What matters most for cultivating healthy diets: agricultural diversification or market integration?

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BACKGROUND

- Inertia in LMICs toward increasing i) the **extent of specialization** of smallholder farms, and 2) **orientation toward commercial markets**

- Not inherently at odds with preservation of agricultural biodiversity, but genetically uniform production systems often result

- **Agricultural biodiversity important** for ecosystem services (e.g., stability, resource use efficiency, pest regulation), and productivity (e.g., via sampling effect, facilitation, seasonal evenness)

- Nutritional consequences of changes in agricultural biodiversity, and trade-offs with market integrations are not clear

Source: Collier P, Dercon S (2013), African Agriculture in 50 Years: Smallholders in a rapidly changing world? Oxford, UK: University of Oxford

OBJECTIVE

Through a review of empirical evidence, assess and compare the **assocation of agricultural biodiversity** and **market access with** the quality and diversity of **diets** of agricultural households in low- and middle-income countries

METHODS

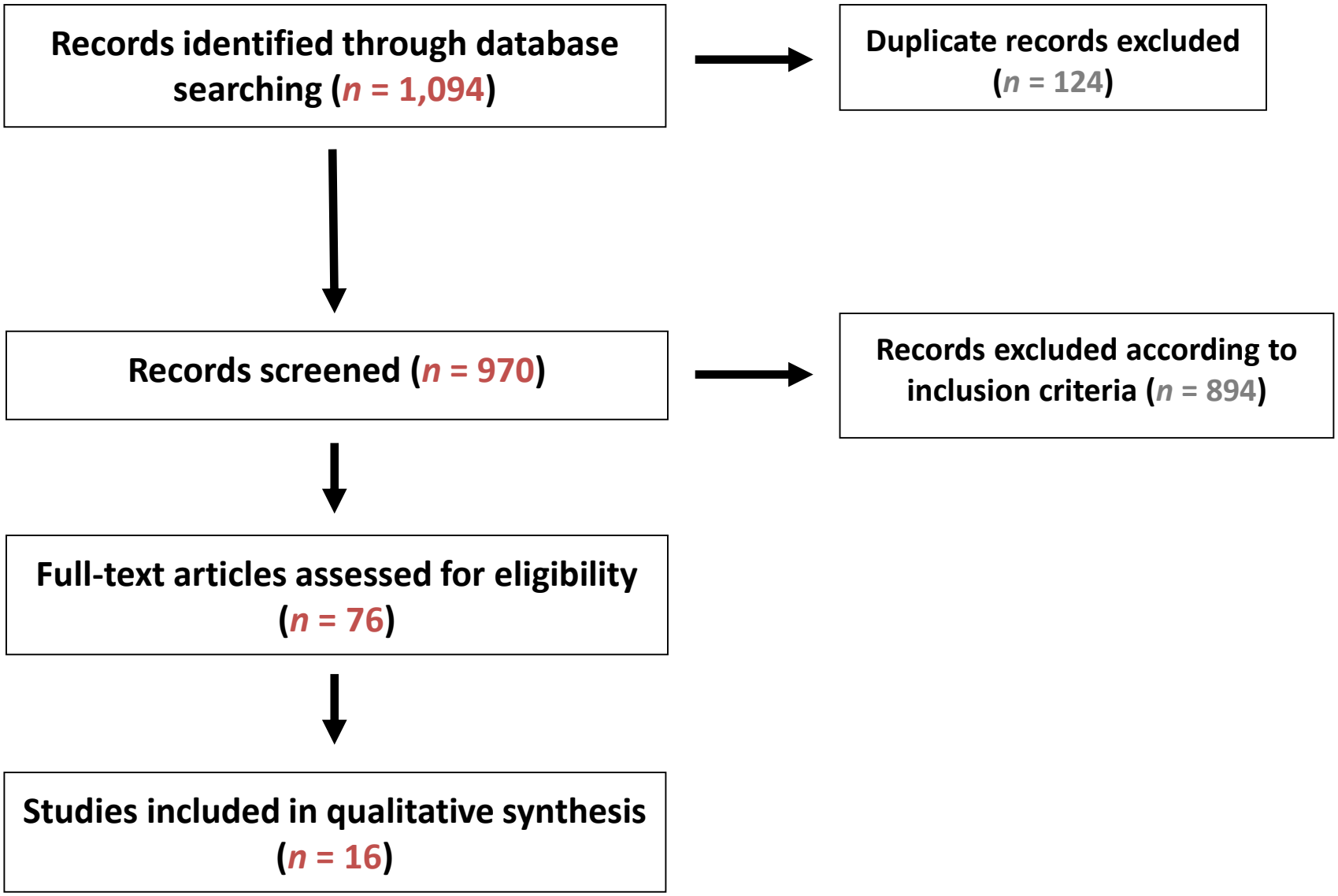
- Systematic literature review

- 2 independent reviewers examined 5 databases of English-language indexed literature using key search terms identified *a priori*

- Inclusion/exclusion criteria:
  - at least 1 metric of terrestrial, cultivated agricultural biodiversity
  - at least 1 metric of dietary diversity or quality
  - studies exclusively of home gardens were excluded
  - non-empirical theoretical studies or unpublished theses excluded

- Heterogeneity in measurement approaches, indicators, models, correlation measures precluded a quantitative meta-analysis

ARTICLE SCREENING AND EXCLUSIONS



SUMMARY OF INCLUDED ARTICLES

	Author (Year)	Country	Sample size
1	Dewey (1981)	Mexico	149 children
2	Torheim et al. (2004)	Mali	319
3	Ekesa et al. (2008)	Kenya	144
4	Remans et al. (2011)	Kenya, Malawi, Uganda	170
5	Keding et al. (2012)	Tanzania	252 women
6	Oyarzun et al. (2013)	Ecuador	51
7	Jones (2014)	Bolivia	251
8	Jones et al. (2014)	Malawi	6,623
9	Pellegrini et al. (2014)	8 countries	33,119
10	Remans et al. (2014)	Global	113 countries
11	Dillon et al. (2015)	Nigeria	2,154
12	Kumar et al. (2015)	Zambia	3,040
13	Malapit et al. (2015)	Nepal	3,332
14	Sibhatu et al. (2015)	Indonesia, Kenya, Ethiopia, Malawi	8,230
15	Snapp & Fisher (2015)	Malawi	9,189
16	M'Kaibi et al. (2016)	Kenya	525

DIETARY ASSESSMENT

Measurement approaches

- quantitative 24-hour dietary recalls (5)
- qualitative 24-hour food group recall (2)
- 7-day food frequency questionnaire (2)
- 7-day household food consumption (4)
- instrument not specified (2)

Indicators

- diet diversity score (food groups) (11)
- food variety score (food items) (6)
- Food Consumption Score (2)
- Mean Adequacy Ratio (1)
- Infant and Child Feeding Index (1)

MEASUREMENT OF AGRICULTURAL BIODIVERSITY

Crop count (12)

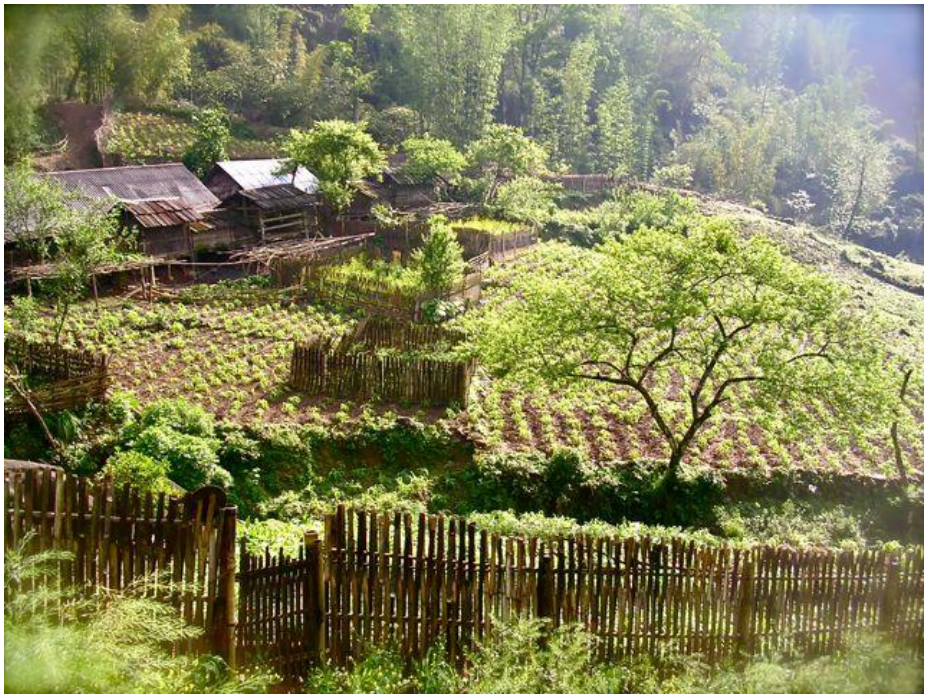
- food crops only (3)
- horticultural crops only (1)
- non-maize crops (1)
- intercrops (1)

Evenness indices (4)

- Margalef Index (2)
- Simpson Index (1)
- Shannon Index (1)

Combined crop count (4)

- crop and livestock (3)
- crop, livestock, and wild collected foods (1)



MEASUREMENT OF MARKET ACCESS

- 7 studies included some indicator of market access

Production orientation of households

- proportion of food consumed by household from own production (1)
- proportion of cropped land area devoted to market crops (1)
- selling any part of farm produce to the market (1)
- number of vegetable species sold v. purchased (1)
- value of subsistence production (unspecified measurement) (1)

Proximity to locations/services

- distance to nearest road or market (2)
- access to own mode of transport (2)
- community bus stop, rural location, school feeding program in community (1)

Livelihood source

- any income from off-farm/non-farm employment (1)

RELATIONSHIP BETWEEN AGRICULTURAL BIODIVERSITY AND DIETARY DIVERSITY

- In 14 of 15 studies, household-level agricultural biodiversity was positively associated with household- or individual-level dietary diversity or quality, independent of household wealth or market access

MAGNITUDE OF ASSOCIATION BETWEEN AGRICULTURAL BIODIVERSITY AND DIETARY DIVERSITY

	Study	Magnitude of association
1	Dewey (1981)	adjusted r = 0.25 for HH ≥5 crops
2	Torheim et al. (2004)	β = 0.002 (for MAR); β = (NS) (for FVS, DDS)
3	Ekesa et al. (2008)	unadjusted R^2 = 0.485
4	Remans et al. (2011)	associations not reported
5	Keding et al. (2012)	r = 0.313 (with DDS); r = 0.247 (with FVS); unadjusted
6	Oyarzun et al. (2013)	unadjusted R^2 = 0.194
7	Jones (2014)	β = 0.04 (with ICFI)
8	Jones et al. (2014)	β = 0.23 (CC with DDS); β = 0.68 (SI with DDS)
9	Pellegrini et al. (2014)	β = 0.01 (DDS, pooled)
10	Remans et al. (2014)	point estimates for associations not given
11	Dillon et al. (2015)	log β = 0.24
12	Kumar et al. (2015)	β = 0.217/0.250 (with child/HH DDS)
13	Malapit et al. (2015)	β = 0.1 (with maternal DDS); β = 0.06 (with child DDS)
14	Sibhatu et al. (2015)	IRR = 1.009/1.054/1.015 (pooled/Indonesia/Malawi)
15	Snapp & Fisher (2015)	IRR = 1.019
16	M'Kaibi et al. (2016)	ANOVA: F = 14.791

RELATIONSHIP BETWEEN AGRICULTURAL BIODIVERSITY AND DIETARY DIVERSITY

- Magnitude of associations typically small
  - 1 unit increase in agricultural biodiversity associated with 0.1-0.25 increase in DDS
  - 1 unit increase in agricultural biodiversity associated with 1-2% increase in DDS
  - 10 percent increase in agricultural biodiversity associated with 2.4% increase in DDS

RELATIONSHIP BETWEEN MARKET ACCESS AND DIETARY DIVERSITY

- In 5 of 5 studies, greater market access was associated with more positive dietary diversity or quality

- Heterogeneous proxy indicators of market access
  - reliance on own production for consumption (-)
  - selling higher share of production (+)
  - devoting more land to market crops (+)
  - access to public or own transport (+)
  - distance to nearest road or market (-)
  - rural location (-)

MAGNITUDE OF ASSOCIATION BETWEEN MARKET ACCESS AND DIETARY DIVERSITY

	Study	Magnitude of association
1	Dewey (1981)	adj. r = -0.44/-0.59 (value of subsistence production associated with lower dependence on purchased foods)
5	Keding et al. (2012)	results not shown; women who sold more of their vegetables, had higher DDS and FVS
6	Oyarzun et al. (2013	unadj. R^2 = 0.40 (CC and number of products destined for family consumption)
8	Jones et al. (2014)	β = 0.264 (proportion of cultivated land in market crops); = -2.64 (proportion of food from own production) (both CC with DDS)
12	Kumar et al. (2015)	results not shown; access to own mode of transport independently associated with DDS; inclusion of this variable in regressions did not change coefficient of association btw. agricultural biodiversity and DDS
14	Sibhatu et al. (2015)	IRR = 0.999 (km to nearest market; pooled); = 1.039 (any off-farm income); 1.045 (sell any production)
15	Snapp & Fisher (2015)	IRR = 0.997 (km to nearest road); = 1.019 (bus stop in community); = 1.018 (school feeding program in community); = 1.056 (daily market in community); = 0.919 (rural residence); = 1.049 (bicycle ownership)

RELATIONSHIP BETWEEN MARKET ACCESS AND DIETARY DIVERSITY

- Magnitude of associations
  - 1 km increase in distance to nearest market or road associated with a 0.1-0.3% decrease in DDS
  - access to market in community, and bicycle ownership associated with a 5.6% and 4.9%, respectively, increase in DDS
  - any off-farm income associated with 3.9% increase in DDS
  - sell any production associated with 4.5% increase in DDS
  - an increase of 1 percentage point in land devoted to market crops associated with 0.26 increase in DDS

ADDITIONAL FINDINGS

- Association between agricultural biodiversity and dietary diversity often follows an “inverted U” shape

- Greater production diversity was associated with fewer food purchases, and greater share of consumption from own production

- Total agricultural production and agricultural revenues were positively associated with dietary diversity in several studies, but not as strongly as agricultural biodiversity

- Relationship between agricultural biodiversity and dietary diversity stronger in woman- vs. male-headed households

DISCUSSION

- Consistent positive association between agricultural biodiversity and dietary diversity, independent of wealth and market access; market access has independent positive association with dietary diversity
- Practical meaning of magnitude of associations difficult to compare out of policy context
- Policy implications often indicate an “either-or” approach, though these are not necessarily mutually exclusive approaches
- Just as diversification interventions must account for potential trade-offs and farmers’ capacities, commercialization interventions must address market complementarity
- All diversity is not equal

RESEARCH GAPS

Data quality

- Comprehensive reporting of data (baseline ABD likely affects nature of relationships)
- Longitudinal and quasi-experimental studies

Measurement

- Differences when using food group and evenness indices
- Direct measurement of agricultural biodiversity, including varieties
- Poor proxies for market access
- Limited data on village- or landscape-level agricultural biodiversity
- Challenges with 7-day consumption data as well as dietary diversity

- Limited understanding of mechanisms or the potential moderating influence of agroecological context and place

THANK YOU

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SUPPLEMENTARY INFORMATION

KEY POINTS

- Pooling data across countries may mask important relationships that depend on local agroecological contexts
- Household wealth and education remain the most important predictor of dietary diversity and quality in most settings
- At a minimum, interventions must move beyond a focus on increased agricultural production or revenues

CONCEPTUAL FRAMEWORK ON THE LINKAGES BETWEEN AGRICULTURAL BIODIVERSITY AND DIETARY DIVERSITY