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Influence of nutrition-sensitive interventions on dietary profiles of smallholder farming households in East and Southern Africa

by
Marian Amaka Odenigbo
Patience Elabor-Idemudia
Nigatu Regassa Geda

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Abstract

This study was conducted to explore the influence of nutrition-sensitive interventions on dietary profiles of beneficiaries in the agriculture and rural development projects funded by the International Fund for Agricultural Development (IFAD). Dietary profiles were assessed based on primary data collected from a sample of five projects in three countries of East and Southern Africa (ESA). The methodology adopted 'purposive sampling' guided by the project investment themes: agribusiness (Zambia); dairy (Kenya); productivity promotion (Zambia); rural marketing (Mozambique); and natural resource management (Kenya). Quantitative data were collected from 402 rural smallholder farming households. Dietary diversity was measured at both household (household dietary diversity score [HDDS]) and individual levels (minimum dietary diversity for women [MDD-W] and minimum dietary diversity for children [MDD-C]). The multiple classification analysis (MCA) model was used to relate key project interventions as variables affecting dietary diversity profiles.

Study findings indicate that the projects have diverse nutrition-related production activities, ranging from training to provision of inputs and services, including labour- and energy-saving technologies. Creating access to markets was reported as an important intervention by a significant number of beneficiaries. A significant proportion of respondents in two specific projects reported receiving nutrition education, food demonstrations, and training in cooking, recipe development and kitchen gardening. The study found that good dietary diversity was higher at the household level (63.7-97.3 per cent), compared with minimum dietary diversity for children (1.2-47.6 per cent) and for women (22.5-63.5 per cent). Over 30 per cent of women in all projects had a poor dietary profile (consumption of less than five food groups). The situation was even worse for children, with over 50 per cent having a poor dietary profile (consumption of fewer than four food groups).

Multivariate analysis revealed that the mean dietary diversity score is a function of project-related factors, sociodemographic and economic variables ($p<0.05$). The HDDS varied significantly according to diversification services, market linkages, women's empowerment, capacity-building and literacy status. For MDD-W, household size, women's empowerment and diversification were strong determinant factors, while capacity-building had the most influence on MDD-C. This study confirmed that agricultural and rural development investments in food production and household income growth have many opportunities to positively influence dietary profiles. However, there is a need to integrate planned, continuous nutrition interventions that target behavioural changes in the consumption patterns of nutritionally-at-risk populations.

1 Introduction

While some regions have recorded remarkable progress towards food security and eradicating malnutrition, progress in sub-Saharan Africa has been worryingly slow. A total of 156 million of the world's children are stunted, of whom 37 per cent are in Africa; 42 million are overweight with 25 per cent in Africa; and 50 million are wasted with 28 per cent in Africa (UNICEF/WHO/World Bank Group 2016). In most countries in East and Southern Africa (ESA), the level of malnutrition remains critical, particularly among poor rural communities. According to the Global Nutrition Report (2016), the burden of stunting and iron and vitamin A deficiency rates are of great concern in Burundi (57.5, 44.6 and 27.9 per cent, respectively); Madagascar (49.2, 68.3 and 42.1 per cent); Malawi (47.8, 62.5 and 59.2 per cent); Mozambique (43.1, 68.7 and 68.8 per cent); and Zambia (40.1, 52.95 and 54.1 per cent).

To address the burden of malnutrition, present in multiple forms, the international community is accelerating its activities. The last few years have witnessed tremendous efforts to implement global visions and strategies, and to mobilize resources and commitments towards eliminating hunger and significantly reducing malnutrition. These include adoption of the 17 Sustainable Development Goals (SDGs), the World Health Assembly targets (2025), the Scaling-Up Nutrition Movement (SUN 2012), the Zero Hunger vision, and the Second International Conference on Nutrition (ICN2). The SDG commitment proposes to end poverty, protect the planet and ensure prosperity for all as a new 2030 Sustainable Development Agenda.

Despite these commitments and efforts, multiple forms of malnutrition are increasingly found coexisting within the same country or household or even in the same individual, because a person can suffer from more than one type of malnutrition. Two billion people are affected by one or more micronutrient deficiencies. Among the adult population of 5 billion, nearly 2 billion are overweight/obese. This trend has resulted in the progressive use of multisectoral approaches and innovations to harness the potentials of agriculture for good nutrition (FAO 2012). There is growing interest among development partner organizations, both national and international, in making the agriculture sector more nutrition sensitive in response to the growing need to increase the volume of food production and reduce malnutrition (World Bank 2013).

IFAD is actively promoting the nutrition-sensitive agriculture agenda, which is aligned with a principal objective of the Fund's founding agreement: "… improving the nutritional level of the poorest populations in developing countries". In addition, the IFAD Strategic Framework 2016-2025 states a corporate commitment to nutrition. IFAD's presence in all countries committed to the SUN Movement puts the Fund in an advantageous position to dialogue with governments and relevant stakeholders to ensure mainstreaming of nutrition in development investments. IFAD (2015) identifies two initiatives to make investments more nutrition sensitive: (i) integration of nutrition considerations and indicators into the existing elements of a programme/project to promote nutrition (e.g. a typical project component, such as enhancing production, will use a new technology or pursue a new goal, such as the use of a nutrient-dense food variety or species); or (ii) adding nutrition-promoting activities to the project itself (i.e. a complementary activity, such as nutrition education or 'behaviour change communication', will likely enable the project to promote improved dietary intake).

As an approach to ascertaining the effects of interventions in nutrition-sensitive agriculture on the improved dietary profile of smallholder farming communities, IFAD conducted a study in three ESA countries: Kenya, Mozambique and Zambia (IFAD 2016). This study relates the possible impacts of key project interventions (such as women's empowerment, production diversification, market access, income generation, capacity-building and integrated nutrition activities) as variables that explain dietary diversity among project beneficiaries.

Most previous similar studies in Africa and developing countries have focused on the relationship between dietary diversity and individual/household sociodemographic characteristics (Taruvinga, Muchenje and Mushunje 2013; Ihab et al. 2013; Brinkman et al. 2010). Factors such as women's participation in decision-making (Patel et al. 2012), headship (i.e. position of being the head) (Taruvinga, Muchenje and Mushunje 2013) and degree of purchasing power (Ihab et al. 2013) are some factors reported. Income and educational level are more-frequently reported factors impacting dietary diversity. For instance, Brinkman et al. (2010) reported that families with more income and resources had a more-diversified diet.

On the other hand, studies addressing the impacts of nutrition-sensitive agricultural interventions on the dietary intake of rural smallholder farmers – at both household and individual levels – are relatively scarce. Previous studies have considered dietary diversity at the household level, which overlooked the possible differential effects of intervention activities on women's and children's dietary profiles. Thus this study collected data from five IFAD-funded projects in three countries to analyse the impacts of production diversity and other nutrition-sensitive interventions on the dietary diversity of households, women and children.

2 Data sources and methodology

2.1 Data sources and design

This study began with a desk review of 37 IFAD-funded projects in the ESA region. The projects were validated using project documents such as: country strategic opportunities programmes (COSOPs); project design, supervision, project completion, portfolio review and impact assessment reports; and country programme evaluations. The study used a cross-sectional survey design, and 'purposive sampling' was adopted to select the countries and projects for data collection. Selection was based on intervention focus, project goals, development objectives and key nutrition activities. Consideration was given to projects in advanced implementation (i.e. projects approved in or after 2015 were not included).

Data were generated from five projects (box 1) in three countries: Kenya – Upper Tana Catchment Natural Resource Management Project (UTaNRMP) and Smallholder Dairy Commercialization Programme (SDCP); Mozambique – Rural Markets Promotion Programme (PROMER); Zambia – Smallholder Productivity Promotion Programme (S3P) and Smallholder Agribusiness Promotion Programme (SAPP).

2.2 Sampling techniques

The sample size was determined by a population-based formula developed by Cochran (1977). The computed sample size was 150 households (including contingency) for each country. Disproportionate (equal) sampling was then used to allocate the computed size across projects to allow for variations in the number of beneficiary households under each individual project. The procedure of selecting eligible households started with a random selection of representative villages/districts from each project area, followed by selection of beneficiary households using simple random sampling techniques.

2.3 Data collection

Structured checklists and survey questionnaires were used to collect data from beneficiaries and stakeholders. The dietary diversity score (DDS) was used to measure dietary profiles at household and individual levels (women and children). The FAO[1] guidelines for measuring dietary diversity were used in creating the dietary profile measures (FAO 2012; FAO 2016). Different lists of food groups were used to compute the DDS for households (household dietary diversity score – HDDS); for women of reproductive age (minimum dietary diversity for women – MDD-W); and for children (minimum dietary diversity for children – MDD-C).

Differences in the number of food groups used in constructing the HDDS, MDD-W and MDD-C reflect the different objectives of the measures. For instance, the HDDS represents a household's socio-economic level, while the MDD-W is a proxy of nutritional quality among

1. Food and Agriculture Organization of the United Nations.

Box 1

S3P (Zambia): 2011-2018

Project goal: To sustainably improve income levels and food and nutrition security among poor agricultural households in the programme area.

- Investment focus: **Productivity promotion**

SAPP (Zambia): 2009-2017

Project goal: To increase the income levels of poor rural households involved in production, value addition and trade in agricultural commodities.

- Investment focus: **Agribusiness/value-chain development**

UTaNRMP (Kenya): 2012-2020

Project goal: To contribute to rural poverty reduction in the Upper Tana River catchment.

- Investment focus: **Natural resources**

SDCP (Kenya): 2006-2019

Project goal: To increase the incomes of poor rural households whose livelihoods depend substantially on the production of, and trade in, dairy products.

- Investment focus: **Dairy commercialization**

PROMER (Mozambique): 2009-2018

Project goal: To improve the livelihoods of poor rural households by increasing their incomes from agricultural activities.

- Investment focus: **Rural marketing**

Source: IFAD project design reports, available at https://login.ifad.org/login.

women of reproductive age. The HDDS was computed using 12 food groups. A good HDDS means an intake of five or more groups, while an intake of four groups or less is classified as a poor HDDS. The MDD-W was computed with only 10 food groups; an intake of at least five groups is rated good, while fewer than five is considered poor. For the MDD-C, seven food groups were used, with an intake of four or more rated good, while fewer than four is considered poor. Examples of the food items contained in each group are illustrated in box 2.

2.4 Data analysis

Once the required data were collected, quantitative data were input into the Statistical Package for Social Science (SPSS) computer program. Analysis began with extraction of information from the desk review, followed by analysis of the quantitative and qualitative data. The quantitative section of the study employed various statistical techniques, ranging from simple tabulation to multivariate regression analysis.

The patterns and determinants of dietary diversity for households, women and children were evaluated through multivariate analysis. The HDDS, MDD-W and MDD-C were used as dependent variables in the analysis, while eight predictors were included in the model. Regression analysis was employed to identify the influence on dietary diversity scores of key project activities (such as women's empowerment activities, market linkage services, capacity-building activities and other covariates).

Multiple classification analysis (MCA) is one of the techniques of multivariate data analysis commonly employed to examine the contribution of each category of the predetermined predictor variables before and after adjustment for controlling variables. It is an ordinary linear multivariate regression model consisting of the nominal variables (n) as dummies. MCA is a technique for analysing interrelationships among several predictor variables and a dependent variable within the context of an additive model. The predictors in an MCA can be measured in either ordinal or nominal scale. The dependent variable has to be either in an interval scale or in a dichotomous category.

The MCA model has various advantages over traditional regression models. The first key feature of MCA technique is its ability to show the effect of each predictor on the dependent variable both before and after taking into account the effects of all other variables. Second, the importance of the MCA model lies in the fact that the predictors are always treated as sets of classes or categories, and thus it does not matter whether a particular set represents a nominal scale (categorical), an ordinal scale (ranking) or an interval scale (classes of a numerical variable). Third, the MCA model is known for its salient features of solving the problem of multicollinearity, which arises from predictor variables being correlated, and/or the problem of non-linear relationships, which are adequately handled. The model can be expressed in simple terms as: $Y_{ijklw}=\acute{\alpha} + a_i + b_j + c_k + d_l + e_{ijklw}$, where $\acute{\alpha}$=general effect and $a,b,c,d..n$ are effects of the categories of the respective independent variables. The MCA procedure provides figures and estimates for each predictor. It provides estimates of the 'unadjusted' and 'adjusted' effects of each independent variable on the response variable. The unadjusted effect (deviation) of a particular category of a (a_1 for example) is equal to the mean value of Y among those belonging to category 1 of a, minus the overall mean of Y values of 1.

Box 2 Food groups used to compute the DDS for households, children and women

<table>
<tr><th>Food groups</th><th>Household=12</th><th>Women=10</th><th>Children=7</th></tr>
<tr><td>Cereals</td><td>✓</td><td rowspan="2">✓
All starchy staples</td><td rowspan="2">✓
All starchy staples</td></tr>
<tr><td>Roots and white tubers</td><td>✓</td></tr>
<tr><td>Beans and peas</td><td>✓</td><td>✓</td><td rowspan="2">✓</td></tr>
<tr><td>Nuts and seeds</td><td>✓</td><td>✓</td></tr>
<tr><td>All dairy products</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Flesh foods (meat, poultry, organ meats)</td><td>✓</td><td>✓</td><td rowspan="2">✓</td></tr>
<tr><td>Fish and seafood</td><td>✓</td><td>✓</td></tr>
<tr><td>Eggs</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Vitamin A-rich (dark green leafy vegetables)</td><td></td><td>✓</td><td rowspan="2">✓</td></tr>
<tr><td>Other vitamin A-rich (vegetables and fruits)</td><td></td><td>✓</td></tr>
<tr><td>Other fruits</td><td>✓
And vitamin A-rich fruits</td><td>✓</td><td rowspan="2">✓</td></tr>
<tr><td>Other vegetables</td><td>✓
And vitamin A-rich vegetables</td><td>✓</td></tr>
<tr><td>Oils and fats</td><td>✓</td><td></td><td></td></tr>
<tr><td>Non-alcoholic beverages and sweets</td><td>✓</td><td></td><td></td></tr>
<tr><td>Miscellaneous (tea, coffee, spices, condiments)</td><td>✓</td><td></td><td></td></tr>
</table>

Source: Adapted from FAO guidelines for measuring dietary diversity (FAO 2012, 2016).

3 Results

3.1 Respondents' characteristics

Table 1 presents the background characteristics of the 402 rural smallholder farming households involved in the study. The educational status showed that a larger proportion of respondents in all projects have completed at least primary-level education, while relatively more illiteracy was reported from the PROMER and SAPP (25 per cent each). A higher proportion of respondents were self-employed in the UTaNRMP, SDCP and S3P (62.8, 74.4 and 77.8 per cent, respectively). The PROMER had the highest proportion of unemployed domestic workers (52 per cent), followed by the UTaNRMP (30.8 per cent) and SDCP (24.3 per cent). This magnitude of unemployment could be associated with the respondents' indicative low level of education. Distribution of respondents by household size showed that more than 90 per cent of households in the PROMER, S3P and SAPP had large family sizes (7 or more). The percentages for the UTaNRMP and SDCP were still quite significant at 68 and 72 per cent, respectively. Average household sizes ranging from 3.5 to 6.22 are consistent with the national average household size (in Kenya 4.4, Zambia 4.8 and Mozambique 4.5).

Larger landholdings per household (>2 hectares) were reported among respondents in the PROMER (46.1 per cent) and S3P (54 per cent), while a larger proportion of respondents in the SAPP and UTaNRMP were reported to be landless (61 and 21 per cent). The percentages of households with 1-2 hectares were greater for the SDCP and S3P (32.4 per cent and 28.6 per cent, respectively). The respondents' household headship distribution shows that fewer than 20 per cent of households in each project were headed by women (HHW). The S3P had the smallest proportion of HHW, at under 8 per cent. Households' wealth status was computed from commonly available lists of household assets: electricity, radio, bicycle, sewing machine, cart, kerosene, cell phone and lamp. The computed values were further categorized into poor, medium and better-off wealth status. The percentage distribution in table 1 indicates that the PROMER, S3P and SAPP constituted relatively larger proportions of poor households at 60.8, 52.4 and 34.1 per cent, respectively. This finding is consistent with the low levels of education and unemployment among these groups of respondents.

Table 1 Percentage distribution of respondents by sociodemographic characteristics and project types (n=402[a])

Variable	Project name				
	PROMER (n=102)	UTaNRMP (n=78)	SDCP (n=74)	S3P (n=63)	SAPP (n=85)
Educational status					
Elementary level (1-6)	51.5	6.4	10.8	20.6	**16.5**
Junior (7-8)	20.8	37.2	24.3	44.4	**28.2**
Secondary (9-12)	2.0	37.2	44.6	31.7	**24.7**
College	1.0	9.0	17.6	0	**5.9**
None[b]	24.8	10.3	2.7	3.2	**24.7**
Employment status					
Self-employed	12.7	62.8	74.3	77.8	**0**
Paid contract worker	1.0	6.4	0	0	**0**
Unemployed domestic worker	52.0	30.8	24.3	0	**0**
Unemployed	34.3	0	1.4	22.2	**0**
Household size					
≤3 members	1.0	15.4	8.1	0	**1.2**
4-6 members	3.9	16.7	20.3	3.2	**2.4**
≥7 members	95.1	67.9	71.6	96.8	**96.4**
Land size					
Landless	0	20.5	1.4	3.2	**61.2**
<1 hectare	27.5	51.3	40.5	14.3	**9.4**
1-2 hectares	26.5	17.9	32.4	28.6	**10.6**
>2 hectares	46.1	10.3	25.7	54.0	**18.8**
Household headship					
Women	13.7	16.7	18.9	7.9	**17.6**
Men	86.3	83.3	81.1	92.1	**82.4**
Wealth index[c]					
Poor (0-3 assets)	60.8	3.8	4.1	52.4	**34.1**
Better-off (4-6 assets)	39.2	84.6	87.8	47.6	**63.5**
Rich (≥7 assets)	0	11.6	8.1	0	**2.4**

[a] Number of households that provided responses.

[b] No formal schooling and non-responses.

[c] Wealth index based on nine different household assets.

Source: Based on survey data collected in the field.

3.2 Dietary profiles

The results in table 2 represent dietary profiles at household and individual (women and children) levels. Household data were collected from 402 respondents, and as all households had female members of reproductive age (15-49 years), a total of 402 responses were also collected for MDD-W. The total number of respondent children (through their mothers) for MDD-C was 227, distributed by project as follows: PROMER=88; UTaNRMP=18; SDCP=22; S3P=46; SAPP=53.

The HDDS shows generally better results compared with the MDD-C and MDD-W. A smaller proportion of respondents had poor dietary diversity at the household level: the UTaNRMP, SDCP and S3P showed proportions of 9.0, 2.7 and 0 per cent, respectively. On the other hand, the proportion of poor dietary diversity at individual levels was high in all projects. Women with a poor MDD-W (<5 food groups) represent more than 30 per cent. The proportion becomes even worse for children across all projects: 50 per cent had <4 food groups. The SAPP and UTaNRMP showed higher proportions of poor MDD-C (at 99 and 87 per cent, respectively).

3.3 Nutrition-sensitive activities and perceived benefits

Table 3 shows project nutrition-sensitive interventions, which refer to the interdependent relationships that connect project activities and nutrition at household and individual levels. The study showed that integrated nutrition-focused activities, as well as key project investment activities – such as production diversification, women's empowerment, commercialization and good markets – were reported to have indirect effects on dietary profiles. Although some projects were just beginning to implement the integrated nutrition-focused activities, an attempt was made to collect data on beneficiaries' perceptions of the changes brought about by these projects.

Table 2 Percentage distribution of respondents by dietary diversity score for households, women and children

Variable	Project name				
	PROMER (n=102)	UTaNRMP (n=78)	SDCP (n=74)	S3P (n=63)	SAPP (n=85)
Household dietary diversity score (HDDS)					
Poor diet diversity (DDS <4)	36.3	9.0	2.7	0	30.6
Good diet diversity (DDS 5-8)	44.1	76.9	58.1	0	65.9
Very good diet diversity (DDS >8)	19.6	14.1	39.2	100.0	3.5
Minimum dietary diversity for women (MDD-W)					
Poor diet diversity (DDS <5)	77.5	66.7	36.5	41.3	67.1
Good diet diversity (DDS ≥5)	22.5	33.3	63.5	58.7	32.9
Minimum dietary diversity for children 6-23 months (MDD-C)					
Poor diet diversity (DDS <4)	67.6	87.2	83.8	52.4	98.8
Good diet diversity (DDS ≥4)	32.4	12.8	16.2	47.6	1.2

Source: Based on survey data collected in the field.

Table 3 Nutrition-sensitive interventions since project implementation (n=335)[a]

Changes influenced by project	Project name				
	PROMER (n=101)	UTaNRMP (n=78)	SDCP (n=74)	S3P (n=62)	SAPP (n=20)
Production and diversification	83.3	97.4	90.5	96.8	**12.5**
Commercialization and marketing	78.4	53.8	62.2	93.5	**0**
Household food-security profile	66.7	91.0	93.2	88.7	**12.5**
Maternal and child nutritional status	71.6	53.8	24.3	83.9	**0**
Women's empowerment	58.8	50.0	71.6	88.7	**12.5**
Savings practices and income generation	64.7	83.3	87.8	90.3	**12.5**
Knowledge of health and nutrition	71.6	50.0	17.6	85.5	**12.5**
Training events on food preparation and recipe development	**61.8**	**30.8**	**20.3**	**82.3**	**0**

[a] Total number of respondents/households.

Source: Based on survey data collected in the field.

3.4 Influence of project interventions on dietary diversity – multivariate analyses

The three MCA tables below provide: Eta (ή), which indicates the ability of a predictor, using the categories given, to explain variations in the dependent variable; Eta squared ($ή^2$), which is the correlation ratio indicating the proportion of the total sum of squares explainable by the predictor; Beta and Beta squared (β and β^2), which are directly analogous to the Eta statistics, but are based on the adjusted means rather than the raw means, and provide a measure of the ability of the predictor to explain variation in the dependent variable after adjusting for the effects of all other predictors. Thus heterogeneity within the data is controlled, but other possible factors existing outside the data cannot be controlled in this study. The multiple correlation coefficient squared (unadjusted for degree of freedom) indicates the proportion of variance explained by the whole model, and the multiple correlation coefficient squared (R^2 – adjusted for degree of freedom) indicates the proportion of variance in the dependent variable explained by all predictors. The study included eight best-fitting predictors for each of the three groups (household, women and children) based on a review of the literature.

The eight predictor factors used as determinants of the dietary diversity score are: household size, literacy status, headship, women's empowerment, asset/wealth index, capacity-building, market linkages and diversification support services.

MCA results showed that diversification support services had the greatest absolute influence on dietary diversity among households. The HDDS obtained for households reporting a greater number of such services was 9.15, compared with 6.21 for households with fewer services. It also varied significantly according to market linkages, women's empowerment, capacity-building and literacy status. A household head with literate status had a significantly

Table 4 Results of multiple classification analysis (MCA) for key determinants of the household dietary diversity score (HDDS) by selected predictors and covariates (n=398)

Variable	Mean DDS					
	n	Unadjusted mean	Eta (ή)	Adjusted mean	Beta (β)	Sig
Household size			.067		.099	.329
0-3 members	16	6.25		5.77		
4-6 members	36	7.36		7.19		
7 and above members	346	7.24		7.28		
Literacy status of respondents			.158		.084	.000[a]
Literate	300	7.48		7.35		
Illiterate	98	6.39		6.77		
Headship			.099		.011	.055
Women	57	6.49		7.13		
Men	341	7.33		7.22		
Wealth index (asset-based)			.100		.072	.615
Poor	30	6.30		6.62		
Medium	39	6.85		6.86		
Better-off	329	7.33		7.30		
Capacity-building activities			.290		.049	.000[a]
Low	137	6.17		7.17		
Medium	108	7.15		7.02		
High	153	8.18		7.38		
Market linkage services provided			.362		.266	.000[a]
Low market linkages	123	5.76		6.14		
Good market linkages	144	7.33		7.30		
Very good market linkages	131	8.44		8.11		
Women's empowerment services			.169		.248	.050[b]
Very poor	212	6.78		7.82		
Mild	79	7.33		6.93		
Moderate	45	8.02		6.72		
High	62	7.92		5.82		
Diversification support services			.392		.348	.000[a]
Very poor	159	5.99		6.21		
Mild	116	7.27		7.10		
Moderate	70	8.37		8.18		
High	53	9.19		9.15		

R=0.48; R^2=0.23; grand mean=7.21; number of cases=398.

[a] Significant at ά .001; [b] significant at ά .05.

Source: Based on survey data collected in the field.

higher HDDS (7.35) compared with an illiterate head (6.77). Households receiving more capacity-building services had a better HDDS than those with fewer services. Similarly, a higher HDDS was found among households reporting very good market linkage services than among those without such services (8.11 and 6.14, respectively). This finding is consistent with the reported low employment and educational status among respondents in the PROMER and SAPP and their relatively higher proportions of poor dietary diversity at the household level (36 and 31 per cent, respectively – see table 2).

In the MDD-W category (table 5), there are far more predictors affecting the DDS, including household size (probability [p]=0.000), literacy status (p=0.000), wealth index (p=0.040), capacity-building activities (p=0.052), market linkages provided (p=0.003), women's empowerment services (0.011) and diversification support services (0.001). Taking the beta (β) coefficients as indicators, literacy and household size are the strongest predictors compared with the other five predictors included in the model. Larger-sized households (7 or more members) have a significantly higher mean DDS (4.95) compared with medium-sized and small households (1.67 and 1.08, respectively). Those with illiterate household heads had a mean DDS of 3.39 compared with literate household heads (4.86). In terms of the asset-based wealth index, richer households had an adjusted mean DDS of 4.69, whereas poor households' mean score was 3.49. Households receiving very good market linkage services had a mean DDS of 4.86 compared with those with fewer services. Similarly, those households receiving more diversification support services had a higher mean DDS (5.93) compared with those with very poor (4.83), mild (4.28) and moderate services (3.03).

Mean scores for the MDD-C category are generally very low across all variables (table 6). Five variables seem to predict the dependent variable of interest: household size (p=0.000), headship (p=0.029), wealth index (p=0.024), capacity-building activities (p=0.000) and market linkages provided (p=0.003). Having a larger-sized household is still the marker of a better mean DDS, where those with 7 or more household members had an adjusted mean score of 2.0 compared with medium- and small-sized households (0.64 and 0.90, respectively). The adjusted mean score for headship by women was 0.99, while the computed mean for headship by men was 1.89. Similarly, those households receiving better services in women's empowerment and market linkages had a higher adjusted mean score compared with those receiving fewer services.

Table 5 Results of multiple classification analysis (MCA) for the key determinants of the women's minimum dietary diversity score (MDD-W) by selected predictors and covariates (n=398)

Variable	Mean DDS					
	n	Unadjusted mean	Eta (ή)	Adjusted mean	Beta (β)	Sig
Household size			**.275**		**.285**	**.000[a]**
0-3 members	16	.8750		1.08		
4-6 members	36	1.9444		1.67		
7 and above members	346	4.9335		4.95		
Literacy status of respondents			**.170**		**.154**	**.000[a]**
Literate	300	4.9000		4.86		
Illiterate	98	3.2755		3.39		
Headship			**.065**		**.027**	**.527**
Women	57	3.8421		4.22		
Men	341	4.6100		4.55		
Wealth index (asset-based)			**.136**		**.101**	**.040[b]**
Poor	30	2.9667		3.49		
Medium	39	3.5641		3.67		
Better-off	329	4.7508		4.69		
Capacity-building activities			**.116**		**.153**	**.052[b]**
Low	137	5.1168		3.94		
Medium	108	3.9259		4.21		
High	153	4.3529		5.35		
Market linkage services provided			**.185**		**.065**	**.003[c]**
Low market linkages	123	4.9919		4.43		
Good market linkages	144	3.4931		4.23		
Very good market linkages	131	5.1450		4.86		
Women's empowerment services			**.158**		**.169**	**.011[b]**
Very poor	212	4.3208		4.06		
Mild	79	3.6582		4.14		
Moderate	45	5.6889		5.86		
High	62	5.3226		5.47		
Diversification support services			**.265**		**.205**	**.001[c]**
Very poor	159	4.9371		4.83		
Mild	116	3.8017		4.28		
Moderate	70	3.0571		3.03		
High	53	6.6226		5.93		
Constant						**.000**

R=0.47; R^2=0 .22; grand mean=4.52; number of cases=398.

[a] Significant at ά .001; [b] significant at ά .05; [c] significant at ά .01.

Source: Based on survey data collected in the field.

Table 6 Results of multiple classification analysis (MCA) for the key determinants of the children's minimum dietary diversity score (MDD-C) by selected predictors and covariates (n=398)

Variable	Mean DDS					Sig
	n	Unadjusted mean	Eta (ή)	Adjusted mean	Beta (β)	Sig
Household size			**.213**		**183**	**.000[a]**
0-3 members	20	.00		.64		
4-6 members	36	.028		.90		
7 and above members	346	2.04		2.00		
Literacy status of respondents			**.024**		**.031**	**.372**
Literate	304	1.81		1.82		
Illiterate	98	1.62		1.58		
Headship			**.134**		**.099**	**.029[b]**
Women	61	.72		.99		
Men	341	1.95		1.89		
Wealth index (asset-based)			**.128**		**.121**	**.024[b]**
Poor	130	2.33		2.29		
Medium	255	1.54		1.56		
Better-off	17	.76		2.47		
Capacity-building activities			**.325**		**.216**	**.000[a]**
Low	138	.62		.88		
Medium	109	1.37		1.76		
High	155	3.06		2.54		
Market linkage services provided			**.280**		**.191**	**.003[c]**
Low market linkages	124	.73		1.06		
Good market linkages	145	1.51		1.59		
Very good market linkages	133	2.99		2.60		
Women's empowerment services			**.244**		**.105**	**.127**
Very poor	213	1.23		1.81		
Mild	80	1.38		1.18		
Moderate	46	3.02		2.41		
High	63	3.11		1.86		
Diversification support services			**255**		**.097**	**.382**
Very poor	161	1.12		2.04		
Mild	117	1.44		1.46		
Moderate	71	2.38		1.37		
High	53	3.58		2.10		

R=0.45; R^2=0.20; grand mean=2.17.

[a] Significant at ά .001; [b] significant at ά .05; [c] significant at ά .01.

Source: Based on survey data collected in the field.

4 Discussion

This study has primarily aimed to explore influencing factors in IFAD-funded projects on dietary profiles at household and individual levels, based on data collected from five projects in three countries. It is not an impact evaluation, but the reported findings on dietary profile can suggest the likelihood and potential effect of project interventions on beneficiaries' dietary intake.

Dietary diversity is considered a key outcome of nutrition-sensitive agriculture. It was adopted to measure the influence of project interventions on the dietary profile, which has implications for nutrition outcomes for project beneficiaries. Changes/improvement in dietary diversity were measured at individual (women of reproductive age and children) and household levels.

Notably, this study found that dietary diversity among women and children is generally low, with only a small proportion consuming the acceptable number of food groups (≥5 food groups for MMD-W and ≥4 food groups for MDD-C). The implications of this finding are twofold. First, it indicates that there are intrahousehold differences in food access. Second, it may also imply that poor dietary diversity may in the long run result in more-complex nutritional outcomes, especially during conception and pregnancy and up to the second birthday (the first 1,000 most-critical days). In most cases, especially in the context of poor rural farming communities, children and their mothers do not have the same meal composition (Amugsi, Mittelmark and Oduro 2015; Skafida 2013). Recent studies in African communities reported substantial differences in intrahousehold food distribution (Tsegaye et al. 2015), which translate into some household members having better access to specific food items than others. The findings suggest that programmes of this kind should use separate output and outcome measures for the two groups to gauge the envisaged changes that such interventions bring to households and vulnerable individuals.

Multivariate analysis adopted the MCA model to present the key project interventions as variables explaining dietary diversity among project beneficiaries. A simple trickle-down approach was assumed in this analysis, through the perception of mutual relationships between nutrition and agriculture at household and individual levels. A review of the effects of rural agricultural involvement by rural Malawian households adopted a similar simplified trickle-down approach and reported increased food consumption and greater dietary diversity with agricultural involvement (IFAD 2016). The three multivariate analyses taken together revealed that the DDS is a function of household sociodemographic and project intervention factors such as literacy status, household size, headship, wealth index, capacity-building activities, and market linkage and diversification support services.

The analysis indicated that production diversity is strongly associated with the DDS in both the household and women's categories (p=0.000 and p=0.001, respectively). The effects of production on dietary diversity are plausible, because much of what smallholder farmers produce is consumed at home. Previous studies conducted in developing societies also reported that diversifying production on smallholder farms is often perceived as a useful approach to improving dietary diversity and nutrition (Jones, Shrinivas and Bezner-Kerr 2014; Pellegrini and Tasciotti 2014). As was demonstrated in table 3, the most important benefits reported by a great majority of beneficiaries were increased productivity and diversification. Most projects work through changing supply and demand and reducing the cost of food commodities for the poor, including nutritious foods, as shown in the SDCP. In addition, production raises household income relatively for net consumer households by reducing food prices, which literally improves access to food. Beneficiaries of the SDCP reported that milk production showed a dramatic increase (perceived as excess at the household level), which resulted in more sales and consequently more purchasing power. Thus households could afford to buy more food that would otherwise have been unaffordable. For example, respondents said they can now afford to buy meat more frequently.

Diversifying production on these farms is often perceived as a promising strategy for improving dietary quality and diversity. Several recent development efforts have promoted smallholder farm production diversification through introducing additional crop and livestock species to improve household diet diversity and nutritional status (Burlingame and Dernini 2012). A cross-section survey of farm households in Ethiopia, Indonesia, Kenya and Malawi documented that higher farm production diversity contributes significantly to dietary diversity in situations where food security is a prime concern (Sibhatu, Krishna and Qaim 2015). However, the results of this study and available evidence indicate that focusing exclusively on agricultural production can only guarantee increased household income and has very limited scope for improving the nutritional profiles of women, children and households.

Project interventions to create market access have witnessed a clear influence on all three DDS categories (household, women and children). This corroborates and supports the notion that better market access through reduced distances could contribute to higher dietary diversity. More-commercialized farms producing cash crops for the market have more-diverse diets than subsistence farms on average. Households with higher cash incomes tend to buy more-diverse foods (Sibhatu, Krishna and Qaim 2015; Jones, Shrinivas and Bezner-Kerr 2014).

The wealth index seems to be an important determinant of DDS for women and children, unlike at the household level, indicating that poverty puts more pressure on these two vulnerable groups than on other family members. Multiple studies in low-income societies have documented the inverse association between poverty and diet diversity (Melgar-Quinonez et al. 2006).

As women's empowerment is observed to be an important determinant of dietary diversity at the household level and among women, it follows that interventions that increase women's empowerment contribute to improving child nutrition as well as women's own well-being. FAO, IFAD and the World Bank report that the goal of feeding the world cannot be realized without the contribution of women, who make up a significant part of the labour force (FAO 2011; World Bank, FAO and IFAD 2009). Similarly, Mosse (1993) emphasized the significant contribution of women to agriculture and to any development activity. For instance, women who receive capacity-building training and have access to land may have to decide whether to consume produce at home or to sell. Allendorf (2007) has shown that women with access to resources had better decision-making power at household levels and provided better care for children. Within local, national and regional communities, given that there are often specific nutritionally at-risk groups that suffer from insufficient availability of and access to nutritious food, nutrition-sensitive agriculture adopts approaches that recognize the specific vulnerability of these groups (Detlef 2013). This finding may suggest that empowering women by building their knowledge, employment opportunities, land rights and access to resources can further help reduce the gender gap, thus enhancing nutritional outcomes for women and children.

The literacy status of women and the capacity-building activities undertaken by projects appear to have significantly influenced ($p<0.05$) the diet diversity profiles at all three levels (i.e. households, women and children). These variables have a huge leverage particularly on decision-making and autonomy, which may translate into impact on dietary diversity scores. Previous studies have documented an association of decision-making with minimum meal frequency. In a previous study, children of mothers involved in decision-making in the household were 1.5 times more likely to meet their recommended meal frequency, as compared with children of mothers not involved in decision-making (Patel et al. 2012).

The key message of this analysis is that nutrition-sensitive interventions in agricultural and rural development projects pass through multiple pathways, including market access, capacity-building, active involvement of women and empowerment. A holistic approach involving more than a single sector should be used if an agricultural and rural development project/programme intends to impact the dietary and nutritional profiles of vulnerable groups.

5 Conclusions

This paper has examined the current status of agricultural and rural development investment projects and how project interventions trickle down to influence dietary profile at both individual and household levels. It was noted that most of the projects studied have brought about a number of quantitative changes in the lives of beneficiaries in terms of increasing and diversifying agricultural production and household income. The study group takes the position that interventions to support food production and income growth, acquisition of skills through capacity-building and women's empowerment with a nutrition focus provide the major opportunities for a positive influence on the dietary profile of households and their individual members.

Finally, this study is not without limitations. The present analysis is based mainly on data collected from 402 beneficiaries in five case studies, which may reduce its generalizability to all projects in ESA countries. There might have been some self-selection bias and omission and commission errors during data collection. We suggest that future research focus on collecting time series data from more projects to determine their respective changes and impacts.

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