Behavioral change investment through food hygiene education: impacts on water quality, sanitation, hygiene and health in rural households of north-western Bangladesh- a Randomized Controlled Trial (RCT) experiment

Mohammad Monirul Hasan
Center for Development Research (ZEF), University of Bonn
mhasan@uni-bonn.de

Nicolas Gerber
Center for Development Research (ZEF), University of Bonn
ngerber@uni-bonn.de

EuHEA Conference 2016
Universität Hamburg
July 13-16, 2016

Problem Statement

- **91% of the world's population** do have access to improved drinking water sources (United Nations, 2015). But does improved source ensure water quality at POU??

- **Water quality** at the point of source (POS) and at the point of use (POU) differs because of improper handling during transportation (Wright et al. 2004; Günther & Schipper 2013).

- Contaminated water either at POS or POU is one of the main cause of **diarrhea** (Nath et al. 2006; Zwane & Kremer 2007; Prüss et al. 2002; Prüss-Üstün et al. 2008). **Diarrhea** has a long-term negative impact on **cognitive development** in young children (Keusch et al. 2006).

- **Food hygiene** in the households can be affected by water quality and hygiene practices throughout the food preparation, processing, serving and storing.

Problem Statement

- Provision of improved water access do not necessarily produces positive health impact (Hasan & Gerber 2016; Devoto et al. 2012; Klasen et al. 2012) or limited impact shown in (Waddington et al. 2009; Zwane & Kremer 2007; Wright et al. 2004).

- Despite having improved drinking water infrastructure, households in the north-western Bangladesh re-contaminate water because of improper hygiene. 78% households are found positive in *E. coli* in 100 ml drinking water and 60% HH in food preparing utensils.

- Hand washing with soap is inadequate in the study area: 68% HH does after coming from toilet and only 3% HH does before eating food.

- When consumers underestimate the health benefit of certain behavior, the natural response is to provide them the information of the **prevention measures** (Kremer & Glennerster 2011).

Research question

To what extent food hygiene education (FHE) impacts on water and food safety, sanitation, hygiene and health in rural households of north-western Bangladesh?
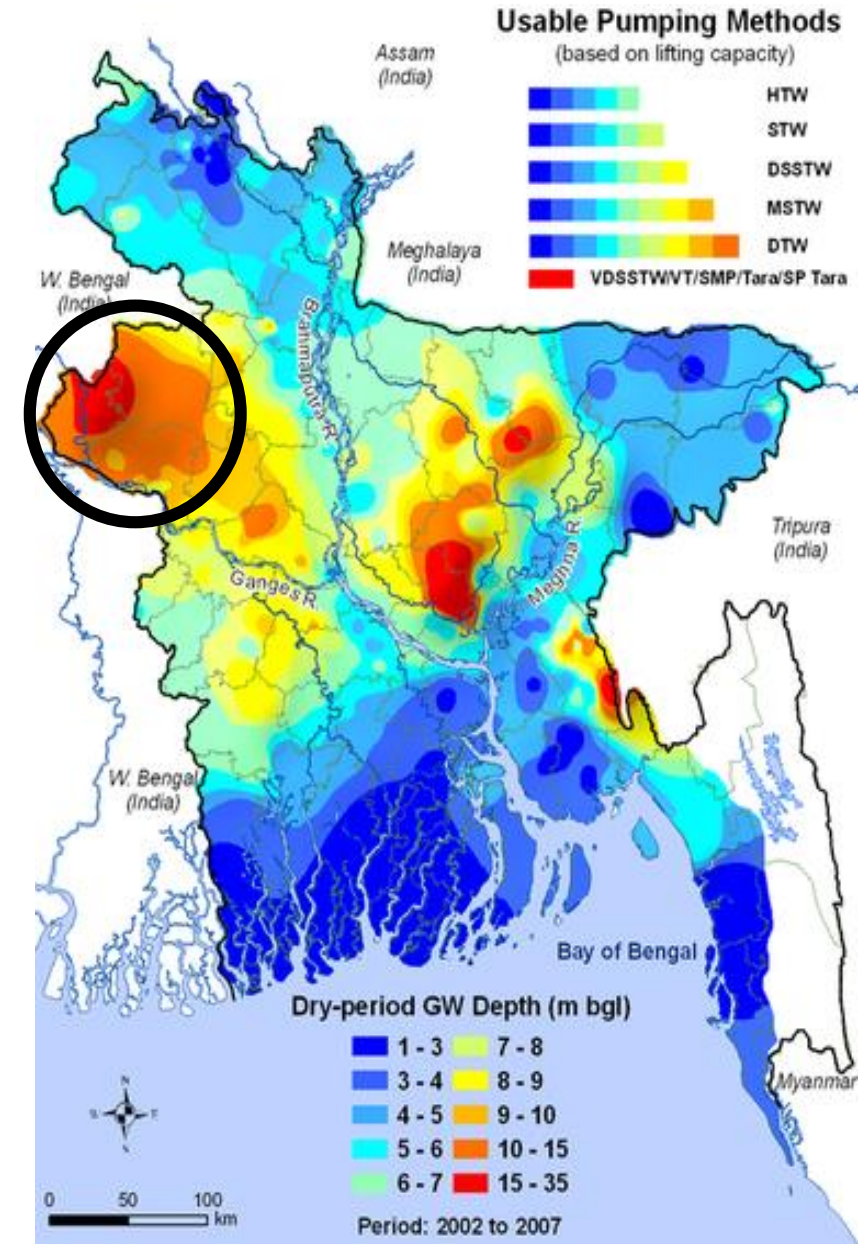

source: Shamsudduha, Taylor, Ahmed, and Zahid (2011)

4

Contribution of this paper

- The impact of food hygiene education in the development economics literature is very limited and almost absent and especially no trial of food hygiene interventions are available (Curtis et al. 2011; DFID 2013).

- A longitudinal study in **Vietnam** reported that risk of child diarrhoea was significantly higher for those mothers who prepared food not on table than who used table (Takanashi et al. 2009).

- A cross sectional study in **Indonesia** highlighted the role of food hygiene maintenance in lowering diarrhoea incidence in low-socioeconomic people (Agustina et al. 2013). But the study suffers from endogeneity issues.

- To our knowledge, we are the first to analyse the stand-alone impact of Food Hygiene Education (FHE) providing the households with microbiological test results of water and kitchen utensils, training and a poster in a marginalized rural setting.

Conceptual Framework
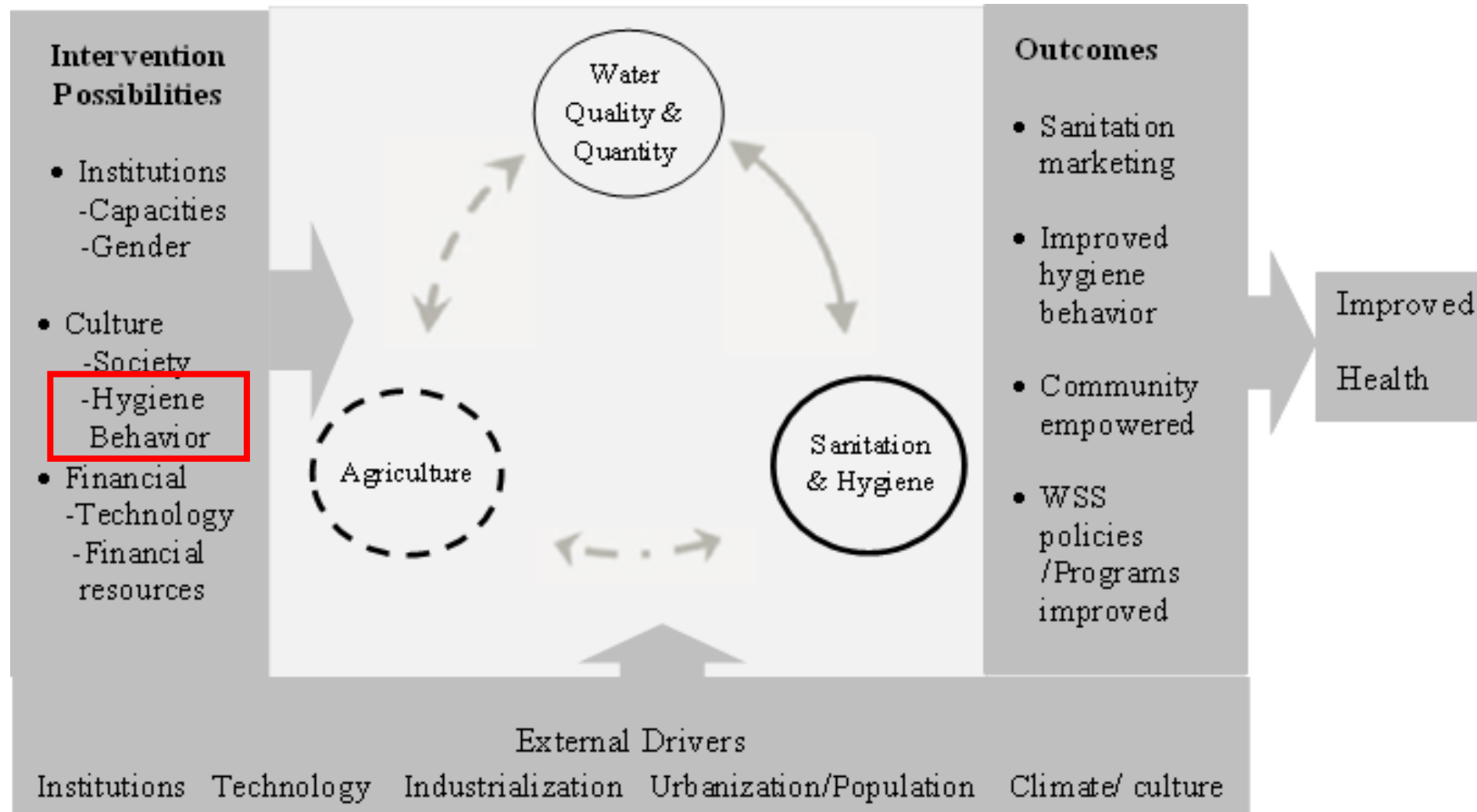
Source: (Tsegai et al., 2013)
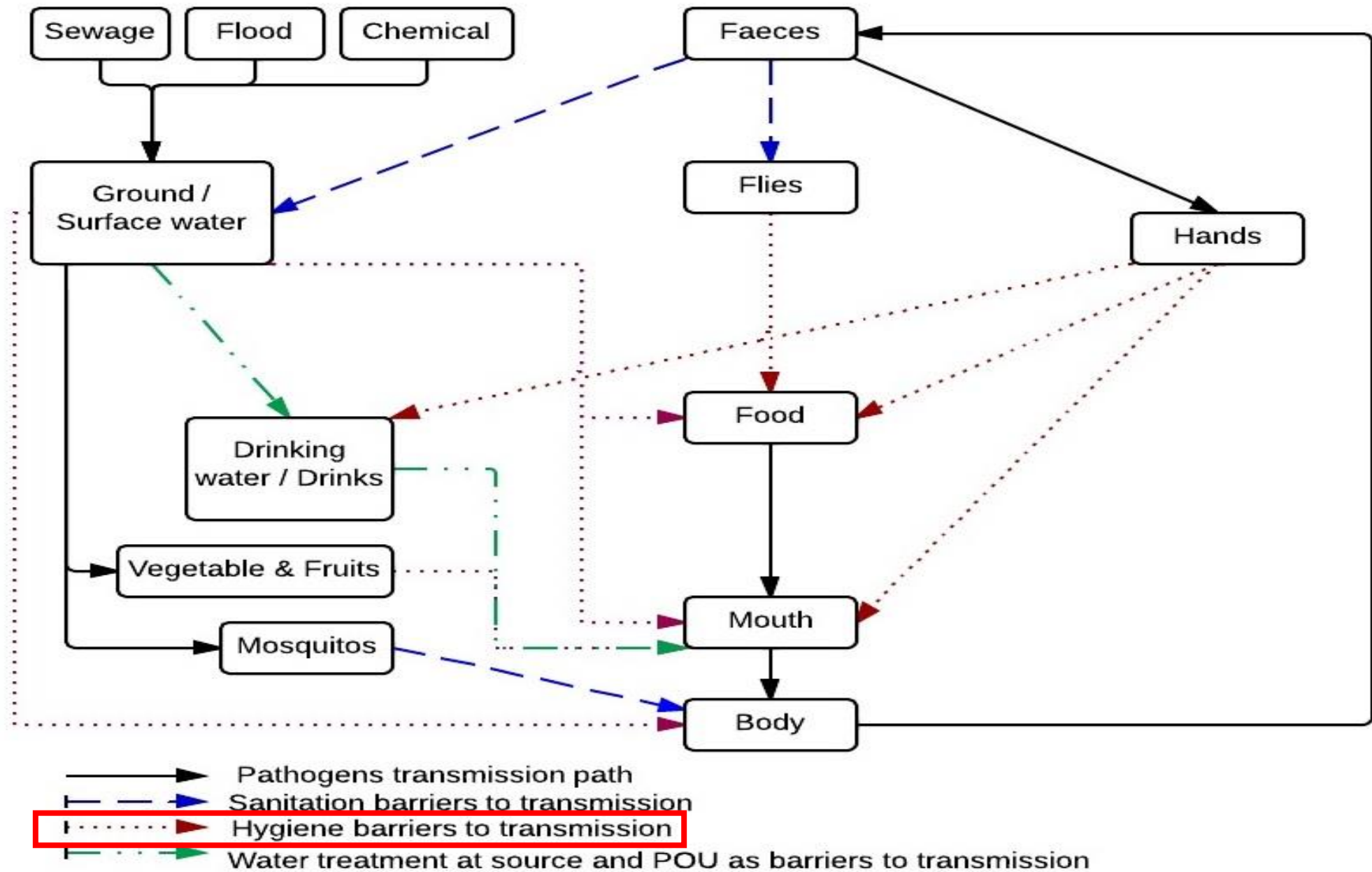
Source: Author's calibration; adopted from (Waddington et al. 2009; Prüss et al. 2002). 7

Intervention

Treatment was designed consisting of the following elements:

(1) Providing *E. coli* test results of drinking water and food preparing utensils;

(2) Training of how to maintain food hygiene in the household level;

(3) Food Hygiene Education poster is given to hang in their dining area
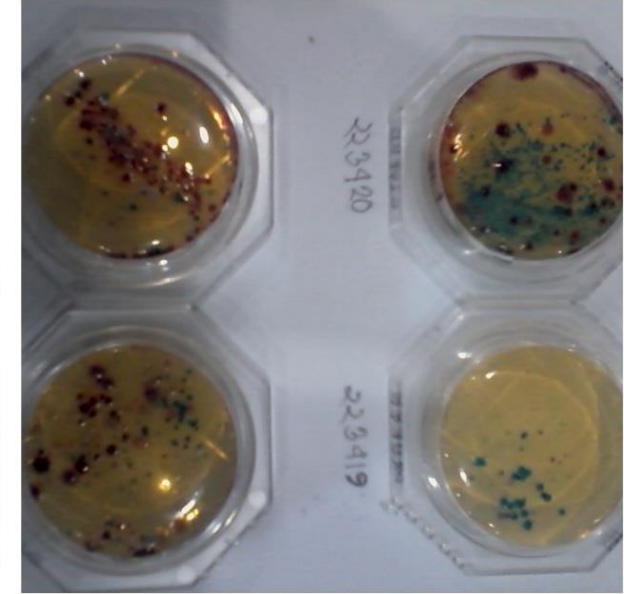
Intervention

- Baseline (October, 2014)

- Midline (23 February- 10 March 2015)

- Endline (April, 2015).

- Intervention first phase (22 Jan-8 Feb, 2015)

- Second phase (26 Feb to 18 Mar, 2015)

- Each village received one month time in between treatment and follow up survey.

Food Hygiene Education (FHE) for rural households in Bangladesh
Mohammad Monirul Hasan
Center for Development Research (ZEF), University of Bonn, Germany. Email: mhasan@uni-bonn.de

8 Ways for keeping food safe and clean

1. Wash your hand properly with soap: before eating, feeding child, before cooking and after defecation.

2. Use safe water to: wash food utensils with soap before and after use. Wash raw materials before cooking.

3. Separate raw meat and sea food from other foods. Use separate cutting utensils for meat and vegetable.

4. Thoroughly cook food and reheat food before use. Boil water and milk before serving.

5. Wash cutting utensils, plates and glass with soap. Wipe water from plate before serving.

6. Do not drink open water. Drink water boiled or filtered. Always cover water from dust and dirt.

7. Protect kitchen and dining areas from animals.

8. Cover cooked food to protect from flies, dust and dirt.

Methods and Data

- Two districts of North-western Bangladesh: Rajshahi and Naogaon
- Sampling procedure: *cluster sampling*
- Two big cluster: BMDA area(389 mouza) and Non-BMDA area (359 mouza)
- 16 villages are taken randomly from BMDA areas and another 16 from non-BMDA areas.
- A total of 512 households are covered: 256 (BMDA), 256 (non-BMDA)
- The power analysis considered an effect size (ES) of 0.95 and a multicollinearity across the covariates of 0.7 (which is quite extreme) and allowed for a probability of Type I error of 5% and a statistical power of 80%.

- The study assumes treatment homogeneity and 100 percent compliance of the participating households.

- No attrition because no households or villages dropped out of either the treatment or control group over the intervention implementation period.
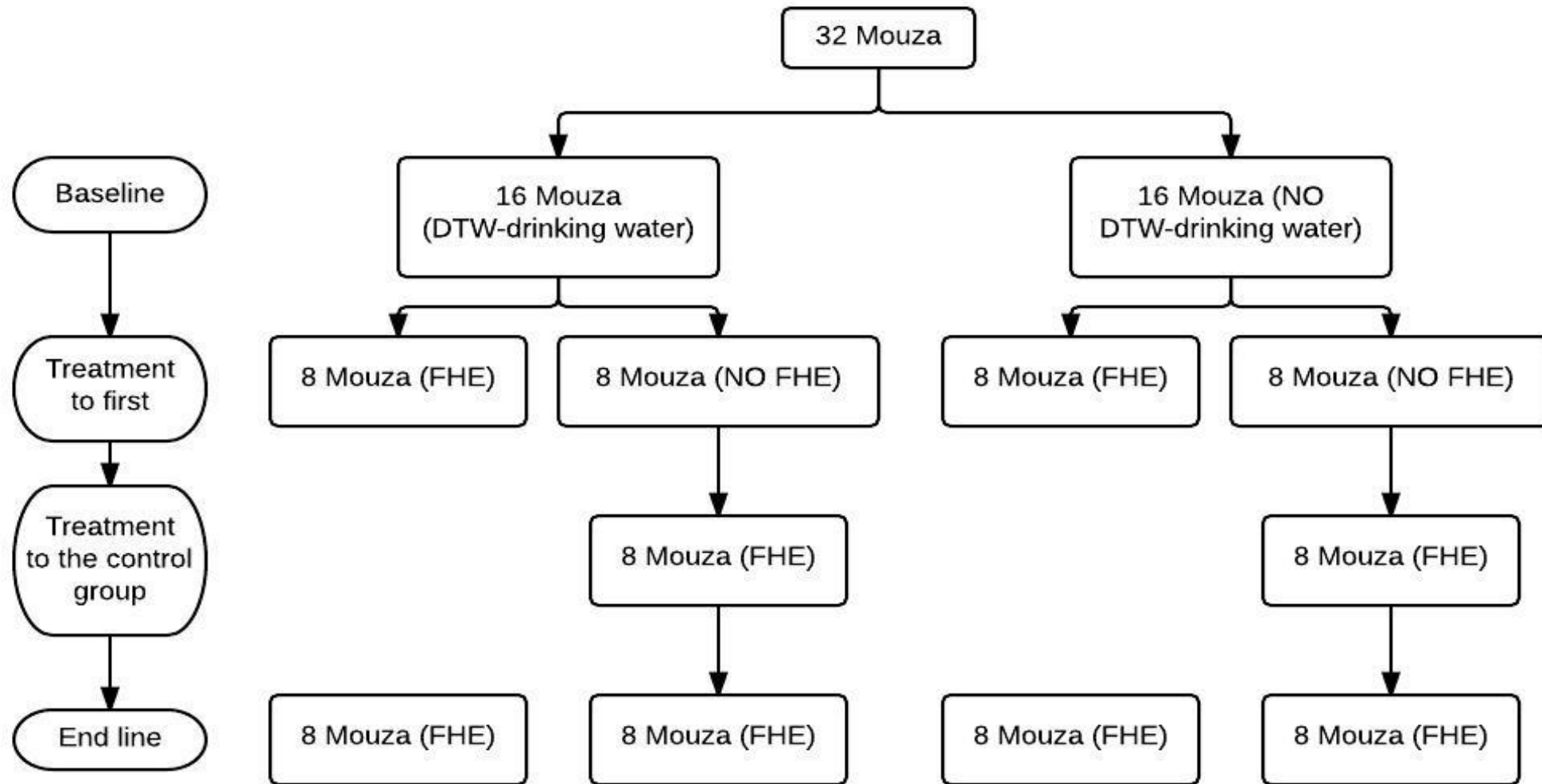
Each Mouza contains 16 households. So in total 32*16=512 households are selected for the experiment.

Table 1: Household characteristics of treatment and control households in the baseline before the intervention

Household characteristics	Control	Treatment	P-value [Treatment – Control]
Age of household head (years)	35.0	35.5	0.61
Completed years of schooling of household head	4.7	4.6	0.72
Maximum completed schooling in the household	7.8	7.7	0.75
Household size	4.6	4.9	0.02
Percentage of female headed household	1%	1%	0.65
Household head currently married (dummy)	98%	98%	0.52
Household occupation: wage earning (dummy)	49%	54%	0.29
Household occupation: agriculture (dummy)	61%	54%	0.11
Household occupation: non-agriculture (dummy)	45%	50%	0.25
Total land (in acre)	81.3	57.1	0.10
Number of shared livestock	0.20	0.17	0.63
Number of cows	1.0	1.4	0.04
Number of goat	1.0	0.9	0.52
Number of poultry	10.3	7.8	0.02
Number of Livestock	14.8	15.8	0.82
Food expenditure (BDT)	59230	60155	0.73
Non-food expenditure (BDT)	41741	38090	0.36
Total expenditure (BDT)	106532	103247	0.61
Per capita expenditure (BDT)	23328	20886	0.04
Household savings (BDT)	47070	26389	0.01
Participants of Microfinance program (dummy)	45%	51%	0.22
Household have access to electricity (percentage)	61%	56%	0.28
Distance from road (kilometre)	0.5	0.4	0.23
Distance from small market (kilometre)	0.9	1.9	0.00
Distance from big market (kilometre)	5.3	5.1	0.60
Distance from health centre (kilometre)	3.4	3.5	0.55
Distance from nearest town (kilometre)	8.0	10.9	0.00

Source: Authors calculation from baseline survey 2014.

Estimation technique

- We have applied difference-in-difference (D-i-D) estimation for our analysis.

- For the **short term** impact we have analysed the midline survey having one group of households as control considering the baseline characteristics.

- In the **medium term**, we have analysed the endline survey including the baseline characteristics. Medium term analysis exhibits the marginal benefit of having one more month of exposer although both of the groups have the treatment already.

- The regression equation of D-i-D is:

$$Y_{it} = a + DD.T_i t + \beta T_i + \delta t_i + \varepsilon_{it}$$

Results

Table 5: Impact of Food Hygiene Education (FHE) on <u>child growth</u>

	Height-for-age z-score		Weight-for-age z-score		Weight-for-height z-score	
Treatment (FHE)	0.117	0.126	-0.031	-0.033	-0.137	-0.147
	(0.107)	(0.113)	(0.086)	(0.091)	(0.095)	(0.100)
Time	0.211***	0.209***	0.056	0.053	-0.111	-0.115
	(0.061)	(0.061)	(0.049)	(0.049)	(0.073)	(0.073)
Treatment* Time (Impact)	-0.053	-0.047	0.102	0.107	0.188*	0.194*
	(0.085)	(0.085)	(0.068)	(0.068)	(0.102)	(0.102)
BMDA operated area	0.044	-0.006	0.082	0.074	0.074	0.099
	(0.098)	(0.101)	(0.079)	(0.081)	(0.081)	(0.084)
Household characteristics	No	Yes	No	Yes	No	Yes
Constants	-1.66***	-1.68***	-1.53***	-1.71***	-0.83***	-1.09***
	(0.091)	(0.275)	(0.073)	(0.222)	(0.079)	(0.230)
Observation	1118	1118	1118	1118	1118	1118

Source: Authors calculation

Table 6: Impact of Food Hygiene Education (FHE) on child growth

	Stunted		Severely Stunted		Underweight		Severely underweight		Wasted		Severely wasted	
Treatment (FHE)	-0.131	-0.096	-0.158	-0.369	0.432	0.373	0.146	-0.143	0.393*	0.377*	-0.996	-1.024
	(0.402)	(0.414)	(0.540)	(0.616)	(0.424)	(0.441)	(0.595)	(0.670)	(0.212)	(0.221)	(0.729)	(0.773)
Time	-0.704**	-0.684**	-0.480	-0.482	-0.595**	-0.574*	-0.489	-0.506	0.304*	0.313*	0.285	0.290
	(0.282)	(0.281)	(0.425)	(0.438)	(0.302)	(0.302)	(0.522)	(0.533)	(0.181)	(0.182)	(0.523)	(0.524)
Treatment* Time (Impact)	-0.345	-0.377	-0.429	-0.485	-0.508	-0.541	-0.634	-0.685	-0.521**	-0.541**	0.422	0.413
	(0.397)	(0.396)	(0.614)	(0.629)	(0.418)	(0.416)	(0.756)	(0.773)	(0.249)	(0.249)	(0.867)	(0.871)
BMDA operated area	-0.257	-0.161	-0.664	-0.807	-0.653*	-0.614	-0.138	-0.268	-0.007	-0.121	-0.215	-0.339
	(0.360)	(0.360)	(0.496)	(0.559)	(0.383)	(0.392)	(0.534)	(0.587)	(0.167)	(0.175)	(0.496)	(0.534)
Household characteristics	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Constants	-1.16***	-0.79	-4.59***	-5.72***	-1.75***	-0.27	-6.51***	-4.30**	-3.51***	-3.74***	-5.03***	-4.22**
	(0.354)	(1.010)	(0.525)	(1.792)	(0.386)	(1.129)	(0.545)	(1.867)	(0.441)	(0.994)	(1.046)	(1.788)
Observation	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118	1118

Source: Authors calculation

Table 7: Impact of Food Hygiene Education on <u>child diarrhoea</u>

	Child diarrhoea in past one month			
	Short term			Medium term
Treatment (FHE)	0.183	0.127		0.094
	(0.281)	(0.293)		(0.283)
Time	0.039	0.039		-0.344
	(0.278)	(0.278)		(0.296)
Treatment* Time (Impact)	-0.434	-0.434		0.165
	(0.398)	(0.397)		(0.399)
BMDA operated area	-0.293	-0.214		-0.168
	(0.212)	(0.220)		(0.213)
Household characteristics	No	Yes		Yes
Constants	-2.048***	-1.913***		-2.225***
	(0.274)	(0.629)		(0.603)
Observation	1024	1024		1024

Source: Authors calculation

Table 8: Impact on **microbiological quality** of drinking water and food utensils

	E.coli in drinking water (number of colonies)			E.coli in Food utensils (number of colonies)			Percentage of households with E. coli in drinking water		
	Short term	Medium term		Short term	Medium term		Short term	Medium term	
Treatment (FHE)	40.039***	25.152*	26.540**	-7.185*	-9.345**	-8.621**	0.385**	0.113	0.214
	(14.605)	(15.237)	(12.309)	(4.213)	(4.457)	(4.038)	(0.165)	(0.165)	(0.160)
Time	23.580*	23.859*	-9.432	-15.164***	-14.880***	-29.762***	0.182	0.180	0.159
	(14.062)	(14.113)	(11.334)	(3.965)	(3.985)	(4.064)	(0.139)	(0.137)	(0.134)
Treatment* Time (Impact)	-79.607***	-80.058***	-43.662***	-18.265***	-18.536***	1.831	-0.820***	-0.816***	-0.645***
	(19.951)	(20.027)	(16.002)	(5.927)	(5.959)	(5.788)	(0.202)	(0.201)	(0.196)
BMDA operated area	11.456	17.570	4.567	2.267	2.480	-1.290	0.042	0.173	0.001
	(10.786)	(11.165)	(9.062)	(3.343)	(3.468)	(3.034)	(0.126)	(0.125)	(0.118)
Household characteristics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Constants	-7.929	-41.224	-35.477	3.988	24.236**	25.749***	1.397***	0.046	0.371
	(11.848)	(32.097)	(25.987)	(3.436)	(9.718)	(8.520)	(0.236)	(0.608)	(0.572)
Observation	1018	1018	1019	1018	1018	1018	1024	1024	1024

Table 9: Impact on **microbiological quality** of drinking water and food utensils

	Percentage of households with E. coli in food preparing utensils			Percentage of households uses improved water for general use			Percentage of households treat water		
	Short term		Medium term	Short term		Medium term		Short term	Medium term
Treatment (FHE)	-0.327	-0.447**	-0.401**	-0.398	-0.052	-0.211	-0.004	-0.008	-0.001
	(0.203)	(0.210)	(0.192)	(0.260)	(0.258)	(0.250)	(0.012)	(0.013)	(0.011)
Time	-0.732***	-0.732***	-1.144***	1.140***	1.115***	0.962***	0.012	0.012	0.023**
	(0.194)	(0.194)	(0.187)	(0.256)	(0.252)	(0.243)	(0.012)	(0.012)	(0.011)
Treatment* Time (Impact)	-0.658**	-0.653**	0.070	0.814**	0.905**	0.407	0.047***	0.047***	0.008
	(0.278)	(0.278)	(0.265)	(0.362)	(0.366)	(0.335)	(0.017)	(0.017)	(0.015)
BMDA operated area	-0.003	0.024	-0.194	0.792***	0.407*	0.675***	0.016*	0.015*	0.003
	(0.152)	(0.154)	(0.138)	(0.230)	(0.215)	(0.205)	(0.009)	(0.009)	(0.008)
Household characteristics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Constants	0.628***	1.693***	1.536***	0.574***	-0.594	-0.568	-0.004	-0.011	-0.001
	(0.166)	(0.452)	(0.402)	(0.217)	(0.627)	(0.585)	(0.010)	(0.025)	(0.022)
Observation	1024	1024	1024	1024	1024	1024	1024	1024	1024

Table 10: Impact on <u>hygiene practices</u>

	Soap handwashing after defecation (%)			Soap handwashing before feeding (%)			Number of soap use per month		
	Short term	Medium term		Short term	Medium term		Short term	Medium term	
Treatment (FHE)	-0.405	-0.399	-0.307	0.233	0.203	0.222	-0.262	-0.276	-0.422**
	(0.254)	(0.264)	(0.243)	(0.273)	(0.275)	(0.250)	(0.185)	(0.169)	(0.169)
Time	0.769***	0.780***	2.710***	0.856***	0.847***	1.470***	3.508***	3.508***	3.926***
	(0.248)	(0.249)	(0.440)	(0.244)	(0.243)	(0.237)	(0.161)	(0.161)	(0.162)
Treatment* Time (Impact)	2.203***	2.234***	1.012	0.567*	0.561*	-0.039	0.703***	0.703***	0.211
	(0.455)	(0.458)	(0.619)	(0.303)	(0.300)	(0.271)	(0.227)	(0.227)	(0.229)
BMDA operated area	0.357	0.180	0.074	0.159	0.005	0.033	0.332**	0.034	0.080
	(0.223)	(0.220)	(0.220)	(0.148)	(0.146)	(0.117)	(0.146)	(0.120)	(0.120)
Household characteristics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Constants	1.054***	-0.397	-1.198*	-4.635***	-5.681***	-4.539***	2.279***	0.249	-0.926***
	(0.225)	(0.669)	(0.680)	(0.639)	(1.039)	(0.810)	(0.150)	(0.341)	(0.342)
Observation	1024	1024	1024	1024	1024	1024	1024	1024	1024

Table 11: Impact on <u>hygiene practices</u>

	Draw drinking water with mug (%)			Cleaning water jar with soap (%)			Clean toilet with soap materials (%)		
	Short term		Medium term	Short term		Medium term	Short term		Medium term
Treatment (FHE)	-0.384	-0.327	-0.394*	-0.554**	-0.322	-0.323	0.009	0.309	0.145
	(0.245)	(0.253)	(0.212)	(0.279)	(0.262)	(0.239)	(0.412)	(0.371)	(0.334)
Time	-0.603***	-0.599***	-0.506**	0.153	0.152	1.265***	0.404	0.398	1.323***
	(0.219)	(0.219)	(0.200)	(0.226)	(0.225)	(0.218)	(0.273)	(0.271)	(0.274)
Treatment* Time (Impact)	0.410	0.406	0.101	0.987***	0.947***	0.088	0.140	0.144	-0.121
	(0.310)	(0.309)	(0.287)	(0.329)	(0.326)	(0.298)	(0.384)	(0.382)	(0.362)
BMDA operated area	-0.049	-0.136	-0.018	0.161	-0.303	-0.028	0.851**	0.154	0.057
	(0.195)	(0.198)	(0.158)	(0.213)	(0.190)	(0.164)	(0.370)	(0.306)	(0.270)
Household characteristics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Constants	-0.610***	-0.415	-0.542	-1.296***	-1.245**	-1.533***	-1.382***	-3.901***	-3.098***
	(0.199)	(0.564)	(0.448)	(0.231)	(0.549)	(0.479)	(0.361)	(0.958)	(0.831)
Observation	1024	1024	1024	1024	1024	1024	1024	1024	1024

Table 12: Impacts on water sanitation <u>investment and costs.</u>

	WATSAN investment (BDT)			Monthly cost of water (BDT)			Sanitation maintenance Cost (BDT)		
	Short term		Medium term	Short term		Medium term	Short term		Medium term
Treatment (FHE)	-26.675	-37.532	-24.444	2.656	2.013	0.488	34.023	38.054	32.223
	(39.366)	(41.021)	(33.111)	(4.435)	(4.435)	(4.235)	(32.047)	(31.147)	(25.161)
Time	107.965***	107.836***	75.370**	12.312***	12.312***	22.906***	103.23***	103.23***	16.289
	(39.344)	(39.282)	(29.742)	(3.901)	(3.901)	(3.714)	(27.550)	(27.550)	(23.619)
Treatment* Time (Impact)	70.504	70.633	6.219	5.070	5.070	-7.320	-22.043	-22.043	-35.328
	(55.613)	(55.526)	(42.038)	(5.516)	(5.516)	(5.253)	(38.961)	(38.961)	(33.403)
BMDA operated area	-1.311	-18.686	-48.177*	29.586***	24.611***	29.640***	86.123***	49.044**	0.335
	(27.838)	(29.064)	(24.625)	(3.473)	(3.346)	(3.200)	(25.446)	(23.409)	(18.126)
Household characteristics	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Constants	136.339***	51.024	69.639	3.180	-40.582***	-38.344***	113.27***	-125.785*	30.866
	(31.122)	(82.617)	(69.603)	(3.585)	(9.443)	(9.030)	(25.988)	(66.123)	(51.450)
Observation	1023	1023	1023	1024	1024	1024	1024	1024	1024

Table 13: Impact of Food Hygiene Education on <u>Water-sanitation and hygiene index</u>

	WATSAN index			Handwashing score			Food Hygiene Index			Socio-environmental index		
	Short term		Medium term	Short term		Medium term	Short term		Medium term	Short term		Medium term
Treatment (FHE)	-0.019	-0.025	-0.032	-1.92***	-1.16**	-1.09**	-0.33*	-0.262	-0.28*	0.041	0.033	0.033
	(0.030)	(0.030)	(0.029)	(0.594)	(0.478)	(0.473)	(0.171)	(0.164)	(0.164)	(0.039)	(0.041)	(0.038)
Time	0.005	0.005	0.17***	-31.41***	-31.41***	-30.73***	1.28***	1.28***	2.97***	0.18***	0.177***	0.006
	(0.026)	(0.026)	(0.026)	(0.592)	(0.457)	(0.453)	(0.135)	(0.135)	(0.149)	(0.034)	(0.034)	(0.033)
Treatment*Time (Impact)	0.15***	0.15***	-0.020	2.42***	2.42***	1.94***	1.46***	1.46***	0.49**	-0.093*	-0.093*	0.022
	(0.036)	(0.036)	(0.037)	(0.838)	(0.647)	(0.641)	(0.191)	(0.191)	(0.210)	(0.049)	(0.049)	(0.046)
BMDA operated area	0.023	-0.004	-0.001	-0.420	-0.102	-0.135	0.26*	-0.010	-0.019	0.074**	0.079**	0.052*
	(0.024)	(0.023)	(0.022)	(0.421)	(0.339)	(0.335)	(0.141)	(0.128)	(0.121)	(0.030)	(0.031)	(0.029)
Household characteristics	No	Yes	Yes	No	Yes	yes	No	Yes	Yes	No	Yes	Yes
Constants	2.42***	2.28***	2.27***	33.28***	45.42***	45.42***	3.92***	2.82***	2.95***	1.65***	1.586***	1.681***
	(0.025)	(0.066)	(0.061)	(0.470)	(0.963)	(0.954)	(0.140)	(0.361)	(0.341)	(0.031)	(0.088)	(0.082)
Observation	1024	1024	1024	1024	1024	1024	1024	1024	1024	1024	1024	1024

Source: Authors calculation

Summary

- Food Hygiene Education improved weight-for-height z-score and reduced the percentage of wasting children but no impact on diarrhoea.

- Bacterial contamination was reduced in the drinking water and food preparing utensils in terms of cfus and percentage of households as well.

- Water quality improved in both periods-short run and long run but food utensils quality improved only in the short run.

- Households started using improved water for general use and also increased the practice of water treatment.

- Hygiene situation improved only in the short run.

- No impacts are found in WATSAN investment, monthly cost of water and sanitation maintenance cost.

- Households WATSAN index, handwashing scores, food hygiene index and socio-environmental index are improved.

- Handwashing score and food hygiene index are found significant in medium term too.

Policy Implications

- This Food Hygiene Education experiment is a small doable action and can be easily replicated in any rural urban context.

- Hygiene messages in the poster are low cost intervention and can easily be provided to the households, schools and in the work place.

- Hygiene practices work well in the short run, so continuous dissemination can be provided to the households.

- This experiment has produced some significant positive impacts on health and behavioural changes without increasing the costs.

- Both government and non-government organizations should focus more in this food hygiene issues as a part of food and nutrition security.

Thank you