN). Geneva.

Gibson, R.S. 2005. *Principles of Nutritional Assessment.* 2nd edition. Oxford University Press. New York.

Gibson, R.S. & Ferguson, E.L. 2008. *An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries.* International Food Policy Research Institute (IFPRI). Washington, DC and International Center for Tropical Agriculture (CIAT), Cali, Colombia.

Medical Research Council. http://dapa-toolkit.mrc.ac.uk/dietary-assessment/methods/recalls/index.html

USDA. Automated Multiple Pass Method for 24-hour recall. http://www.ars.usda.gov/Services/docs.htm?docid=7711

Winichagoon, P. 2008. Limitations and resolutions for dietary assessment of micronutrient intakes. *Asia Pacific Journal of Clinical Nutrition,* 17 (S1): pp. 296–298.

World Health Organization. 1996. *Preparation and use of food-based dietary guidelines.* Report of a joint FAO/WHO consultation, Nicosia, Cyprus. Geneva: WHO.

Ethnobotanical surveys

Alexiades, M.N. 1996. *Selected guidelines for ethnobotanical research: a field manual.* The New York Botanical Garden. New York.

Cotton, C.M. 1996. *Ethnobotany. Principles and applications.* John Wiley and sons. Chichester, UK.

Cunningham, A.B. 2001. *People, wild plant use and conservation.* WWF, Earthscan. London.

Fanzo, J. *et al.* 2011. *Improving nutrition with agricultural biodiversity. A manual on implementing food systems field projects to assess and improve dietary diversity, and nutrition and health outcomes.* Bioversity International. Maccarese, Italy.

Kuhnlein, H.V. *et al.* 2006. *Documenting Traditional Food Systems of Indigenous Peoples: International Case Studies. Guidelines for procedures. Centre for Indigenous Peoples' Nutrition and Environment.* Mc Gill University, Canada. (available online at http://www.mcgill.ca/cine/research/global)

Martin, G.J. 1995. *Ethnobotany: A methods manual.* WWF, UNESCO, Kew, Chapman and Hall.

Food Composition

FAO INFOODS http://www.fao.org/infoods/infoods/en/

- On nutrition and biodiversity http://www.fao.org/infoods/biodiversity/index_en.stm
- FAO/INFOODS e-Learning Course on Food Composition Data http://www.fao.org/infoods/infoods/training/en/
- Food Composition Study Tool, module 12, Food biodiversity

Websites on taxonomy and food biodiversity[15]

Biodiversity Indicators Partnership
http://www.bipindicators.net/

Bioversity International
www.bioversityinternational.org

[15] Adapted from FAO, 2010.

Canadian Biodiversity Information Facility (CBIF)
http://www.cbif.gc.ca/home_e.php

FAO Fisheries and Aquaculture Department
http://www.fao.org/fishery/species/search/en

Fishbase
http://www.fishbase.org/home.htm

Global Facilitation Unit for Underutilized Species
www.underutilizedspecies.org

International Plant Name Index
www.ipni.org

International Seed Testing Association – ISTA
http://www.seedtest.org/en/home.html

International Society for Horticultural Science
www.ishs.org

Kew Royal Botanical Gardens
www.kew.org

Mansfeld's World Database of Agriculture and Horticultural Crops
http://mansfeld.ipk-gatersleben.de/apex/f?p=185:3

Multilingual multiscript plant name database
http://www.plantnames.unimelb.edu.au/

National Center for Biotechnology Information, Taxonomy
http://www.ncbi.nlm.nih.gov/taxonomy

Species 2000
http://www.sp2000.org/

The plant list
www.theplantlist.org

Tropicos from the Missouri botanical garden
www.tropicos.org

USDA Agriculture Research Service National Plant Germplasm System
http://www.ars-grin.gov/npgs/index.html

USDA Natural Resources Conservation Service
www.plants.usda.gov

ANNEX 4: EXAMPLE OF DATA COLLECTION TOOL FOR TAXONOMIC IDENTIFICATION OF LOCAL FOODS[16]

USEFUL INFORMATION FOR BIODIVERSE FOODS CONSUMED WITHIN THE STUDY POPULATION	
Specimen #	
Specimen name (local)	
Specimen name (English, if known)	
Location (Village)	
GPS coordinates	
Specimen type (leaf, fungus, fern, reptile, insect)	
Habitat (cultivated or wild, field, forest)	
Availability (common, seasonal, rare)	
Seasonality (when available)	
Flowers (describe flower shape and colour)	
Fruit (describe shape, colour and size)	
Fruiting months	
Plant part consumed (stem, leaf, root, seed)	
Animal part consumed (milk, egg, brain, liver, muscle)	
Uses of each part (spice, herb, staple, vegetable)	

[16] Adapted from Fanzo *et al.*, 2011 and Greenfield and Southgate, 2013. (available online at http://www.fao.org/docrep/008/y4705e/y4705e00.htm).

State when harvested (half-ripe, ripe, dried)	
Preservation method (sun dry, pickle)	
Folk taxonomic classification (record name of category and other foods in the same category)	
Who should eat this food? Why? How does it taste?	
Who should not eat this food? Why?	
Date of specimen collection	
Special notes	
Alternative name	
Scientific name	
Code	
Preparation method	

ANNEX 5: DIETARY ASSESSMENT INSTRUMENTS – POTENTIAL FOR ADAPTATION TO INCLUDE BIODIVERSE FOODS

METHODS	POTENTIAL FOR ADAPTATION (FROM HIGH TO LOW)	USEFULNESS AS PRELIMINARY WORK TO BE DONE BEFORE ADAPTATION (HIGH, MEDIUM, LOW)
Recall (e.g. 24-hour or repeated)	**High.** As it is an open-ended instrument, people can spontaneously record cultivars/varieties/breeds. Probing questions on food biodiversity can be added.	High
Food frequency questionnaire	**Medium to High.** As it is a closed food list, it can be difficult to add new foods or cultivars/varieties/breeds. However, probing or open-ended questions on food biodiversity can be added.	High
Food records Weighed food records Estimated food records	**Medium to high.** As it is an open-ended instrument, people can spontaneously record cultivars/varieties/breeds. Probing questions on food biodiversity can be added.	High
Inventory of food biodiversity from key informants, interviews, community focus groups and observation, ethnobiology (people based)	**High.** As it is an open-ended instrument, people can spontaneously record cultivars/varieties/breeds. Probing questions on food biodiversity can be added.	**High.** These inventories can provide an extended list of the available food biodiversity.
Market Surveys	**High.** These surveys provide information on food biodiversity, but do not provide the complete list of foods eaten, e.g. gathered or home-grown foods. Scientific names will be rarely given	Medium

METHODS	POTENTIAL FOR ADAPTATION (FROM HIGH TO LOW)	USEFULNESS AS PRELIMINARY WORK TO BE DONE BEFORE ADAPTATION (HIGH, MEDIUM, LOW)
Dietary history	**Medium.** As it is an open-ended instrument, people can spontaneously report cultivars/varieties/ breeds and probing questions on food biodiversity can be added.	High
Qualitative survey (Household/ individual dietary diversity questionnaire)	**Low to medium.** Do not currently have the details on cultivars/varieties/ breeds, but there is potential to add some questions on a small number of foods.	Low
Household budget surveys (List-recall method, Food-account method, Inventory method and other techniques)	**Low to medium.** The instruments are country-specific and could be more promising in developed countries. Existing food lists would need to be extended in order to have details on cultivars, varieties or breeds. Additional questions could be added for biodiversity, but questionnaires are already long and cumbersome for respondents.	Low
Biological inventory surveys	**Low.** These surveys do not reflect food consumption	**High.** Useful as preliminary work to investigate available plants and animal species in an area.
Duplicate portion method	**Low.** The method provides only information on the whole diet and not on single foods.	Low

(Source: Adapted from Expert Consultation on Nutrition Indicators for Biodiversity 2. Food Consumption. FAO, 2010).

ANNEX 6: ENUMERATOR INSTRUCTIONS AND EXAMPLE OF AN ADAPTED 24-HOUR RECALL FORM

Instructions for the enumerator

Step 1: Ask the respondents to recall all of the food and drinks consumed starting from the time they wake up in the morning until they woke up the following morning. This step is sometimes referred to as a Quick List as the enumerator allows for an open and free recall before going into detail.

Step 2: When the quick list is completed ask probing questions for anything that may have been forgotten. Examples of probing questions are "Did you have anything else at this time?" "Did you add any milk?" "Did you have anything to drink with this meal?"

Step 3: Start at the beginning of the quick list. Provide more specific details sequentially of each food and beverage consumed. Record the time and eating occasion (breakfast, lunch, dinner, snack etc.) for each food and the preparation (pounding, fermenting, soaking etc.) and cooking method (boil, fry, steam etc.)

Step 4: Detailed description. In this step more details can be requested. This includes the details on the ingredients used in any mixed dishes and the name of the biodiverse food consumed. Record the portion size consumed.

Sample 24-hour recall form for collecting food biodiversity with modification for collecting food biodiversity in red type

TIme	**Place eaten (home or away)**	**Name of food/drink**	**Description, preparation and cooking method**	**Variety/ cultivar/ breed or market type or name of wild food ingredient**	**Amount eaten**	**Weight (g)**	**Food code**	**Cultivar code**

The above is only an example. Additional lines to be added to the table as needed

Sample completed 24-hour recall

Time	**Place eaten (home or away)**	**Name of food/drink**	**Description, preparation and cooking method**	**Name of biodiverse food**	**Amount eaten**	**Weight (g)**	**Food code**	**Cultivar code**
0800	Home	Banana	Raw	Cavendish	1 meidium size	100	25	1
		Tea			1 cup			
		Sugar			1 teaspun			

ANNEX 7: EXAMPLE OF ADAPTING A FOOD RECORD

Instructions for the respondent: Provide as much information as possible about the *kind of food you ate.* Record brand name or variety/ cultivar/breed/market type, or wild food name (genus/species and/or local name) and list all ingredients individually and the method of preparation. For example: a. **Milk**: 1%, 2%, whole milk, evaporated, powdered, chocolate, strawberry. Method of Cooking: boiled, fried, roasted, creamed, baked. **For combination foods, list individual ingredients:** e.g. Mixed salad ingredients were lettuce, tomato and tuna. If casserole with mixed ingredients, please describe individual ingredients recipe.

Once you have itemized all individual food items, record the brand name or the variety/cultivar/ breed/market type or wild food name of the food item in column five. To assist you in recording variety/cultivar/breed/wild food information, refer to your photo book received when you picked up your questionnaire form. If you have any questions call one of the survey staff.

Name: _____ Day and date: _____

Time of day	Meal name (breakfast, lunch dinner or snack)	Record the foods that you consumed during each eating occasion	Please try to list individual ingredients in meal and/or provide a description of the food item and how the food was prepared*	Record variety/ cultivar/ breed/market type, wild food name or brand name of food if known	Was the meal eaten at home or eaten (purchased) from a restaurant, fast food or food vendor
0800	Breakfast	Cereal		Cheerios	Eaten at home
		Milk	1%		Eaten at home
		Coffee			Eaten at home
		Milk	1%		Eaten at home
		Sugar			Eaten at home
1000	Snack	Apple	Raw	Granny Smith	Eaten at home

1300	Lunch	Mixed salad	Lettuce	Romaine	Eaten at home
			Tomato	Cherry tomato	
			Tuna	Starkist	
		Water			
		Bread	Whole wheat bread	Unknown	Eaten at home
1900	Dinner	Chicken breast with mushrooms	Chicken breast sautéed	Unknown	Restaurant
			Mushrooms, sautéed		
			Olive oil	Unknown	Restaurant
		Potato	Baked potato	Unknown	Restaurant
			Butter		
		White wine		Unknown	Restaurant

ANNEX 8: EXAMPLE OF AN ADAPTED FOOD FREQUENCY QUESTIONNAIRE

Food Intake Household and child (age 6 months–5 years)

Introduction: The following questions examine the food consumption pattern of your (household) and your child (age 6–59 months) in the last one month by looking at the frequency of consuming specific foods in each of the nine food groups during this period and their sources.

1. Did your household eat the following varieties of foods and food products under each food item (mention the foods one by one)? Enumerator to write the number of time food is consumed under the column that corresponds to the yes reply otherwise, skip to the next.
2. If a food was eaten during the reference period, indicate the frequency of consumption.
3. If the food was eaten daily, please indicate the **number of times** it was eaten **per day**.
4. If the food was eaten in the last seven days or one month, please indicate **the number of days** in the last seven days or one month the food was eaten (e.g. 4).
5. Indicate the source of food or food varieties (where applicable) mentioned: 1=own production, 2= purchased/bought, 3= borrowed, 4= gift, 5 collected from wild 6= food aid, 7=other (specify).
6. Indicate if the food is normally prepared at home or purchased and consumed out of home: 1=home prepared, 2= prepared out of home
7. For vegetables, fruits, sugars & beverages and spices & condiments groups, you will use the **food list provided** to probe whether the food was eaten or not; if the food was eaten please write the food and its variety (where applicable) in the spaces provided and fill the frequency of consumption as above.
8. Repeat steps 1-5 for the index child's section.

Name: _____ Day and date: _____ Language of respondent: _____

Name of village: _____

			Frequency of consumption								
CODE	**Food groups, items and varieties consumed**	**Household**					**Index child**				
		Last 24 hours	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**	**Last 24 hours**	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**
1.0	Cereals/grains and products										
	Mbemba (Maize)										
	Katumani										
	Kikamba										
	Nduma 41										
	Nduma 42										
	Nduma 43										
	Nduma 44										
	Pioneer/pionea										
	Makueni										
	DH01										

			Frequency of consumption								
CODE	**Food groups, items and varieties consumed**	**Household**					**Index child**				
		Last 24 hours	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**	**Last 24 hours**	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**
	DH02										
	DH03										
	DH04										
	511										
	513										
	DK8031										
	Katongelele										
	Panna										
	Matolekya										
	Mwee (Pearl millet)										
	Agriculture/ngilikasa/ndilikasa/katungulu/katumani										
	Kikamba/local										
	Wa meru										

			Frequency of consumption								
CODE	**Food groups, items and varieties consumed**	**Household**					**Index child**				
		Last 24 hours	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**	**Last 24 hours**	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**
	Kikuku										
	Muvya (sorghum)										
	Kateng'u/ Wa muyo										
	Kamenzele										
	Mwemba										
	Kakomo/ Kasilikali/katumani/ Mwai umwe/ Ndilikasa										
	Muthikwa										
	Kayumbi										
	Kamuveta										
	Iviti										
	Kalulu										
	Muvovi										
	Mungomo/kamuungomo										

			Frequency of consumption								
CODE	**Food groups, items and varieties consumed**	**Household**					**Index child**				
		Last 24 hours	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**	**Last 24 hours**	**Last 7 days**	**Last one month**	**Food source**	**In/Out home**
	Manyalala										
	Katumila/kaasele										
	Kaselina										
	Mung'uu										
	Wimbi/Uimbi (finger millet)										
	Mutune										
	Mweu										
	Mwiu										
	Nganu (wheat and products)										
	Ata										
	Museleku										
	Kyapati										
	Mandazi										

(Source: Maundu, 2011.)

ANNEX 9: ADDITIONAL EXAMPLE OF FOOD FREQUENCY QUESTIONNAIRES (FFQ) (SELF-ADMINISTERED)

Please describe how often on average over the past year you consumed the following foods by checking the appropriate box in column two corresponding to the most applicable frequency of consumption of the food over the past year. Next please put a check mark by all of the varieties of apple you have consumed during the past year. You can refer to the photographs in the last column to help you remember the available varieties. (Biodiversity Component in red)

Apple – Put an "x" next to the right of the most applicable frequency as seen in the example below		**Which variety/market type of apple do you usually eat? Or have ever consumed in the past year? Please put an "x" in the next column for any variety/market type you consumed over the past year. You may "x" all that apply as in the example to the right**		**Photo inserted here for identification**
Never		Granny Smith (green skinned)	X	
Less than once per month		Golden Delicious (yellow skinned)		
1-3 times per month		Pink Lady (combination of red and green skin)	X	
1 time per week		Mc Intosh (red skinned)		
2-4 times per week	X	Gala (reddish with some streaking)		
5-6 times per week		Other (add name)		
1 time per day				
2-3 times per day				
4 or more times per day				

In the case of seasonal foods, the respondent can be asked to estimate the number of times the foods are consumed when in season and write down the name of the season.

ANNEX 10: EXAMPLES OF ADAPTING THE DIETARY DIVERSITY QUESTIONNAIRE

Instructions for Administering the Dietary Diversity Questionnaire (Biodiversity Component in red)

1. Ask the respondent if the previous day was a usual/typical day in terms of their food intake. Ask it they consumed more or less than usual. If the previous day's intake was usual continue with the questionnaire.

2. Explain to the respondent that you are going to ask them a series of questions about the food and drink that they consumed the previous day. Tell the respondent that there are no correct or incorrect answers.

3. Ask the respondent to think back to yesterday, to the moment they woke up in the morning. Ask them to tell you the first thing they had to eat or drink – record this in the free recall space.

4. Continue asking "after this, what was the next thing you ate or drank". Continue through the entire day until the respondent went to bed. Use local names for meal occasions such as breakfast, lunch, dinner and snack. Record these items in the spaces provided at the top of the questionnaire.

5. Probe for snacks eaten between main meals. Probe for added foods such as sugar in tea, oil in mixed dishes or fried foods.

6. For any mixed dishes (stew, casserole) record each ingredient in the free recall space.

7. After the respondent recalls all the foods and beverages consumed, underline the corresponding foods in the list under the appropriate food group and write "1" in the column next to the food group if at least one food in this group has been underlined. If the food is not listed in any group, write it in the margin and discuss it with the supervisor.

8. Once the recall is finished, probe for food groups where no food was underlined. It is not necessary to read out to the respondent the exact name of the food group, but simply ask (for example) about fruits, vegetables or tubers if these groups were not previously indicated. Write "0" in the right hand column of the questionnaire when it is certain that no foods in that group were eaten.

9. Once this step is finished, tell the respondent that you would like to ask a few more questions about certain foods consumed. Reference the list of commonly consumed dishes that use biodiverse foods in the study area (Section 3). In the supplementary biodiversity table (section 4), write down the names of all biodiverse foods of interest to the biodiversity aim of the study.

10. Confirm that yesterday the respondent ate the biodiverse food of interest. For example "You remembered that yesterday you had an apple for lunch. Do you know what variety of apple it was that you ate yesterday?" If the respondent says yes, record the variety. Show the photo of the variety mentioned by the respondent, and confirm that the information is correct.

11. If the respondent says they do not remember the variety consumed, show the pictures of the varieties for this food item and ask if they can recognize the variety consumed. Record the answers in the appropriate lines.

Adapted Dietary diversity questionnaire form

SECTION ONE: OPEN RECALL

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink of the morning.

Write down all foods and drinks mentioned. When composite dishes are mentioned, refer to list of commonly consumed dishes and ask for the list of ingredients.

When the respondent has finished, probe for meals and snacks not mentioned.

Time:	**Breakfast**
Time:	**Snack**
Time:	**Lunch**
Time:	**Snack**
Time:	**Dinner**
Time:	**Snack**

SECTION TWO: COMPLETING THE FOOD GROUP FORM AND PROBING FOR ANY FORGOTTEN FOOD GROUPS

When the respondent recall is complete, fill in the food groups based on the information recorded above. Underline the individual food item for the food group and record "1" in the fourth column. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

Question number:	Food group	Locally Available foods, including any biodiverse foods	YES=1 NO=0
1	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. ugali, nshima, porridge or pastes*	
2	WHITE ROOTS AND TUBERS	white potatoes, white yam, white cassava, or other foods made from roots	
3	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrot, squash, or sweet potato that are orange inside + other locally available vitamin A rich vegetables (e.g. red sweet pepper)	
4	DARK GREEN LEAFY VEGETABLES	dark green/leafy vegetables, including wild forms + locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach	
5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) , including wild vegetables	
6	VITAMIN A RICH FRUITS	ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + *other locally available vitamin A rich fruits*	
7	OTHER FRUITS	other fruits, including wild fruits and 100% fruit juice made from these	
8	ORGAN MEAT	liver, kidney, heart or other organ meats or blood-based foods	
9	FLESH MEATS	beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects	
10	EGGS	chicken, duck, guinea fowl or any other egg	
11	FISH AND SEAFOOD	fresh or dried fish or shellfish	
12	LEGUMES, NUTS AND SEEDS	bean, pea, lentil, nuts, seeds or foods made from these	
13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products	
14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
15	RED PALM PRODUCTS	red palm oil, palm nut or palm nut pulp sauce	
16	SWEETS	sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes	
17	SPICES, CONDIMENTS, BEVERAGES	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	
	Did you eat anything (meal or snack) OUTSIDE the home yesterday?		

SECTION THREE: LIST OF MOST CONSUMED DISHES THAT USE BIODIVERSE FOODS CLASSIFIED BY MEALS IN [STUDY AREA NAME]

	A. Breakfast	*Main Ingredients including biodiverse foods*
1	Name of dish	
	B. Lunch/ Dinner	*Main Ingredients including biodiverse foods*
1	Name of dish	
	C. Snack/ tea break	*Main Ingredients including biodiverse foods*
1	Name of dish	

(Source: Adapted from Annex 5 of 'Project report on the integration of the Minimum-Dietary Diversity Women (MDD-W) module into the Household Budget Survey (HBS) in Tajikistan'. FAO, 2015)

SECTION FOUR: COMPLETING THE FOOD BIODIVERSITY TABLE

After you have completed sections one and two, probe for the foods for which information on food biodiversity is needed. Record the food item in the table below.

Confirm with the respondent that the food item was eaten. For example, ask the respondent "Yesterday you ate an apple for lunch. Can you remember the variety of apple which you ate?" If the respondent can name the variety, record this in the second column. Show the respondent the photo of the variety to confirm this was the variety eaten.

If the respondent does not remember the variety, show them the photographs of the local varieties and ask if they can remember with the photo. If yes, record the variety, if no, write "99" for does not know.

Food item consumed	**Name of variety cultivar/breed/market type or "99" for unknown**
Apple	Pink lady

ANNEX 11: LIST OF PARTICIPANTS IN THE FAO TECHNICAL MEETING IN GRANADA, 21-22 SEPTEMBER 2013

Three groups of experts were invited to this meeting:

(1) experts with experience in capturing information on biodiversity within food consumption surveys;

(2) experts with experience in capturing information on food processing within food consumption surveys;

(3) experts with experience in large-scale food consumption surveys.

These three groups were brought together in order to identify the best methods for capturing information on food processing and biodiversity, taking into account feasibility of the methods when applied to large-scale food consumption surveys. The meeting consisted of plenary sessions and two working groups: one working group focused on biodiversity and the other on food processing. The following participants were present at the technical meeting on biodiversity.

Overall chair of the FAO technical meeting: Mark Wahlqvist

Overall rapporteur of the FAO technical meeting: Hilary Creed-Kanashiro

Chair of the working group on biodiversity: Harriet Kuhnlein

Rapporteur of the working group on biodiversity: Céline Termote

List of participants

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