

Farm Diversification and Food and Nutrition Security in Bangladesh: Empirical Evidence from a Nationally Representative Household Panel Data

Kathmandu, Nepal

12 July, 2017

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Funded by:



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Research on Agriculture and Health

Outline of Presentation

- Background and motivation
- Methodology
- Major findings
- Conclusion

Introduction-I

- Despite major success, 795 million people– just over one in nine – are undernourished, nearly two thirds of them living in the Asia and the Pacific region (FAO, WFP and IFAD, 2015).
- About 2 billion people suffer from micronutrient malnutrition and nearly 800 million people suffer from calorie deficiency (IFPRI, 2016).
- Malnutrition is responsible for a large health burden in terms of lost productivity, impaired physical and mental human development, various diseases, and premature deaths etc. (Lim et al., 2012)
- Malnutrition is the result of low food intake, and poor dietary quality and diversity.
- Numerous research shows dietary diversity is link with better nutrition and health.

Introduction-II

- Thus agricultural production needs to be diversified but over the few decades, agricultural commercialization and modernization has contributed to narrowing the number of crops grown in the world (Khoury et al., 2014).
- Different research and programs are advocating for farm diversification as it can improve dietary diversity, nutrition and environment (Sibhatu et al., 2015).
- Like many other developing countries, Bangladesh agriculture has experienced structural transformation. Rahman (2009), stated that crop diversification is the desired strategy for agricultural growth in Bangladesh.
- But is there a clear link and what are the other confounders?

Data and Methods-I

- **Two round panel data** from IFPRI- BIHS.
- BIHS is the most comprehensive, **nationally representative** household survey ever conducted in Bangladesh.
- The **first round was in 2011/12**, and the **second round in 2015**. The survey was administered to the same sample of households.
- **Data set is representative** at various levels: across all of **rural Bangladesh**; throughout all seven of the country's **administrative divisions** (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet); and at USAID-supported **Feed the Future (FTF) zone**.
- Sampling design: **stratified sampling** design in **two stages**—selection of PSUs and selection of households within each PSU—using the **sampling frame** developed from the community series of the **2001 population census**.
- **Attrition** between 2011/12 and 2015 was exceptionally low, at **just 1.26 percent per year**.

Data and Methods-II

- To investigate the relationship between farm production diversity and HH dietary diversity we estimate the following equation:
- $DS_{it} = \beta X_{it} + \gamma Z_i + \alpha_i + \mu_t \dots\dots\dots(1)$
- where X_{it} and Z_i are vectors of time-variant and time-invariant exogenous variables, with β and γ as the respective vectors of coefficients to be estimated. α_i and μ_t represent unobserved individual and time-specific effects, respectively.
- As our all outcome variables are count variables, Poisson distribution is assumed. Thus the equation (1) is estimated using **conditional maximum likelihood Poisson fixed effect model**.

Results: Descriptive statistics of dependent variables

Variable	Description	Round 1 (2011/12)		Round 2 (2015)		Mean diff.
		Mean	Std. Dev.	Mean	Std. Dev.	
HH Dietary diversity score (HDDS)	Number of food groups consumed (from 12 food group) in the last 7 days	8.964	1.814	9.810	1.631	0.846***
HH Dietary diversity score (HDDS) of healthy foods	Number of healthy food groups consumed (from 9 food group) in the last 7 days	6.285	1.579	7.025	1.440	0.740***
Food variety score	Number of food items consumed in the last 7 days	28.583	8.641	33.924	9.742	5.341***
Purchase food variety score	Number of purchased food items consumed in the last 7 days	19.838	6.539	21.978	7.477	2.140***
HH Purchase foods Dietary diversity score	Number of food groups consumed (from 12 food group) only with respect to purchased foods in the last 7 days	7.485	2.028	7.291	2.170	-0.194***

Results: Descriptive statistics of Key independent variables

Variable	Description	Round 1 (2011/12)		Round 2 (2015)		Mean diff.
		Mean	Std. Dev.	Mean	Std. Dev.	
Key independent variables						
Production diversity	Number of crop species produced in the last year	4.294	3.886	5.224	3.389	0.930***
Food crop production diversity	Number of food crop species produced in the last year	4.158	3.783	4.720	3.552	0.562***
Production diversity index	Margalef species richness index	0.106	1.240	0.324	1.052	0.218***
Fish production status	=1 if HH produced any fish species	0.352	0.478	0.265	0.441	-0.088***
Livestock rearing status	=1 if HH reared any livestock species	0.820	0.385	0.825	0.380	0.005
Number of observations		6503		6435		

Other variables are: Market distance, HH Off-farm income, Share of produce sold, Age of HH head, Sex of HH head, Education of HH head, Household (HH) size, Farm size , Female earning status.

FE Results: Association between farm production diversity and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity	0.019***	0.002
Production diversity squared	-0.001***	0.000
HH Dietary diversity score (HDDS) of healthy foods		
Production diversity	0.023***	0.002
Production diversity squared	-0.001***	0.000
HH Purchase foods Dietary diversity score		
Production diversity	-0.003	0.002
Production diversity squared	0.000	0.000
Food variety score		
Production diversity	0.044***	0.004
Production diversity squared	-0.002***	0.000
Purchase food variety score		
Production diversity	0.028***	0.003
Production diversity squared	-0.001***	0.000

*, **, *** Statistically significant at the 10%, 5%, and 1% level, respectively

FE Results: Association between farm production diversity and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity index	0.023***	0.003
Production diversity index squared	-0.002**	0.001
HH Dietary diversity score (HDDS) of healthy foods		
Production diversity index	0.027***	0.004
Production diversity index squared	-0.003***	0.001
HH Purchase foods Dietary diversity score		
Production diversity index	-0.012***	0.004
Production diversity index squared	0.002***	0.001
Food variety score		
Production diversity index	0.051***	0.006
Production diversity index squared	-0.006***	0.002
Purchase food variety score		
Production diversity index	0.031***	0.005
Production diversity index squared	-0.003***	0.001

*, **, *** Statistically significant at the 10%, 5%, and 1% level, respectively

FE Results: Association between farm production diversity and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Food crop production diversity	0.0138***	0.0015
Food crop production diversity squared	-0.0004***	0.0001
HH Dietary diversity score (HDDS) of healthy foods		
Food crop production diversity	0.0160***	0.0019
Food crop production diversity squared	-0.0005***	0.0001
HH Purchase foods Dietary diversity score		
Food crop production diversity	-0.0035*	0.0020
Food crop production diversity squared	0.0002*	0.0001
Food variety score		
Food crop production diversity	0.0338***	0.0030
Food crop production diversity squared	-0.0013***	0.0002
Purchase food variety score		
Food crop production diversity	0.0214***	0.0026
Food crop production diversity squared	-0.0009***	0.0002

*, **, *** Statistically significant at the 10%, 5%, and 1% level, respectively

FE Results: Farm production diversity, market access, off-farm income and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity	0.0178***	0.0020
Production diversity squared	-0.0006***	0.0001
Market distance	-0.0054***	0.0021
[Production diversity] x [Market distance]	0.0004	0.0003
HH Off-farm income	2.03E-07***	7.00E-08
[Production diversity] x [HH Off-farm income]	9.69E-12	8.78E-09

FE Results: Farm production diversity, **market participation**, market access, off-farm income and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity	0.0169***	0.0019
Production diversity squared	-0.0006***	0.0001
Market distance	-0.0053***	0.0021
[Production diversity] x [Market distance]	0.0003	0.0003
HH Off-farm income	2.07E-07***	6.96E-08
[Production diversity] x [HH Off-farm income]	-1.93E-09	8.75E-09
Share of produce sold	0.0005***	0.0002
[Production diversity] x [Share of produce sold]	1.31E-05	2.02E-05

FE Results: Farm production diversity, market participation, market access, off-farm income, **gender** and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity	0.0166***	0.0019
Production diversity squared	-0.0005***	0.0001
Market distance	-0.0050**	0.0021
[Production diversity] x [Market distance]	0.0003	0.0003
HH Off-farm income	2.03E-07***	6.71E-08
[Production diversity] x [HH Off-farm income]	-2.65E-09	8.53E-09
Share of produce sold	0.0005***	0.0002
[Production diversity] x [Share of produce sold]	1.41E-05	2.03E-05
Female earning status	0.0406***	0.0076
[Production diversity] x [Female earning status]	-0.0017	0.0012

FE Results: Farm production diversity, market participation, market access, off-farm income, gender, livestock and fish production status and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity	0.0183***	0.0025
Production diversity squared	-0.0005***	0.0001
Market distance	-0.0050**	0.0021
[Production diversity] x [Market distance]	0.0003	0.0003
HH Off-farm income	2.04E-07***	6.68E-08
[Production diversity] x [HH Off-farm income]	-2.96E-09	8.43E-09
Share of produce sold	0.0005***	0.0002
[Production diversity] x [Share of produce sold]	1.46E-05	2.04E-05
Female earning status	0.0358***	0.0078
[Production diversity] x [Female earning status]	-0.0011	0.0012
Fish production status	-0.0236***	0.0089
Livestock rearing status	0.0274***	0.0108
[Production diversity] x [Livestock rearing status]	-0.0028	0.0022
[Production diversity] x [Fish production status]	0.0011	0.0013

FE Results: Farm production diversity, market participation, market access, off-farm income, gender, socio-economics characteristics of individual and HH and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity	0.0136***	0.0024
Production diversity squared	-0.0003***	9.27E-05
Market distance	-0.0046**	0.0020
[Production diversity] x [Market distance]	0.0002	0.0003
HH Off-farm income	1.37E-07***	4.76E-08
[Production diversity] x [HH Off-farm income]	-4.76E-09	6.79E-09
Share of produce sold	0.0005***	0.0002
[Production diversity] x [Share of produce sold]	-2.4E-05	2.03E-05
Female earning status	0.0277***	0.0075
[Production diversity] x [Female earning status]	-0.0009	0.0012
Fish production status	-0.0157*	0.0087
Livestock rearing status	0.0252**	0.0105
[Production diversity] x [Livestock rearing status]	-0.0026	0.0022
[Production diversity] x [Fish production status]	0.0013	0.0012
Age of HH head	0.0022***	0.0005
Sex of HH head	-0.0140	0.0105
Education of HH head	0.0151***	0.0048
Household (HH) size	0.0398***	0.0026
Farm size	1.96E-05	3.78E-05
Farm size squared	-7.64E-09	2.41E-08

Robustness of FE Results: Farm production diversity index (**Margalef index**) market participation, market access, off-farm income, gender, socio-economics characteristics of individual and HH and HH dietary diversity

HH Dietary diversity score (HDDS)	Coef.	Robust Std. Err.
Production diversity index (Margalef)	0.011629**	0.00584
Production diversity index squared	-0.0007	0.000648
Market distance	-0.00323***	0.001258
[Production diversity index] x [Market distance]	-0.00163	0.001159
HH Off-farm income	1.20E-07***	2.96E-08
[Production diversity index] x [HH Off-farm income]	-1.79E-08	2.11E-08
Share of produce sold	0.000334***	9.86E-05
[Production diversity index] x [Share of produce sold]	-2.6E-05	9.07E-05
Female earning status	0.024568***	0.004741
[Production diversity index] x [Female earning status]	0.007819**	0.003951
Fish production status	-0.00836	0.00564
Livestock rearing status	0.018217***	0.007214
[Production diversity index] x [Livestock rearing status]	-0.0035	0.005699
[Production diversity index] x [Fish production status]	0.006043	0.004213
Age of HH head	0.002339***	0.000458
Sex of HH head	-0.0154	0.010525
Education of HH head	0.015918***	0.004855
Household (HH) size	0.042002***	0.00264
Farm size	4.79E-05	3.92E-05
Farm size squared	-2.20E-08	2.32E-08

Robustness of FE Results: Farm production diversity index(Margalef index) market participation, market access, off-farm income, gender, socio-economics characteristics of individual and HH and **HH food variety score**

Food variety score	Coef.	Robust Std. Err.
Production diversity	0.028814***	0.004217
Production diversity squared	-0.00089***	0.000214
Market distance	-0.00203	0.002964
[Production diversity] x [Market distance]	-0.0001	0.00046
HH Off-farm income	3.79E-07***	1.22E-07
[Production diversity] x [HH Off-farm income]	-1.92E-08	1.47E-08
Share of produce sold	0.000724***	0.000241
[Production diversity] x [Share of produce sold]	-3.2E-05	3.34E-05
Female earning status	0.065541***	0.011843
[Production diversity] x [Female earning status]	0.001562	0.001987
Fish production status	0.017103	0.013198
Livestock rearing status	0.022225	0.016173
[Production diversity] x [Livestock rearing status]	-0.00347	0.003493
[Production diversity] x [Fish production status]	-0.0012	0.001951
Age of HH head	0.004442***	0.000735
Sex of HH head	-0.00514	0.015676
Education of HH head	0.028409***	0.007007
Household (HH) size	0.079433***	0.004215
Farm size	0.000123*	6.71E-05
Farm size squared	-6.41E-08	6.00E-08

Conclusion and Policy Implications

- Higher farm production diversity is **positively associated** with household nutrition needs. BUT
- It is not sufficient or not always the best strategy to improve household nutrition (non linear relation) .
- Thus future policy and programs should focus on improving farm diversification to certain extent along with facilitating market access, income diversification towards off farm income and women empowerment.

THANK YOU FOR YOUR ATTENTION !



Appendix

Variable	Description	Round 1 (2011/12)		Round 2 (2015)		Mean diff.
		Mean	Std. Dev.	Mean	Std. Dev.	
Other variables						
Market distance	from home to nearby market distance (Kilometer)	1.723	1.691	1.687	1.860	-0.037
HH Off-farm income	Taka per year	47329.170	74716.360	67138.700	98263.600	19809.530* **
Share of produce sold	Share of production sold to the market (%)	13.721	20.365	21.805	30.285	8.084***
Age of HH head	Years	44.252	13.948	45.763	13.837	1.511
Sex of HH head	1 if Male HH head; otherwise 0	1.177	0.382	1.189	0.391	0.011
Education of HH head	Years of Schooling	2.714	1.265	2.789	1.254	0.075
Household (HH) size	Number of people in the HH	4.196	1.628	4.958	1.998	0.762
Farm size	HH Total land (decimal)	62.416	122.482	83.548	131.539	21.132***
Female earning status	1 if main female of the HH earns money; otherwise 0	0.588	0.492	0.739	0.439	0.151***
Number of observations		6503		6435		