Developing new quantitative indices for assessing the potential of edible species for dietary diversity

Lukas Pawera

Czech University of Life Sciences Prague

and Ali Khomsan, Ervizal AM Zuhud, Nur Indrawaty Lipoeto, Zbynek Polesny, Danny Hunter

Introduction and rationale

Recently, there has been considerable effort in developing metrics for assessing human diets

Yet, quantifying the importance of individual edible species within diets has often been overlooked or difficult

Therefore, we propose simple quantitative indices to better understand the importance and potential of biodiversity for dietary diversity

The proposed indices

Species' Food Reports (FR_s)

1. Species' **Contribution** to Dietary Diversity (CDD_s)

2. Species' **Potential** for Dietary Diversity (PDD_s)

3. Species' **Underutilization** for Dietary Diversity (UDD_s)

The idea behind the proposed metrics

- There are numerous species with edible products belonging to more than one food group.
- We hypothesise that those species have a higher potential to contribute to dietary diversity.
- Therefore, the proposed indexes take into account edible plant parts, which in some instances belongs to different food categories.
- The proposed metrics are inspired by quantitative ethnobotany while aligned with the standard for measuring dietary diversity.
- Quantitave ethnobotanical index Use Value (UV) = Number of use reports/number of respondents (Phillips and Gentry, 1993, 839 citations)

Ethnobiology

Phillips O and Gentry AH (1993) The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. Economic Botany 47(1): 15-32.

Species' Food Reports (FR_s)

- FR is an event when a respondent consumed the species *S* in the food groups *FG* (*FG*$_1$…*FG*$_{10}$)
- The three different types of FR must be calculated per species from the total sample of respondents:

A) FR_{max} (*is the **theoretical maximal number** of events when respondents could consumed the species S in the food groups FG (FG1 - FG10*)

FR_{max} = NFG x N

NFG = Number of food groups provided by the species
N = Total number of respondents in the study

B) FR_{actual} (*is the **actual number** of events when respondents consumed the species S in food groups FG (FG1-FG10*)

C) $FR_{untapped}$ (*is the **difference between** the theoretical maximal number of FR and the actual number of FR*)

$FR_{untapped} = FR_{max} - FR_{actual}$

1. Species' Contribution to Dietary Diversity (CDD_s)

- **The first proposed index is assessing the species' ACTUAL contribution to the dietary diversity**

$CDD = (FR_{actual} / N)$

FR_{actual} = Actual number of food reports for the species S in the food groups FC (FG1…FG10)

N = Total number of respondents in the study

Note: The higher the value is, the greater the **contribution** to dietary diversity ☺

2. Species' Potential for Dietary Diversity (PDD_s)

- **The second proposed index is assessing the species' MAXIMAL POTENTIAL to contribute to the dietary diversity**

$PDD = (FR_{max} / N)$

FR_{max} = The theoretical maximum number of food reports for the species S in the food groups FC (FG1…FG10)

N = Total number of respondents in the study

Note: The higher the value is, the greater the **potential** for dietary diversity ☺

3. Species' Underutilization for Dietary Diversity (UDD_s)

- **The third proposed index is assessing the species' level of UNDERUTILIZATION for the dietary diversity (and its untapped potential)**

$UDD = FR_{untapped} / N$

$FR_{untapped}$ = Is the difference between the theoretical maximal number of food reports and the actual number of food reports for the species S

N = Total number of respondents in the study

Note: The higher the value is, the greater the extent of **underutilization** for dietary diversity ☹

Data collection and analysis

- A sample of 100 Minang and 100 Mandailing women of reproductive age from cocoa farming households in West Sumatra, Indonesia.
- Socio-economy, expenditures, agrobiodiversity levels, food insecurity, local knowledge, seasonal calendars, food taboes, barrier analysis
- Ethnobotanical mapping and plant identification
- Quantitative 24-h food recalls (**qualitative enough**)
- Food categorization into 10 standard food groups (FAO and FHI 360, 2016)
- Calculations and analysis of species' food reports and new indices

FAO and FHI 360 (2016) Minimum dietary diversity for women Minimum. A guide for measurement. FAO, Rome, Italy

Main results – Which species hold the **highest potential** for dietary diversity (**PDD**)?

Species	**NFG** (No. of food groups)	**N** (No. of respondents in the study)	**FR_{max}** $NFG \times N$	**FR_{actual}** (No. of food reports)	**$FR_{untapped}$** $FR_{max} - FR_{actual}$	**PDD_s** (Species Potential for DD) FR_{max}/N	**CDD_s** (Species Contribution to DD) FR_{actual}/N	**UDD_s** (Species Underutilization for DD) $FR_{untapped}/N$
Carica papaya	**3 food groups**	**200**	**600**	**10**	**590**	**3**	**0,05**	**2,95**
Ripe fruit	1 (Vit. A)	200	200	4	196	**1**	0,02	0,98
Papaya leaf	1 (Leafy v.)	200	200	5	195	**1**	0,025	0,975
Unripe fruit	1 (Other v.)	200	200	1	199	**1**	0,005	0,995

“MULTI-FOOD GROUP SPECIES“ = the highest potential (PDD)!

Papaya **(PDD=3)** (CDD=0,05)	*Jackfruit* **(PDD=2)** (CDD=0,10)	*Pumpkin* **(PDD=2)** (CDD=0,05)	*Chicken* **(PDD=2)** (CDD=0,38)	*Cassava* **(PDD=2)** (CDD=0,41)	*Banana* **(PDD=2)** (CDD=0,36)	*Chayote* **(PDD=2)** (CDD=0,05)	*Mungbean* **(PDD=2)** (CDD=0,04)
Leafy vegetables (CDD=0,025)	**Other vegetables** (CDD=0,09)	**Leafy vegetables** (CDD=0,03)	**Meat** (CDD=0,135)	**Leafy vegetables** (CDD=0,355)	**Other fruits** (CDD=0,32)	**Other vegetables** (CDD=0,04)	**Other vegetables** (CDD=0,005)
							
Other vegetables (CDD=0,005)	**Other fruits** (CDD=0,005)	**Vitamin A rich plants** (CDD=0,015)	**Eggs** (CDD=0,245)	**Staples** (CDD=0,055)	**Other vegetables** (CDD=0,015)	**Leafy vegetables** (CDD=0,005)	**Pulses** (CDD=0,035)
							
Vitamin A rich-plant (CDD=0,02)							
							

Based on 200 x 24 hour food recalls, but..

Main results – Species with the highest **contribution** to dietary diversity (**CDD**)

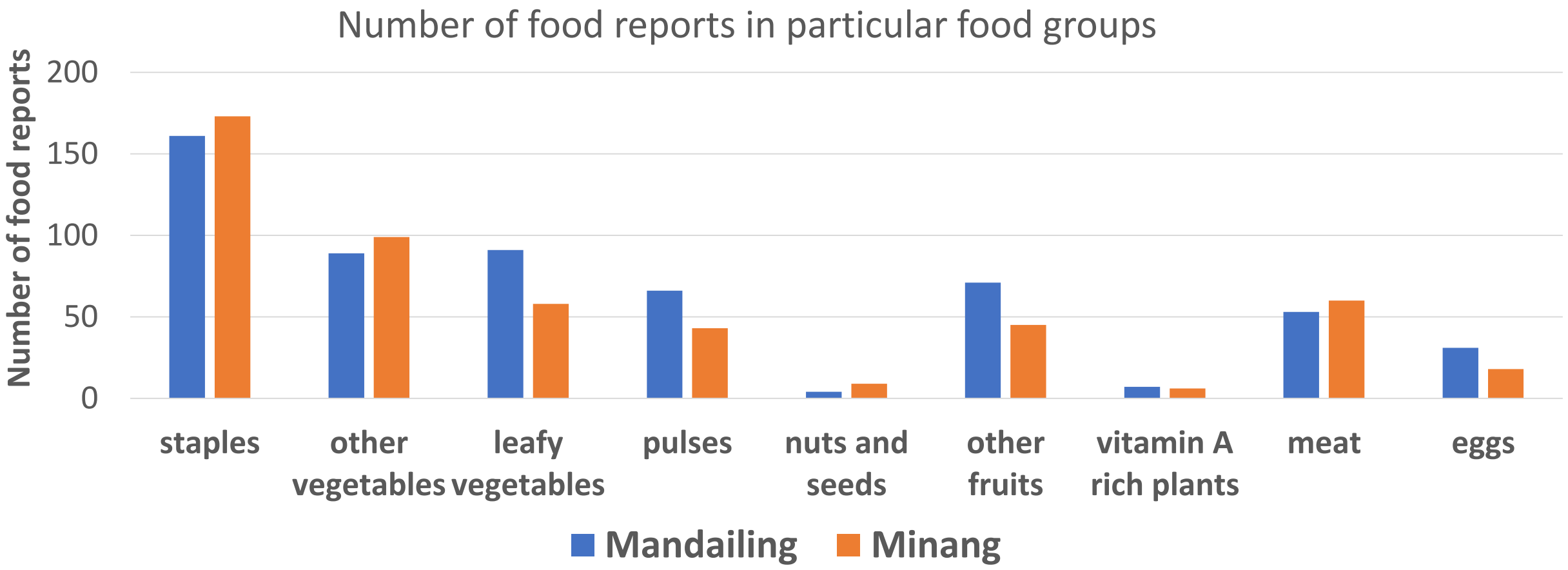
Species	**NFG** (No. of food groups)	**N** (No. of respondents in the study)	**FR_{max}** NFG x N	**FR_{actual}** (Total number of food reports)	**$FR_{untapped}$** $FR_{max} - Fr_{actual}$	**PDD_s** (Species Potential for DD) FR_{max}/N	**CDD_s** (Species Contribution to DD) FR_{actual}/N	**UDD_s** (Species Underutilization for DD) $SFR_{untapped}/N$
Rice	1 (Staples)	200	200	200	0	1	**1**	0
Soybean	1 (Pulses)	200	200	91	109	1	**0,46**	0,56
Cassava	2 (Leafy veg.; Staples)	200	400	82	318	2	**0,41**	1,59
Chicken	2 (Meat; Eggs)	200	400	76	324	2	**0,38**	1,62
Wheat	1 (Staples)	200	200	76	124	1	**0,38**	0,62

Main results – Species with the highest level of **underutilization** for dietary diversity (**UDD**)

Species	**FG** (Food groups)	**NFG** (No. of food groups)	**N** (No. of respondents in the study)	**FR_{max}** NFG x N	**FR_{actual}** (Total number of food reports)	**$FR_{untapped}$** $FR_{max} - FR_{actual}$	**PDD_s** (Species Potential for DD) FR_{max}/N	**CDD_s** (Species Contribution to DD) FR_{actual}/N	**UDD_s** (Species Underutilization for DD) $FR_{untapped}/N$
Papaya	Vitamin A Leafy veg. Other veg.	3	200	600	10	590	3	0,05	**2,950**
Mung bean	Pulses Other veg.	2	200	400	1	399	2	0,005	**1,995**
Pumpkin	Vitamin A Leafy veg.	2	200	400	9	391	2	0,045	**1,955**
Chayote	Other veg. Leafy veg.	2	200	400	9	391	2	0,045	**1,955**
Jackfruit	Other veg. Other fru.	2	200	400	19	381	2	0,095	**1,905**

Also the number of food reports (or sum of CDD index) are suitable for assessing the consumption of FOOD GROUPS

(It may says a different thing than % of food group consumers)



Summarized findings

- **Food items** consumed in the last 24 hours were identified to the species and their actual contribution, potential and underutilization for dietary diversity was counted.
- The multi-food group species (e.g. ***Carica papaya***, ***Artocarpus heterophyllus, Manihot esculenta***) were despite reaching the greatest potential for DD found to be highly underutilized.

Species	NFG (No. of food groups)	N (No. of respondents in the study)	FR_{max}	FR_{actual}	$FR_{untapped}$	PDD_s	CDD_s	UDD_s
Papaya plant	3	200	600	10	590	**3**	**0,05**	**2,95**
Rice	1	200	200	200	0	**1**	**1**	**0**

Discussion on advantanges, disadvantages, implications (-_+)

- Calculation and aggregation at species level
- A slightly higher attention to botany might be needed
- Species (and edible parts) not captured by 24h food recalls will be missed

+ Species with high potential might be targeted by nutrition-sensitive agriculture
+ The indices were helpful in quantifying the role of individual species in a feasible way
+ The indices could be used for monitoring changes in species consumption
+ The wider adoption of the indices is feasible, as the data are collected through qualitative 24h food recalls
+ The quantitative metrics offer new options for further statistical analysis

Thank you for your attention!