FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

Feed the Future BANGLADESH

Zone of Influence Survey 2018/2019—Baseline

July 2022

This publication was prepared for review by the United States Agency for International Development. It was prepared by the International Food Policy Research Institute (IFPRI) for the United States Agency for International Development, USAID Contract Number EEM-G-00-04-00013-00.

Recommended Citation:
Feed the Future. 2020. Feed the Future Bangladesh Zone of Influence Survey 2018/2019 Baseline.

USAID Bureau for Resilience and Food Security Contact:
rfs.ald@usaid.gov

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

5DE	Five domains of empowerment
AIN	Aquaculture for Improved Nutrition activity
ARSSI	Ability to Recover from Shocks and Stresses Index
ATR	Ability to Recover
A-WEAI	Abbreviated Women's Empowerment in Agriculture Index
AWI	Asset Wealth Index
BANA	Bangladesh Aquaculture and Nutrition Activity
BBS	Bangladesh Bureau of Statistics
BIHS	Bangladesh Integrated Household Survey
BMI	Body Mass Index
CBN	Cost of basic needs
CI	Confidence interval
CIP	Country Investment Plan
CWI	Comparative Wealth Index
DATA	Data Analysis and Technical Assistance
DEFF	Design effect
DHS	Demographic and Health Survey
FIES	Food Insecurity Experience Scale
GDP	Gross domestic product
GFSS	United States Global Food Security Strategy
GPI	Gender Parity Index
HIES	Household Income and Expenditure Survey
HYV	High-yielding variety
IFPRI	International Food Policy Research Institute
IMPT	Improved management practices or technologies
LSMS	Living Standards Measurement Survey
MAD	Minimum Acceptable Diet
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental organization
PBS	Population-based survey
PEC	Primary education certificate
PII	Personally identifiable information
PPP	Purchasing power parity
PPS	Probability proportional to size
PRSSP	Policy Research and Strategy Support Program

PSU	Primary sampling unit
RDC	Rice and Diversified Crops activity
RFS	USAID Bureau for Resilience and Food Security
SD	Standard deviation
SDG	Sustainable Development Goals
SEI	Shock Exposure Index
SPI	Standardized Precipitation Index
USAID	United States Agency for International Development
USD	US dollar
USG	United States Government
VCC	Value chain commodity
WHO	World Health Organization
ZOI	Zone of Influence

EXECUTIVE SUMMARY

Background

Feed the Future seeks to sustainably reduce global poverty, hunger, and malnutrition by helping partner countries boost agriculture-led growth, resilience, and nutrition. Program efforts are designed to impact the population in Zones of Influence (ZOI) in Feed the Future target countries. The ZOI is the targeted sub-national regions and districts where the program intends to achieve the greatest household- and individual-level impacts on poverty, hunger, and malnutrition. Progress in achieving Feed the Future's objectives is tracked using population-based performance indicators collected at baseline then periodically thereafter.

The purpose of the Bangladesh Feed the Future Phase 2 ZOI 2018/2019 Baseline Survey, referred to as the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 throughout this report, is to provide the U.S. Government interagency partners, the United States Agency for International Development (USAID) Bureau for Resilience and Food Security (RFS), USAID/Bangladesh, the Government of Bangladesh, and development partners with information on the current status of the Feed the Future ZOI-level population-based survey indicators.

The Feed the Future ZOI in Bangladesh includes a mostly rural, agricultural population. It is comprised of 21 districts in southwest Bangladesh. Most farms in the ZOI are between 0.5 and 1.49 acres.[1]

Bangladesh Feed the Future Phase 2 ZOI 2018/2019 Baseline Survey indicators

The Feed the Future ZOI indicators, which correspond to the Global Food Security Strategy Results Framework (**Figure ES1**), calculated for this survey are as follows:

1. Prevalence of poverty: Percent of people living on less than $1.90/day 2011 PPP [EG-c][2]
2. Depth of poverty of the poor: Mean percent shortfall of the poor relative to the $1.90/day 2011 PPP poverty line [EG-h]
3. Percent of people who are "near-poor," living on 100 percent to less than 125 percent of the $1.90 2011 PPP poverty line [FTF Context-9]
4. Percent of households below the comparative threshold for the poorest quintile of the asset-based comparative wealth index [EG-g]
5. Prevalence of moderate and severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES) [EG-e]
6. Ability to recover from shocks and stresses index [RESIL-a]
7. Percent of households that believe local government will respond effectively to future shocks and stresses [RESIL-c]
8. Index of social capital at the household level [RESIL-b]
9. Percent of households participating in group-based savings, micro-finance, or lending programs [EG.4.2-a]
10. Abbreviated Women's Empowerment in Agriculture Index (A-WEAI) [EG.3-f]

[1] Ahmed et al. (2015)

[2] Text in brackets indicates the Feed the Future indicator number. See the Feed the Future Indicator Handbook.

11. Average percent of women achieving adequacy across the six indicators of the A-WEAI [FTF Context-25]
12. Yield of targeted agricultural commodities within target areas [EG.3-h]
13. Percent of producers who have applied targeted improved management practices or technologies [EG.3.2-a]
14. Percent of women of reproductive age consuming a diet of minimum diversity [HL.9.1-d]
15. Percent of households with access to a basic sanitation service [HL.8.2-a]
16. Percent of households with soap and water at a handwashing station on premises [HL.8.2-b]

These 16 performance indicators at the goal-level measure hunger, malnutrition, and poverty among the population in the Bangladesh Feed the Future ZOI. Roughly half of the indicators measure impact and outcomes at the goal or strategic objective levels, and the other indicators are relevant to programming in Bangladesh. Indicator estimates—in total and by key disaggregates—are presented in **Table ES1**.

Figure ES1: U.S. Government Global Food Security Strategy Results Framework

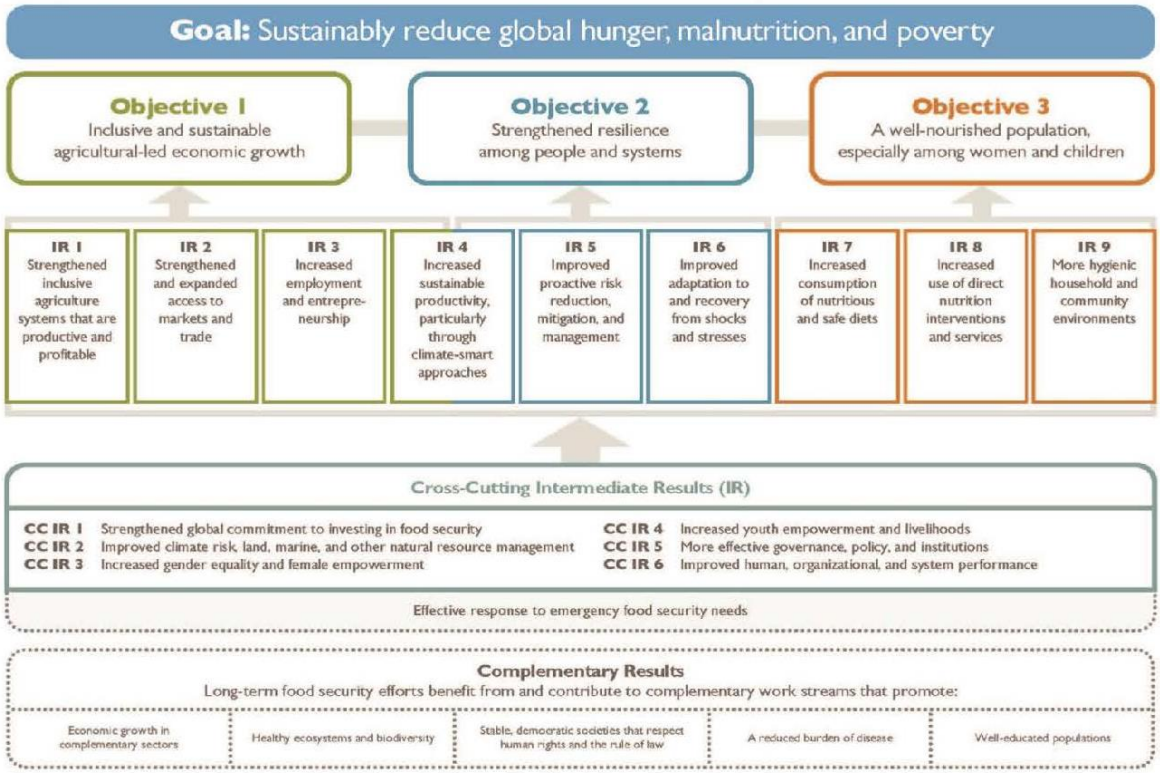


Table ES1: Feed the Future Indicator Estimates, by Key Disaggregates, Bangladesh 2018/2019

Feed the Future indicator	Estimate	95% CI	Sig.[a]	Number (*n*)[b]
Prevalence of poverty: Percent of people living on less than $1.90 per day (2011 PPP)				
All households	10.4	8.8 – 12.0		2,525
Gendered household type			n/s	
Male and female adults	10.3	8.5 – 12.1		2,222
Female adults only	11.4	7.3 – 15.6		296
Male adults only	^	^		6
Children only	^	^		1
Depth of poverty of the poor: Mean percent shortfall of the poor relative to $1.90 per day (2011 PPP) poverty line				
All households	13.5	11.9 – 15.1		223
Gendered household type			n/s	
Male and female adults	13.5	11.8 – 15.1		193
Female adults only	13.6	8.7 – 18.6		30
Male adults only	^	^		^
Children only	^	^		^
Percent of people who are near-poor, living on 100% to less than 125% of the $1.90 per day (2011 PPP) poverty line				
All households	15.0	13.2 – 16.7		2,525
Gendered household type			n/s	
Male and female adults	15.2	13.4 – 17.1		2,222
Female adults only	12.2	8.4 – 16.1		296
Male adults only	^	^		6
Children only	^	^		1
Percent of households below the comparative threshold for the poorest quintile of the asset-based comparative wealth index				
All households	0.6	0.3 – 0.9		2,525
Gendered household type			n/s	
Male and female adults	0.5	0.2 – 0.8		2,222
Female adults only	1.0	0.0 – 2.2		296
Male adults only	^	^		6
Children only	^	^		1
Ability to recover from shocks and stresses index				
All households	5.5	5.4 – 5.6		1,261
Gendered household type			n/s	
Male and female adults	5.5	5.4 – 5.6		1,135
Female adults only	5.5	5.4 – 5.7		125
Male adults only	^	^		1
Children only	^	^		0
Index of social capital at the household level				
Overall index				
All households	66.8	63.7 – 69.9		2,525
Gendered household type			n/s	
Male and female adults	66.7	63.6 – 69.8		2,222
Female adults only	67.2	62.2 – 72.1		296
Male adults only	^	^		6
Children only	^	^		1

Feed the Future indicator	Estimate	95% CI	Sig.[a]	Number (*n*)[b]
Bonding sub-index				
All households	72.1	69.0 – 75.2		2,525
Gendered household type				
Male and female adults	72.0	68.7 – 75.2	n/s	2,222
Female adults only	72.1	67.1 – 77.1		296
Male adults only	^	^		6
Children only	^	^		1
Bridging sub-index				
All households	61.5	58.1 – 64.9		2,525
Gendered household type			n/s	
Male and female adults	61.4	58.0 – 64.8		2,222
Female adults only	62.2	56.3 – 68.0		296
Male adults only	^	^		6
Children only	^	^		1
Percent of households that believe local government will respond effectively to future shocks and stresses				
All households	73.8	69.7 – 77.8		2,485
Gendered household type			n/s	
Male and female adults	73.7	69.7 – 77.7		2,191
Female adults only	73.7	66.6 – 80.7		287
Male adults only	^	^		6
Children only	^	^		1
Percent of households participating in group-based savings, micro-finance, or lending programs				
All households	50.7	47.7 – 53.8		2,518
Gendered household type			***	
Male and female adults	52.4	49.2 – 55.5		2,222
Female adults only	38.4	32.8 – 44.1		296
Male adults only	n/a	n/a		n/a
Children only	n/a	n/a		n/a
Abbreviated Women's Empowerment in Agriculture Index (A-WEAI)				
All women	0.89	0.88 – 0.91		2,327
Women's age			**	
18-29 years	0.87	0.85 – 0.89		556
30 years and older	0.90	0.89 – 0.91		1,771
Percent of women achieving adequacy across the six indicators of the A-WEAI				
All women	18.8	9.3 – 28.2		2,327
Women's age			n/s	
18-29 years	19.3	10.0 – 28.6		556
30 years and older	18.6	9.0 – 28.1		1,771
Percent of producers who have applied targeted improved management practices or technologies in targeted areas				
All producers	93.6	92.2 – 95.0		2,313
Farmers' sex			***	
Male	92.4	90.6 – 94.3		1,680
Female	96.7	95.3 – 98.2		633
Farmers' age			*	
15-29 years	92.0	88.8 – 95.2		401
30 years and older	93.9	92.5 – 95.4		1,912

Feed the Future indicator	Estimate	95% CI	Sig.[a]	Number (*n*)[b]
Commodity				
Rice	84.9	81.9 – 87.9		1,597
Fishponds	98.6	97.4 – 99.7		548
Dairy cows	100.0	n/a		844
Management practice or technology type			n/a	
Agriculture water management non-irrigation based	—	—		—
Aquaculture management	23.2	19.1 – 26.7		2,313
Climate adaptation, climate risk management	—	—		—
Crop genetics	6.5	4.0 – 9.0		2,313
Cultural practices	2.7	1.8 – 3.9		2,313
Irrigation[d]	0.7	0.0 – 1.6		2,313
Livestock management	36.5	33.7 – 38.7		2,313
Marketing and distribution	29.8	26.0 – 33.5		2,313
Natural resource or ecosystem management	—	—		—
Pest and disease management	18.6	15.0 – 22.5		2,313
Post-harvest handling and storage	—	—		—
Soil-related fertility and conservation	34.4	30.9 – 38.4		2,313
Value-added processing	—	—		—
Wild-caught fisheries management	—	—		—
Other	31.3	30.2 – 36.8		2,313
Yield of targeted agricultural commodities within target areas				
Rice (mt/ha)	3.1	3.0 – 3.3		1,591
Farm size				
Smallholder	3.1	3.0 – 3.3		1,589
Farmers' sex			n/s	
Male	3.1	3.0 – 3.3		1,445
Female	3.2	2.9 – 3.4		144
Farmers' age			n/s	
15-29 years	3.3	3.1 – 3.5		269
30 years and older	3.1	3.0 – 3.3		1,320
Non-smallholder	^	^		2
Farmers' sex			n/a	
Male	^	^		2
Female	^	^		0
Farmers' age			n/a	
15-29 years	^	^		0
30 years and older	^	^		2
Fishponds (kg/ha)	213.3	180.2 – 246.3		339
Farmers' sex			n/s	
Male	215.5	181.2 – 249.7		300
Female	191.8	94.2 – 289.4		39
Farmers' age			*	
15-29 years	148.8	83.5 – 214.1		35
30 years and older	220.3	185.3 – 255.3		304
Dairy cows (liters/milking dairy cow)	30.1	24.1 – 36.1		500
Production system				

Feed the Future indicator	Estimate	95% CI	Sig.[a]	Number (*n*)[b]
Agro-pastoral/extensive grassland	—	—		—
Farmers' sex				
Male	—	—		—
Female	—	—		—
Farmers' age				
15-29 years	—	—		—
30 years and older	—	—		—
Smallholder mixed livestock-crop				
Farmers' sex			n/s	
Male	29.8	21.3 – 38.3		197
Female	30.2	22.2 – 38.1		235
Farmers' age			n/s	
15-29 years	27.3	12.6 – 42.1		57
30 years and older	30.4	24.0 – 36.9		375
Urban/peri-urban	—	—		
Farmers' sex				
Male	—	—		—
Female	—	—		—
Farmers' age				
15-29 years	—	—		—
30 years and older	—	—		—
Intensive industrial	—	—		—
Farmers' sex				
Male	—	—		—
Female	—	—		—
Farmers' age				
15-29 years	—	—		—
30 years and older	—	—		—
Prevalence of moderate and severe food insecurity in the population, based on the Food Insecurity Experience Scale				
All households	7.9	6.4 – 9.4		2,525
Gendered household type			n/s	
Male and female adults	7.7	6.2 – 9.2		2,222
Female adults only	9.5	6.3 – 12.7		296
Male adults only	^	^		6
Children only	^	^		1
Severity			**	
Moderate	7.0	5.7 – 8.4		2,525
Severe	0.9	0.6 – 1.1		2,525
Prevalence of exclusive breastfeeding among children under 6 months of age[c]				
All children	53.9	46.3 – 61.5		247
Children's sex			n/s	
Male	50.4	41.0 – 59.9		139
Female	58.1	47.1 – 69.1		108

Feed the Future indicator	Estimate	95% CI	Sig.[a]	Number (*n*)[b]
Percent of children 6-23 months of age receiving a minimum acceptable diet[c]				
All children	35.9	31.9 – 39.9		562
Children's sex			n/s	
Male	34.3	28.4 – 40.2		271
Female	37.3	30.5 – 44.1		291
Percent of women of reproductive age consuming a diet of minimum diversity[c]				
All women	65.7	62.8 – 68.6		2,758
Women's age			*	
15-18 years	70.1	65.1 – 75.0		402
19-49 years	64.9	62.0 – 67.8		2,356
Prevalence of stunted children under 5 years of age[c]				
All children	27.4	24.5 – 30.3		1,857
Children's sex			n/s	
Male	25.9	22.4 – 29.4		954
Female	28.9	24.7 – 33.2		903
Children's age			n/s	
0-23 months	26.6	22.7 – 30.5		804
24-59 months	28.0	24.3 – 31.7		1,053
Prevalence of wasted children under 5 years of age[c]				
All children	7.3	6.0 – 8.7		1,851
Children's sex			n/s	
Male	7.7	5.9 – 9.5		949
Female	6.9	5.0 – 8.9		902
Children's age			n/s	
0-23 months	7.3	5.1 – 9.5		799
24-59 months	7.4	5.7 – 9.1		1,052
Prevalence of healthy weight children under 5 years of age[c]				
All children	90.3	88.8 – 91.8		1,851
Children's sex			n/s	
Male	89.3	87.0 – 91.6		949
Female	91.3	89.2 – 93.4		902
Children's age			n/s	
0-23 months	89.7	87.3 – 92.2		799
24-59 months	90.7	88.9 – 92.6		1,052
Prevalence of underweight women of reproductive age[c]				
All non-pregnant women 15-49 years	10.9	9.6 – 12.2		4,907
Women's age			***	
15-18 years	24.8	19.1 – 30.4		313
19-49 years	9.9	8.6 – 11.2		4,594
Percent of households with access to basic sanitation service				
All households	66.7	64.3 – 69.1		2,525
Gendered household type			n/s	
Male and female adults	67.1	64.5 – 69.6		2,222
Female adults only	64.3	58.6 – 70.0		296
Male adults only	^	^		6
Children only	^	^		1

Feed the Future indicator	Estimate	95% CI	Sig.[a]	Number (*n*)[b]
Residence			n/a	
Urban	—	—		—
Rural	66.7	64.3 – 69.1		2,525
Percent of households with soap and water at handwashing station on premises				
All households	53.3	49.6 – 57.1		2,525
Gendered household type			**	
Male and female adults	54.2	50.2 – 58.2		2,222
Female adults only	46.6	41.2 – 52.1		296
Male adults only	^	^		6
Children only	^	^		1
Residence			n/a	
Urban	—	—		—
Rural	53.3	49.6 – 57.1		2,525

— = Data are not available
CI=confidence interval; n/a=not applicable
^ Results not statistically reliable, n<30
PPP=purchasing power parity
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Number is the number of units (individuals, households) in the sample.
[c] Estimates are based on de facto household members.
[d] Use of axial flow pumps are promoted as a irrigation technology by USAID mission in Bangladesh, which is used by a small percentage of farmers.
Notes:
Estimates are sample-weighted; numbers are unweighted.
Estimates are based on de jure household members, except where noted.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019; Bangladesh Demographic and Health Survey (BDHS) 2017/2018

Summary of key findings

Household economic status

Prevalence of poverty: Percent of people living on less than $1.90/day (2011 PPP)

The percentage of people living on less than $1.90/day (2011 PPP) in the Feed the Future ZOI in Bangladesh is 10.4 percent. The prevalence of poverty is slightly lower in households with both male and female adults (10.3 percent) than households with female adults only (11.4 percent), but the difference is not statistically significant.

Depth of poverty of the poor: Mean percent shortfall relative to the $1.90/day (2011 PPP) poverty line

The depth of poverty measures the average gap between consumption levels of the population and the poverty line. The mean percent shortfall of the poor is 13.5 percent of the poverty line. This means that, on average, the poor have a shortfall of $0.30 per capita per day from the poverty line.

Prevalence of people who are "near-poor," living on 100 percent to less than 125 percent of the $1.90 (2011 PPP) poverty line [Context Indicator]

The prevalence of near-poor in the Feed the Future ZOI is 15.0 percent. These households are marginally above the poverty line, and hence, are at risk of falling into poverty if an adverse event occurs. A larger proportion of households with both male and female adults are near-poor (15.2 percent) compared with households with female adults only (12.2 percent), although these differences are not statistically significant.

Percent of households below the comparative threshold for the poorest quintile of the asset-based comparative wealth index

A very small proportion (0.6 percent) of ZOI households fall below the threshold for the poorest quintile of the Comparative Wealth Index (CWI). The CWI indicator involves converting the Asset Wealth Index (AWI) for the Bangladesh ZOI to comparable CWI scores using anchoring points from a reference survey–the 2017 Senegal Demographic and Health Survey (DHS). This allows for direct comparison of economic status across ZOI countries and over time.

Resilience

Ability to recover from shocks and stresses index

The Ability to Recover from Shocks and Stresses Index (ARSSI) is a proxy indicator for "actual recovery" of households that have faced a shock in the last one year. The ARSSI corrects for differences in shock exposure among households so that the index is comparable across households. In the Feed the Future ZOI, the mean ARSSI is 5.52, which is classified as high on the adjusted Ability to Recover (ATR) i.e, ARSSI scale of 1.93 to 7.83.

Percent of households that believe local government will respond effectively to future shocks and stresses

Nearly three-quarters of all ZOI households (73.8 percent) believe that the local government will respond effectively to future shocks and stresses.

Index of social capital at the household-level

The index of social capital measures the ability of households to draw on social networks to get support to reduce the impact of shocks and stresses on their households. It measures both the degree of bonding among households in their own community (bonding score) and the degree of bridging between households in the area outside their own community (bridging score). The score of each of the two indices ranges from 0 to 100. In the Bangladesh ZOI, the mean bonding score is 72.1, the mean bridging score is 61.5, and the overall mean social capital index score is 66.8. Results show that respondents believe that they will get more support from within the community rather than outside the community as the bonding score is higher than the bridging score.

Percent of households participating in group-based savings, micro-finance, or lending programs

Half of all ZOI sampled households (50.7 percent) participate in group-based savings, micro-finance, or lending programs. Households with both male and female adults participate in these types of groups more than households with only female adults (52.4 percent and 38.4 percent, respectively), and the difference is statistically significant at the 0.1 percent level.

Abbreviated Women's Empowerment in Agriculture Index (A-WEAI)

A-WEAI

A-WEAI is calculated using two sub-indices: (1) the Five Domains of Empowerment (5DE), and (2) the Gender Parity Index (GPI). In the Bangladesh ZOI, women's overall A-WEAI score is 0.89. There is a slightly higher proportion of women (68.3 percent) who have achieved empowerment compared with men (65.9 percent).

Women's average adequacy score is similar to men's average adequacy score (64.8 for women and 64.1 for men). Women's and men's 5DE scores are 0.89 and 0.88, respectively. The proportion of women achieving gender parity is 79.1 percent.

Agriculture

Yield of targeted agricultural commodities within target areas

The USAID/Bangladesh Mission targets three agricultural commodities in the Bangladesh ZOI: (1) rice, (2) fish, and (3) milk.

During the 12 months preceding the Feed the Future 2018/2019 baseline survey, the average yield of rice in the ZOI was 3.1 metric tons per hectare.

In the 30 days preceding the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019, fish farmers reported an average yield of 213.3 kilograms of fish per hectare (kg/ha) of fishpond. Fish farmers 30

years of age and older reported significantly higher yields than farmers 15-29 years of age (220.3 kg/ha versus 148.8 kg/ha)—a difference statistically significant at the 5 percent level.

Among dairy farmers with milking cows in the ZOI, the average yield was 26.0 liters of milk per milking cow per month.

Percent of producers who have applied targeted improved management practices or technologies

Almost all (93.6 percent) targeted value chain commodity (VCC) farmers who are engaged in rice, aquaculture, or dairy apply at least one improved management practice or technology. The top improved management practices and technologies include livestock management (36.5 percent) and soil-related fertility and conservation (34.4 percent).

Food insecurity and dietary intake

Prevalence of moderate and severe food insecurity in the population, based on the FIES

Findings from the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 show that 7.9 percent of surveyed households experienced moderate and severe food insecurity. In disaggregated form, 7.0 percent of households experienced moderate food insecurity and 0.9 percent of households experienced severe food insecurity. Households with only adult females have higher rates of moderate and severe food insecurity (9.5 percent) than households with male and female adults (7.7 percent), although this difference is not statistically significant.

Prevalence of exclusive breastfeeding of children under 6 months of age

BDHS 2017/2018 data were used to calculate the prevalence of exclusive breastfeeding of children under 6 months of age in the ZOI. Over half (53.9 percent) of children under 6 months are exclusively breastfed, more so among female children than male children (58.1 percent and 50.4 percent, respectively). However, the difference is not statistically significant.

Percent of children 6-23 months receiving a minimum acceptable diet

BDHS 2017/2018 data were used to calculate the percentage of children 6-23 months receiving a minimum acceptable diet in the ZOI. In 2017/2018, slightly over one-third (35.9 percent) of children 6-23 months of age received an acceptable diet. A higher proportion of female children 6-23 months of age received a minimum acceptable diet than male children (37.3 percent versus 34.3 percent), but the difference is not statistically significant.

Percent of women of reproductive age consuming a diet of minimum diversity

The women's minimum dietary diversity indicator uses the following 10 food groups: (1) grains, roots, and tubers; (2) legumes and beans; (3) nuts and seeds; (4) dairy products; (5) eggs; (6) flesh foods, including organ meat and miscellaneous small animal protein; (7) vitamin A-rich dark green leafy vegetables; (8) other vitamin A-rich vegetables and fruits; (9) other fruits; and (10) other vegetables. Achievement of women's minimum dietary diversity is defined as having consumed foods from at least 5 of the 10 food groups in the 24 hours preceding the survey. Among women of reproductive age (15-49 years) in the ZOI, about two-thirds (65.7 percent) achieved minimum dietary diversity. Nearly all women reported that they consumed grains, roots, and tubers in the last 24 hours. About 90 percent of

women consumed other vitamin A-rich vegetables and fruits, whereas the least consumed food groups are nuts and seeds (0.9 percent) and dairy products (10.7 percent). Likewise, egg consumption is relatively low among women of reproductive age (20.3 percent).

Nutritional status of women and children

Prevalence of stunted children under 5 years of age

BDHS 2017/2018 data were used to calculate the prevalence of stunted children under 5 years of age in the ZOI. Slightly over one-fourth (27.4 percent) of children under 5 years of age are stunted. The prevalence of stunting is higher among female children than male children (28.9 percent for females and 25.9 percent for males), but the difference is not statistically significant.

Prevalence of wasted children under 5 years of age

Analysis of BDHS 2017/2018 data shows that the prevalence of wasted children under 5 years of age is 7.3 percent in the ZOI. The prevalence of wasting between male and female children is not statistically significant (7.7 percent for males and 6.9 percent for females).

Prevalence of healthy weight children under 5 years of age

Analysis of BDHS 2017/2018 data shows that the prevalence of healthy weight children under 5 years of age is 90.3 percent in the ZOI. The proportion of healthy weight children is similar between female and male children (91.3 percent and 89.3 percent, respectively); the difference in the proportion of healthy weight children between male and female children is not statistically significant.

Prevalence of underweight women of reproductive age

BDHS 2017/2018 data were used to calculate the prevalence of underweight women of reproductive age (15-49 years) in the ZOI. The prevalence of underweight women of reproductive age is 10.9 percent. Women 15-18 years of age are more underweight than women 19-49 years (24.8 percent and 9.9 percent, respectively) and the difference is statistically significant at the 0.1 percent level.

Water, sanitation, and hygiene

Percent of households with access to a basic sanitation service

Only 66.7 percent of ZOI households have access to a basic sanitation service. Nearly two-thirds of ZOI households (64.3 percent) with female adults only have access to a basic sanitation service compared with 67.1 percent of households with both male and female adults; however, the difference is not statistically significant.

Percent of households with soap and water at a hand-washing station on premises

Slightly over half (53.3 percent) of ZOI households have soap and water at a hand-washing station on premises. The proportion of households with soap and water at the hand-washing station is lower for households with female adults only (46.6 percent) than households with both male and female adults (54.2 percent). This difference is statistically significant at the 1 percent level.

The Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 was implemented by the International Food Policy Research Institute (IFPRI), together with the survey firm Data Analysis and Technical Assistance (DATA) Limited.

1 BACKGROUND

This chapter provides background information on Feed the Future in Bangladesh, including a description of the program and the Feed the Future Zone of Influence (ZOI), demographic information on the ZOI population, and a summary of the poverty, food security, nutrition, and agroclimatology[3,4] in the ZOI.

1.1 Feed the Future overview

Feed the Future's collective efforts aim to improve the livelihood and nutritional status of households in Bangladesh through:

- Increased on-farm productivity
- Increased investment in market systems and value chains
- Enhanced food security policy and planning capacity
- Enhanced agriculture innovation capacity
- Improved nutritional status of rural poor

Under the United States Global Food Security Strategy (GFSS) Bangladesh Country Plan, efforts to reduce hunger, malnutrition, and poverty are achieved through three primary objectives:

- Objective 1: Inclusive and sustainable agriculture-led economic growth through a market systems approach
- Objective 2: Strengthened resilience among people and systems
- Objective 3: A well-nourished population, especially women and children

Core Investments

The United States is focusing its efforts on targeted regions and value chains to maximize impact. Concentrating resources, fostering political engagement, linking agriculture to nutrition, and supporting gender equality are critical investments to successfully improve food security throughout Bangladesh.

Targeted Investments

Feed the Future will have the highest impact with focused interventions in areas that offer opportunities to reduce poverty and undernutrition. Specifically, this includes the 20 districts in southwest Bangladesh, as well as Kushtia district, which was added based on poverty and stunting trends. It targets intensification of rice production by promoting higher-yield, saline/drought-resistant, and more nutritious rice by supporting research institutions, government policymakers, non-governmental organizations (NGOs), farmers, and the private sector. The initiative also supports diversification into

[3] Agroclimatology, or agricultural climatology, refers to the interaction between climate and agriculture (Wagner-Riddle, 2005).

[4] Current agroclimatology data for specific countries can be found on FEWS NET (FEWS, n.d.).

higher-value, nutritious products, such as fruits, vegetables, fish, and livestock. This effort will increase farmers' incomes while also making more nutritious food available both in markets and at the household-level. Women are specifically targeted through promotion of homestead food production and nutrition education to encourage consumption of the diversified foods they produce.

Private Sector Engagement

Feed the Future supports private sector growth by identifying market constraints and working with the Government of Bangladesh and the private sector to eliminate constraints. It builds the capacity of farmers, small and medium enterprises, and civil society by promoting market linkages and improving access to market information. The GFSS Bangladesh Country Plan acknowledges the increased involvement of private sector firms across agricultural value chain over the course of the first phase of the Feed the Future program in Bangladesh. This enhanced demand for agricultural goods from the ZOI. Moving forward, private sector engagement will be a critical vehicle for the USG to achieve sustainable and inclusive agriculture-led economic growth and strengthened market systems under the new GFSS country strategy. In particular, the role of the private sector will be critical in promoting agricultural diversification (e.g., through commercializing seeds and other agricultural inputs, investments in irrigation and mechanization) and possibly through new USG programming, such as linking smallholder farmers with private-led extension, financing, and business development services.

Policy Reform

Feed the Future identifies and advocates for policy reforms, stimulates policy dialogue, and strengthens the analytical and monitoring capabilities of national institutions. It generates policy research to fill knowledge gaps in critical areas and communicate research outcomes to relevant stakeholders. It also works to improve the capacity of the government, civil society, farmers, and the private sector to engage in policy dialogue, with an emphasis on supporting and uplifting Bangladesh's most vulnerable populations.

Research and Innovation

Feed the Future strengthens agricultural research capacity with a focus on (1) crops that are resilient to climate change-related challenges, such as salinity, drought, and floods; (2) improved cost-effectiveness; (3) improved farming practices, including fertilizer use and better irrigation; and (4) high-value crops. Socioeconomic research is also prioritized, especially in the promotion of agribusiness marketing, value-added transformation, and analysis of the overall enabling environment. Natural resource management issues, such as soil fertility, erosion, and the impacts of pesticide use, are an important part of building research capacity in Bangladesh. Programs focus on strengthening extension services to farmers through government, NGOs, and the private sector to facilitate the dissemination of research results. In particular, efforts focus on gender roles in farming and household gardening activities and increasing the number and skills of female extension agents.

Nutrition

Through extension activities and community outreach, Feed the Future disseminates information on nutrition and social and behavioral change. In collaboration with the U.S. Government Global Health

Initiative, Feed the Future improves nutrition service delivery for pregnant women and young children. Research on innovative nutrition technologies and bio-fortified varieties of rice are targeted toward improving the quality of food and preventing and treating undernutrition.

Climate Change & Resilience

Crop research and development focus on improving resilience against climate change impacts associated with salinity, drought, and floods. Feed the Future efforts focus on use of energy and fertilizer, as well as on improved irrigation technologies to mitigate greenhouse gas production. Communities are being trained in conservation and sustainable agriculture practices. Feed the Future also promotes improved natural resource management, watershed protection, and sustainable management of water bodies, since Bangladesh is heavily dependent on fishery systems.

Under the GFSS Bangladesh Country Plan, there is a broader focus on building resilience among people and systems, such as through improved employment and entrepreneurship, risk mitigation and management, and adaptive capacity to shocks. Improvements in these areas will build the resilience of communities and reduce the need for emergency assistance over time. Mitigating climate vulnerabilities and increasing resilience to environmental threats are integral to sustaining and increasing agriculture productivity, and in turn, achieving sustainable and inclusive economic growth. Addressing vulnerabilities to shocks will reduce the possibility of backsliding from achievements made over the last 20 years including increased incomes, reduced poverty, and improved rice production. This emboldened focus on resilience under the new GFSS Bangladesh country strategy is particularly critical as the frequency and intensity of climate-related shocks continues to increase, especially in the Feed the Future ZOI.

Gender Integration

Nutrition education focuses on women and children, though not to the exclusion of men. Extension activities reach out to women and ensure that women are well represented in Bangladeshi agricultural support services. Feed the Future's efforts encourage teaching the "whole family at once" approach to ensure access to women and the next generation of farmers and better information retention.

Women's Empowerment

Feed the Future prioritizes empowering women in the food and agriculture sector as a vehicle to ending hunger. Research in Bangladesh shows that enhancing women's empowerment can increase calorie availability and dietary diversity at the household-level.[5] Research also shows that women's empowerment in agriculture leads to increased crop diversification in the use of farmland in Bangladesh.[6] When women are economically empowered, their success leads to more-inclusive growth, better nutrition and health, and less hunger – all of which build resilience and self-reliance.

In 2011, the United States Agency for International Development (USAID) collaborated with the International Food Policy Research Institute (IFPRI) and the Oxford Poverty and Human Development Initiative to develop the Women's Empowerment in Agriculture Index (WEAI) to directly capture women's empowerment and inclusion levels in the agricultural sector. Feed the Future utilizes WEAI

[5] Sraboni et al. (2014)
[6] De Pinto, Seymour, & Bryan (2020)

data at the population- and program-levels to diagnose areas of empowerment and disempowerment, identify strategies to fill empowerment gaps, and assess the effectiveness of these interventions.

Under the GFSS, the collection and analysis of WEAI data will be critical to address constraints to empowerment as a way to uplift women in the ZOI. The USG will continue to identify barriers to women's meaningful contribution to, and benefit from activities. This may include identifying alternative means to access information and inputs. It may also include promoting appropriate technologies based on input and preferences from women. Additionally, GFSS programming will pursue empirically verified opportunities to expand market opportunities for women.

Whole-of-Government Approach

Feed the Future elevates coordination across the U.S. Government so that its investments, resources, and programs are harmonized for greater collective impact. This interagency engagement, led by USAID, includes collaboration with the U.S. Department of State, the U.S. Department of Agriculture, the U.S Department of the Treasury, the Millennium Challenge Corporation, the U.S. African Development Foundation, the U.S. Trade Representative, and the Overseas Private Investment Corporation. For example, the State Department will encourage regulatory reform and market liberalization to improve the business climate for farmers and the private sector.

1.2 Feed the Future ZOI profile

The Feed the Future ZOI is the geographic area where the Feed the Future program is expected to have an impact on hunger, poverty, and nutrition.

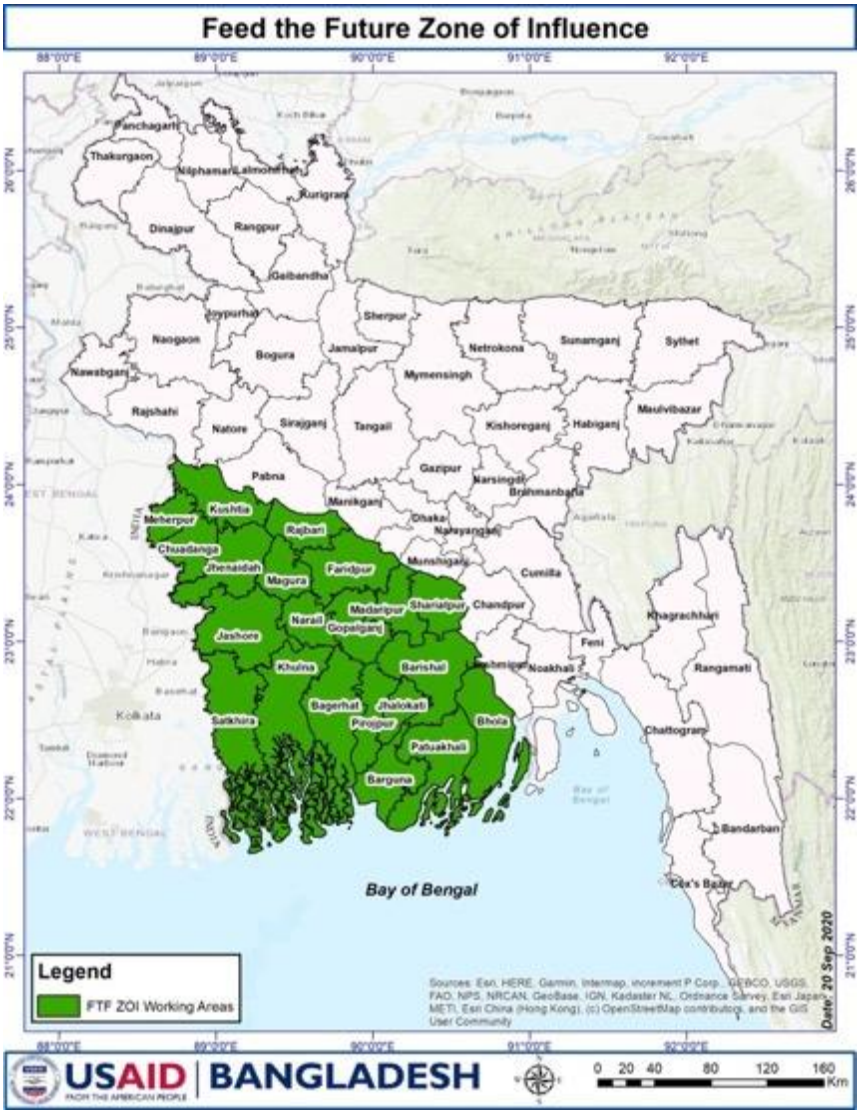
The Feed the Future Phase 2 ZOI includes mostly rural areas in the southwest region of Bangladesh. In addition to the original 20 districts from the 3 divisions forming the Feed the Future Phase 1 ZOI, the Feed the Future Phase 2 ZOI added Kushtia district in Khulna division based on its poverty and stunting trends. The 21 districts making up the Feed the Future Phase 2 ZOI are listed below:

1. Barishal Division (six districts): Barguna, Barishal, Bhola, Jhalakati, Patuakhali, and Pirojpur;
2. Dhaka Division (five districts): Faridpur, Gopalganj, Madaripur, Rajbari, and Shariatpur; and
3. Khulna Division (10 districts): Bagerhat, Chuadanga, Jashore, Jhenaidah, Khulna, Kushtia, Magura, Meherpur, Narail, and Satkhira.

Feed the Future targets investments in the ZOI with the greatest growth potential for rice production and diversification, prioritizing high-value agricultural production, and areas with high levels of poverty and malnutrition. Almost 32.8 million people live in the Feed the Future ZOI, where food security and nutrition face considerable challenges associated with scarce water resources, a rising sea level, vulnerability to extreme shocks, and changing weather patterns.

A map of the Feed the Future ZOI in Bangladesh is provided in **Figure 1.2**.

Figure 1.2: Map of Bangladesh: Feed the Future ZOI



1.2.1 Rationale for ZOI selection

The USG decided to continue its programming in the original 20 ZOI districts plus Kushtia district based on the population demographics, prevalence of poverty, prevalence of stunting, status of women and girls, as well as climate risk and vulnerability. Another reason for the decision was the potential to build off the gains that were made under the same high-level objectives of the first phase of Feed the Future in Bangladesh.[7]

1.2.2 Demography of the ZOI

Table 1.2.1 and **Table 1.2.2** present individual and household population estimates for the ZOI in 2018/2019. Estimates of the total population and sub-populations of the ZOI are presented. The sub-population categories correspond to the various sub-populations for the Feed the Future indicators and disaggregates.

IFPRI researchers used population and housing data from the Bangladesh Bureau of Statistics' (BBS) Population and Housing Census 2011 for the 21 districts that make up the Feed the Future ZOI. IFPRI researchers also obtained BBS data of the 21 ZOI districts for different age groups, disaggregated by gender. However, BBS did not have population data disaggregated by gender for the following age groups: children aged 0-5 months, 6-23 months, and 6-59 months; and for pregnant and non-pregnant women. Therefore, IFPRI researchers estimated the population of these age groups by using the proportional distribution of the respective groups from the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019. For the 6-59 months age group, researchers subtracted the 0-5 months population estimated from the 0-59 months population obtained from BBS to obtain the 6-59 months age group population. Similarly, IFPRI researchers estimated the percentage of pregnant and non-pregnant women in the total population of women of reproductive age (15-49 years) from Feed the Future ZOI 2018/2019 baseline survey. Researchers ascribed the acquired proportions to the population of women of reproductive age from BBS to estimate the total population of pregnant and non-pregnant women in 2011.

BBS did not conduct a Population and Housing Census after 2011. Therefore, IFPRI researchers calculated the population growth rate in two stages. First, intercensal growth rates were used from the past three points of population census data (1981, 2001, and 2011) to predict the national-level population growth rate. Second, since it was observed that the population growth rate is lower in the 21 Feed the Future ZOI districts than the national population growth rate, the growth rates for these 21 districts were adjusted proportionally to obtain a ZOI-specific growth rate of 0.47 percent per year. Therefore, researchers estimated the total population in 2018/2019 in the ZOI to be 30,320,344 (30.3 million) by compounding the total population in 2011 at a growth rate of 0.47 percent per annum for seven years.

Moreover, because there was no population census in 2018/2019, researchers estimated the population growth rates from the BBS population census reports of 2001 and 2011 for specific age groups,

[7] Feed the Future. 2018. *Global Food Security Strategy (GFSS) Bangladesh Country Plan*. Available at: https://www.usaid.gov/sites/default/files/documents/1867/Bangladesh_GFSS_Country_Plan_Public_CLEARED_7.11.18_508_Compliant.pdf

disaggregated by gender for 0-59 months, 15-29 years, and 15-49 years (women of reproductive age). Researchers used these growth rates and the respective 2011 populations for each group and projected the 2018/2019 population for these classifications, as denoted by * in **Table 1.2.1**.

However, growth rates pertaining to other groups could not be estimated from the BBS population census, since population data according to these classifications for 2001 were not available to estimate group-specific growth rates. As a result, for groups for which growth rates were not available (denoted by ** in **Table 1.2.1**), IFPRI researchers used the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 to estimate the population distributions in 2018/2019 for children 0-5 months, 6-23 months, and 6-59 months; and for pregnant and non-pregnant women.

As the ZOI population is mostly rural (85.1 percent), Feed the Future interventions are mostly implemented in rural areas of the ZOI. However, households that own or operate agriculture-driven enterprises usually live in urban areas and members of many rural households work in urban centers.[8] Therefore, the ZOI includes a population from rural and urban areas.

[8] Ahmed et al. (2018)

Table 1.2.1: Population of Individuals in the ZOI, by Category, Bangladesh 2018/2019

Category of individuals	Number[a]	Percent
Total number of individuals	30,320,344	100.0
Total number of individuals, by key sub–population		
Children 0-5 months**	312,550	1.0
Children 0-23 months**	1,375,221	4.5
Children 6-23 months**	1,062,671	3.5
Children 0-59 months*	3,083,828	10.2
Youth 15-29 years*	7,402,974	24.4
Women of reproductive age (15-49 years)*	8,483,505	28.0
Rice farmers	4,753,739	15.7
Fishpond farmers	1,041,834	3.4
Dairy farmers	3,384,472	11.2
Total number of individuals, by residence[b]		
Urban*	4,534,768	15.0
Rural*	25,785,576	85.0
Total number of individuals, by gendered household type		
Male and female adults**	27,572,879	90.9
Female adults only**	2,699,838	8.9
Male adults only**	41,673	0.1
Children only (no adults)**	5,953	0.0
Children 0-5 months, by sex		
Male**	163,717	52.4
Female**	148,833	47.6
Children 6-23 months, by sex		
Male**	529,847	49.9
Female**	532,824	50.1
Children 0-59 months, by sex		
Male*	1,550,844	50.3
Female*	1,532,984	49.7
Youth 15-29 years, by sex		
Male*	3,214,802	43.4
Female*	4,188,172	56.6
Women of reproductive age, by pregnancy status		
Pregnant**	343,582	4.0
Non-pregnant**	8,139,923	96.0
Primary adult female decisionmakers, by age		
18-29 years	857,280	11.4
30 years or older	6,656,616	88.6

[a] Number of individuals in the population.

[b] The urban/rural disaggregate uses the Bangladesh-specific definition of urban and rural reflected in the sampling frame at the time the sample was drawn.

* Total number of households in 2018/2019 in the Feed the Future ZOI are projected using inter-census growth rates estimated from the Bangladesh Bureau of Statistics 2001 and 2011 population census data for the ZOI.

** Inter-census growth rates of households for these classifications could not be acquired because the needed disaggregated data were not available from the BBS 2001 and 2011 Population and Housing Census. Therefore, IFPRI researchers used Feed the Future ZOI Survey data to estimate the respective distributions of these groups and used these estimates to project disaggregated household numbers for 2018/2019.

Source: Bangladesh Bureau of Statistics 2001 and 2011 Population and Housing Censuses; Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 1.2.2: Population of Individual Farmers of Targeted Value Chain Commodities in the ZOI, by Category, Bangladesh 2018/2019

Category of farmers	Number[a]	Percent
Any targeted VCC		
Total number of farmers**	6,885,034	100.0
Farmers' sex		
Male**	5,000,600	72.6
Female**	1,884,434	27.4
Farmers' age		
15-29 years**	1,193,865	17.3
30 years and older**	5,691,169	82.7
Rice		
Total farmers**	4,753,739	100.0
Smallholders**	4,747,786	99.9
Farmers' sex		
Male**	4,313,192	90.7
Female**	434,594	9.1
Farmers' age		
15-29 years**	800,724	16.8
30 years and older**	3,947,062	83.0
Non-smallholders	5,953	0.1
Farmers' sex		
Male	5,953	0.1
Female	0	0.0
Farmers' age		
15-29 years	0	0.0
30 years and older	5,953	0.1
Fishpond aquaculture		
Total farmers**	1,631,214	100.0
Farmers' sex		
Male**	1,443,625	88.5
Female**	187,589	11.5
Farmers' age		
15-29**	1,69,646	10.4
30 years and older**	1,461,568	89.6
Dairy cows		
Total farmers**	2,512,308	100.0
Farmers' sex		
Male**	1,083,558	43.1
Female**	1,428,750	56.9
Farmers' age		
15-29 years**	389,910	15.5
30 years and older**	2,122,398	84.5
Rangelands farmers	—	—
Farmers' sex		
Male**	—	—
Female**	—	—
Farmers' age		

Category of farmers	Number[a]	Percent
15-29 years**	—	—
30 years and older**	—	—
Mixed livestock-crop farmers	2,113,435	100.0
Farmers' sex		
Male**	976,407	46.2
Female**	1,137,028	53.8
Farmers' age**		
15–29 years**	336,459	15.9
30 years and older**	1,776,976	84.1
Urban/peri-urban farmers	—	—
Farmers' sex		
Male	—	—
Female	—	—
Farmers' age		
15-29 years	—	—
30 years and older	—	—
Intensive/commercial production farmers		
Farmers' sex		
Male	—	—
Female	—	—
Farmers' age		
15–29 years	—	—
30 years and older	—	—

— = Data are not available
Note: Number is the number of individuals in the population.
** Inter-census growth rates for these classifications could not be acquired because the needed disaggregated data were not available from the BBS 2001 and 2011 Population and Housing Census. Therefore, IFPRI researchers used Feed the Future ZOI Survey data to estimate the respective distributions of these groups and used these estimates to project disaggregated household numbers for 2018/2019.
Source: Bangladesh Bureau of Statistics 2001 and 2011 Population and Housing Censuses; Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

The total number of ZOI households in 2018/2019 is estimated to be 7,523,804 (7.5 million) by dividing the total baseline population in the ZOI by the average household size obtained from the Feed the Future ZOI 2018/2019 baseline survey. Since the total number of households disaggregated by categories were not available, researchers used the Feed the Future Bangladesh ZOI Survey 2018/2019 and estimated the distribution of households by these categories. These proportions were attributed to the estimated total number of households in 2018/2019 to project the disaggregated number of households by categories. Nearly all ZOI households (88.0 percent) are composed of male and female adults, followed by female adult only households (11.7 percent). A nominal percentage of ZOI households represent male only or child only households. The household statistics are summarized in **Table 1.2.3**.

Table 1.2.3: Number of Households in the ZOI, by Category, Bangladesh 2018/2019

Category of households	Number[a]	Percent
Total number of households	7,523,804	100.0
Total number of households, by gendered household type		
Male and female adults**	6,620,948	88.0
Female adults only**	881,998	11.7
Male adults only**	17,878	0.2
Children only (no adults)**	2,980	0.0
Total number of households, by residence[b]		
Urban	1,122,610	14.9
Rural	6,401,194	85.1

[a] Number of households in the population.

[b] The urban/rural disaggregate uses the Bangladesh-specific definition of urban and rural reflected in the sampling frame at the time the sample was drawn.

Source: Bangladesh Bureau of Statistics 2001 and 2011 Population and Housing Censuses; Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

** Inter-census growth rates for these classifications could not be acquired because the needed disaggregated data were not available from the BBS 2001 and 2011 Population and Housing Census. Therefore, IFPRI researchers used Feed the Future ZOI Survey data to estimate the respective distributions of these groups and used these estimates to project disaggregated household numbers for 2018/2019.

Table 1.2.4 presents information on the crop and non-crop agriculture activities among ZOI households in 2018/2019. Among the 6.1 million ZOI households involved in agriculture in 2018/2019, about two-thirds (64.8 percent) are involved in some type of crop agriculture. The predominant crop grown is rice, cultivated by over half (58.9 percent) of ZOI households. For non-crop agriculture, most households raise chickens or other poultry (84.7 percent), slightly over half (51.6 percent) are involved in aquaculture, and nearly half (48.6 percent) raise milk cows or bulls. Over one-third (36.5 percent) of ZOI households raise goats. This underscores the diverse portfolio of crop and non-crop agricultural activities that many ZOI households engage in.

Table 1.2.4: Number of Households in the ZOI involved in Agriculture, by Category, Bangladesh 2018/2019

Category of households	Number[a]	Percent
Total number of households involved in agriculture**	6,056,417	100.0
Total number of households, by crop cultivated		
Any crops**	3,924,376	64.8
Rice**	3,564,388	58.9
Total number of households, by livestock owned		
Milk cows or bulls**	2,940,747	48.6
Other cattle**	25,351	0.4
Horses, donkeys, or mules**	—	—
Goats**	2,213,165	36.5
Sheep**	40,562	0.7
Chickens or other poultry**	5,128,561	84.7
Any other livestock**	230,696	3.8
Fish**	3,123,276	51.6

— = Data are not available

[a] Number of households in the population.

Note: "Involved in agriculture" refers to ownership of the livestock presented in the table or cultivation of any crops.

Source: Bangladesh Bureau of Statistics 2001 and 2011 Population and Housing Censuses; Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

** Inter-census growth rates for these classifications could not be acquired because the needed disaggregated data were not available from the BBS 2001 and 2011 Population and Housing Census. Therefore, IFPRI researchers used Feed the Future ZOI Survey data to estimate the respective distributions of these groups and used these estimates to project disaggregated household numbers for 2018/2019.

1.2.3 Climate and agriculture in the ZOI

Between 1999 and 2018, Bangladesh was ranked the seventh country most affected by climate risk globally, as measured by Germanwatch's Global Climate Risk Index 2020.[9] Emerging climate risks pose a serious threat to agriculture and livelihoods in Bangladesh, ranging from rising sea levels, naturally-occurring arsenic that contaminates groundwater, intermittent water shortages in different parts of the country, soil degradation, salinization of both soils and irrigation water, erosion, deforestation, and more.[10] It has been estimated that, owing to climate change, crop production may reduce by 30 percent by the end of the century;[11] in particular, rice and wheat production may decrease by 8 to 32 percent by 2050.[12,13] In addition, winter crop production would be seriously hampered due to a warmer and drier environment, whereas moisture stress might force farmers to reduce the area under boro cultivation.[14,

[9] Eckstein et al. (2019)

[10] White, Quinney, and Jarvis (2018)

[11] Müller and Elliott (2015)

[12] Faisal and Parveen (2004)

[13] Practical Action (2012)

[14] Osmani et al. (2016)

[15] The Feed the Future ZOI is particularly more prone to climate change than other regions of the country because a large part of it is covered by the coastal zone in the south, which is often inundated by high tides, saline water intrusion, cyclonic storms, and tidal surges.

The agriculture sector has been an important driver of growth and rural development in Bangladesh, accounting for almost 14 percent of the gross domestic product (GDP) and providing employment opportunities for more than 40 percent of the country's workforce.[16] Between 2005 and 2010, agricultural GDP grew at a high rate of 4.1 percent per annum, but from 2015 to 2019, the rate fell to 2.6 percent per year. Bangladesh has made tremendous progress in fish production, registering an average annual growth rate of 6.2 percent from 2015/2016 to 2018/2019. The livestock sub-sector also grew 3.4 percent over the same period. Livestock contributed 1.5 percent of GDP and 13.6 percent of the agricultural GDP, and the fisheries sector contributed 3.5 percent to the national GDP and 25.7 percent to the agricultural GDP in 2018/2019.[17]

Rice is overwhelmingly dominant in the ZOI's cropping patterns, accounting for 71.3 percent of the total cropped area in the ZOI. Around 44 percent of all ZOI farmers cultivate only rice, indicating minimal crop diversification in the ZOI. The top non-rice crops cultivated in the ZOI in terms of the share of total cropped area include jute (7.0 percent), pulses (6.3 percent), vegetables (3.3 percent), oilseeds (2.0 percent), and maize (1.0 percent). These are the leading non-rice crops grown in the ZOI; however, there are many other non-rice crops grown in this region, too.

1.3 Purpose of this assessment

The purpose of this assessment is to provide the U.S. Government interagency partners, the USAID Bureau for Resilience and Food Security (RFS), USAID/Bangladesh, the Bangladesh government, and development partners with a baseline for Feed the Future Phase 2 ZOI indicators and enable the measurement of changes in indicator estimates and select demographic and household characteristics between 2018/2019 and forthcoming Feed the Future ZOI Surveys. However, the Feed the Future ZOI Surveys are not designed to support conclusions of causality or program attribution.

[15] FAO/WHO (2014)
[16] BBS (2018)
[17] FPMU (2020)

2 METHODOLOGY FOR OBTAINING VALUES FOR FEED THE FUTURE INDICATORS

This chapter describes the methodology used to obtain the Feed the Future population-based ZOI indicators. It provides information on the data sources and describes measures and reporting conventions used throughout the report.

2.1 Methodology

This section describes the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019, including discussion of the sample design (including targeted sample size), questionnaire customization, fieldwork, response rates, and limitations of the survey.[18] Appendix 2.1 provides additional details on the sampling and weighting methodology.

2.1.1 Survey sample design

The Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 included a representative, random sample of the entire population living in the ZOI. The ZOI baseline survey used a cross-sectional, multi-stage cluster sampling design. The sample size was the largest required to capture an estimated meaningful amount of change over a six-year period across three Feed the Future goal-level indicators (prevalence of poverty, prevalence of food insecurity, and prevalence of stunting). It is assumed that an endline PBS will be conducted after six years to test for statistical change in the indicators. To this end, targets were set to reduce stunting by 25 percent, hunger by 50 percent, and poverty by 25 percent of the baseline values over the six-year period.

For the "Prevalence of Stunted Children under Five" indicator, the initial sample size required was 1,383 children. This sample size was finalized after making two adjustments: (1) inflation for the number of households to contact (adj1= 1.76), and (2) inflation for anticipated household non-response (adj2 =1.02).[19] So, considering these, the final required sample size is 2,488. This means that 2,488 households should be sampled to ensure that anthropometric data of 1,383 children aged 0–59 months are collected, after accounting for the number of households that need to be visited and potential household non-responses. The "prevalence of stunted children" indicator has the largest final sample size requirement (2,488 households) of all the indicators. So, this sample size should be large enough to capture statistically significant changes in other indicators. Therefore, the overall sample size for the survey was targeted at 2,500 households.

The Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 sampling frame was developed using the Population and Housing Census 2011. The sampling frame was stratified by division to create 3 strata (Barishal Division, Khulna Division, and 5 districts of Dhaka Division). Only rural areas were

[18] Survey methodological requirements and supporting documentation for Feed the Future Zone of Influence Surveys are available online at https://www.agrilinks.org/post/feed-future-zoi-survey-methods.

[19] Further descriptions and calculations on adjustments are available in the Sampling Guide. Diana Maria Stukel. 2018. *Sampling Guide for Population-Based Surveys in Support of Feed the Future Zone of Influence Indicators.* Washington, DC: Food and Nutrition Technical Assistance Project, FHI 360.

included in the sampling frame of the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 as the Feed the Future program is implemented mostly in rural areas. The number of primary sampling units (PSUs) in each stratum was proportional to the population in that stratum, with at least one PSU in each stratum. A total of 125 PSUs were selected based on 20 households to be interviewed per PSU.

In the first sampling stage, PSUs (or segments, if there were any exceptionally large PSUs) were selected using probability proportional to size methodology. Before fieldwork began, a complete household listing was conducted in each PSU or segment, from which 20 households were selected for interview using fractional interval systematic sampling; this constituted the second stage of sampling. In the third stage, eligible individuals were selected within the households using a "take all" approach–that is, all eligible individuals were selected into the sample. During fieldwork, if more than one household was discovered in a single dwelling unit and they were not listed separately, all resident households were interviewed.

More details on sample sizes and response rates are presented in **Table 2.1.1**. Appendix 2.1 provides additional details on the sampling and weighting methodology.

2.1.2 Questionnaire design

IFPRI has extensive experience in designing and implementing surveys similar to the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 in Bangladesh and other countries. As a starting point, IFPRI researchers used the Feed the Future Bangladesh ZOI Interim Survey 2015 questionnaire as the foundation to update the questionnaire for the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019. IFPRI researchers had previously consulted the 2010 Household Income and Expenditure Survey (HIES) to collect data on a comparable set of variables. In 2018/2019, IFPRI conducted the final round of the Phase 1 ZOI panel survey (endline), and the Phase 2 ZOI Baseline Survey was conducted on a newly-drawn cross-sectional sample. The same survey questionnaire was used for both surveys. Many indicators from the 2015 Interim Survey were maintained in the 2018/2019 survey questionnaire to ensure comparability with previous Phase 1 ZOI survey rounds.

During the planning phase, USAID and IFPRI had several meetings to discuss the necessary modifications. USAID provided IFPRI a draft template survey questionnaire. IFPRI researchers incorporated the new modules and questions from the draft template survey questionnaire provided by USAID into the updated survey questionnaire for the 2018/2019 baseline survey to ensure that it would collect the necessary data to measure the new indicators.

Revisions of the questionnaires took place during the following periods: (1) upon receipt of the questionnaires for initial translation and adaptation of the questionnaires to the local context before the survey enumerator training; and (2) following the survey enumerator training and practice session/pretest (testing stage), during which feedback was incorporated.

The local survey firm Data Analysis and Technical Assistance (DATA) translated the questionnaire into Bangla, and IFPRI and DATA worked together to ensure appropriateness and clarity in the local context. For example, during the translation phase, some questions were rephrased, modified to provide examples where necessary, and the survey questionnaire was reformatted to make it easier for the survey enumerators to deliver the questions.

2.1.3 Timing of the survey

The Feed the Future 2018/2019 baseline survey took place from November 11, 2018 to February 6, 2019, which is considered the non-lean season in Bangladesh. The baseline survey was briefly disrupted for approximately one week due to national elections in December 2018.

Historically, September to October is the worst season in terms of food insecurity, caused by high rice prices and a lack of employment opportunities before the aman rice harvest in early November, both of which exacerbate the severity of this lean season. In contrast, mid-November to February represents the peak season, during which rice price falls and employment opportunities increase due to the aman and boro rice harvest, as well as wheat, and other winter season crop plantations. The second and relatively less severe lean season occurs from March to April, before the boro rice harvest, when rice prices tend to be high.

However, the severity of the two lean seasons has reduced remarkably in recent years. Monthly rice prices displayed a greater degree of stability over the last two decades compared with the 1980s and 1990s, which significantly lessened the severity of both lean seasons. There are two major factors that likely account for the increased price stability. First, the phenomenal growth of irrigated boro rice in the dry season (which increased the share of boro rice in total production from about 20 percent in the early 1980s to about 55 percent in the mid-2010s) increased the stability of production and resulted in a more even distribution of market arrivals of rice. The increase in the share of boro in total rice production has eliminated the steep seasonal rise in prices. Second, improved infrastructure and enhanced capacity of the government and farmers to undertake effective resilience measures may have reduced the magnitude of rice production shortfalls caused by floods and other natural disasters, thus contributing to improved supply stability.

Moreover, rapid growth in micro, small and medium enterprises has been generating year-round employment and income in both urban and rural areas, and thus, contributing to consumption-smoothing. The share of agriculture in Bangladesh's GDP declined from 30.5 percent in 1990 to 12.7 percent in 2019, and the share of non-farm employment has now surpassed that of farm employment. Rural real wages have risen significantly since the early 2000s as more workers have shifted to the formal sector and other non-farm jobs. Labor in rural areas has become scarcer, bidding up real wages, and thereby enhancing total labor earnings and food security.[20]

Bangladesh is no exception to both the spatial and temporal aspects of seasonality. Such spatial variations in seasonality among regions within Bangladesh may be a source of biased estimates. For example, the September to October lean season is most relevant for the northwestern region of Bangladesh where the poverty rate is the highest. By contrast, the months of September and October is 'normal' to 'good' seasons in the southern part of the ZOI, where aquaculture generates higher incomes than rice cultivation.

Setting longer recall periods in survey instruments can ameliorate the impact of seasonality. In the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019, a fixed recall period of 12 months (between December 1, 2017 and November 30, 2018) was used for agricultural production data collection, thus

[20] Zhang et al. (2014)

eliminating potential seasonal bias in the data. Moreover, the non-food expenditure module used recall periods ranging from one to 12 months, reducing seasonal bias in consumption expenditures used as proxies for income. The Food Insecurity Experience Scale (FIES), which measures the percentage of individuals on the population that experienced food insecurity at some levels prior to 12 months of the survey, also has the recall period of 12 months. However, time sensitive information like women's dietary diversity measure only has a 24-hour recall period and much of the consumption data (i.e., food consumption data), has less than 12 months recall period.

IFPRI researchers concluded that seasonality does not bias the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 estimates of indicators in this report based on the five main considerations discussed above: (1) the timing of the ZOI baseline survey, (2) significantly lessened severity of the traditional lean seasons, (3) consumption-smoothing effects of rural non-farm employment generation, (4) spatial variations in seasonality, and (5) the length of recall periods in survey instruments.

2.1.4 Listing

The household listing process included the following several steps. First, after selecting the 125 PSUs in the first stage of sampling, a complete census was conducted in each of the selected PSUs where the number of households residing in the PSU was less than or equal to 300. Next, if the number of households in the PSU was greater than 300, the PSU was hypothetically segmented and clusters of around 300 households were formed. One cluster was then randomly selected, and a complete census was conducted in the selected cluster. Then 20 households were randomly selected from each PSU/cluster of the census list of households.

2.1.5 Training for main fieldwork

Prior to fieldwork, all field staff were trained on survey procedures, including preparing for fieldwork, questionnaire content, human subjects protection, fieldwork procedures, data management, reporting, and communications. Training included hands-on training and practice sessions, a pre-test, and a survey pilot test. As the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 was administered via hard copy questionnaires instead of computer-assisted personal interviewing, tablets were not used and, hence, were not part of the survey training.

2.1.6 Fieldwork

Field-level survey implementation took place over 12 weeks, from November 11, 2018 to February 6, 2019. The fieldwork was conducted by 24 seven-member field teams, composed of a field supervisor and three male interviewers and three female interviewers. Because of the gender-sensitive nature of some aspects of the social survey questionnaire, female interviewers interviewed female respondents and male interviewers interviewed male respondents of each selected households. However, each field team travelled together in a vehicle.

Each field team was visited regularly by a team from Dhaka to ensure they had the needed supplies and that any problems requiring central administration support received prompt attention. The visiting teams also provided the interviewing teams with moral support and an additional layer of field supervision and quality assurance. Appendix 3 provides more information on quality control measures.

Inaccessible clusters were not an issue for this survey.

2.1.7 Data management and analysis

For the Feed the Future ZOI Survey data analysis, IFPRI calculated indicators using Feed the Future standard guidance in the Feed the Future Indicator Handbook and PBS guidance.

The 2018/2019 baseline data were captured by IFPRI on hard copy questionnaires, after which, IFPRI and DATA took extensive care to ensure the quality of the household survey data. For example, in the field, survey supervisors routinely oversaw interviews conducted by enumerators, and verified that enumerators completed all hard copy questionnaires daily. If the supervisors detected inconsistencies in responses to completed questionnaires, they visited the related respondents to find out the reasons and correct the responses as needed. In addition, the supervisors made random checks of about 10 percent of the completed questionnaires by revisiting the sample households. Furthermore, IFPRI researchers made frequent field visits to supervise the fieldwork.

The DATA office in Dhaka carried out the data entry simultaneous to data collection, with about a one-week time lag. Efforts were made to enter the data as soon as possible after data collection in case there were errors that could only be addressed by returning to the PSU where the errors occurred.

DATA carried out a double entry method of data input, where the same data were entered by two individuals to minimize data entry errors in the final dataset. Before the data are published for open access online, IFPRI will remove the personally identifiable information (PII).

DATA completed 100 percent double entry of data of the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 by using a customized data input software developed by DATA. The software utilized the public domain software package of the United States Census Bureau, the Census and Survey Processing System (CSPro), which was programmed to identify values that were out of range or inconsistent with other responses in the questionnaire. These steps in data processing are in line with the Feed the Future Data Processing and Finalization Procedures.[21]

Design weights are calculated based on the separate sampling probabilities for each sampling stage and for each cluster, using the following factors and calculations:

f_{1hi} = first-stage sampling probability of the *i*-th cluster (village) in stratum *h*

f_{2hi} = second-stage sampling probability within the *i*-th cluster (household selection)

f_{3hi} = third-stage sampling probability within the sampled household (individual selection)

The first-stage probability of selecting cluster *i* in the sample is:

$$f_{1hi} = \frac{m_h \times N_{hi}}{N_h}$$

The second-stage probability of selecting household in cluster *i* is:

[21] Dupuis, Useem, and Johnson (2019)

$f_{2hi} = \frac{n_{hi}}{L_{hi}}$

and, the third stage probability of selecting all individuals within the sampled household is:

$f_{3hi} = 1$,

Where,

$m_h =$ number of sample clusters selected in stratum *h*

$N_{hi} =$ total population in the frame for the *i*-th sample cluster in stratum *h*

$N_h =$ total population in the frame in stratum *h*

$n_{hi} =$ number of sample households selected for the *i*-th sample cluster in stratum *h*

$L_{hi} =$ number of households listed in the household listing for the *i*-th sample cluster in stratum *h*

The overall selection probability of each household in cluster *i* of stratum *h* is the product of the selection probabilities of the three stages, and the design weight for each household in cluster *i* of stratum *h* is the inverse of its overall selection probability.

$$W_{hi} = \frac{1}{f_{hi}} = \frac{1}{f_{1hi} \times f_{2hi} \times f_{3hi}} = \frac{N_h \times L_{hi}}{m_h \times N_{hi} \times n_{hi}}$$

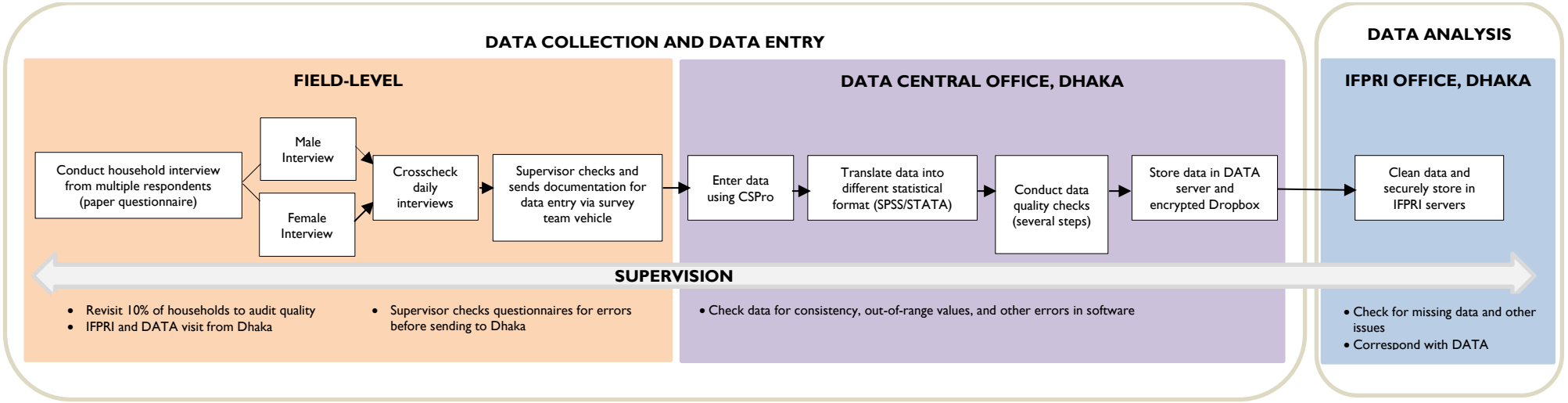
The sampling weight is calculated with the design weight corrected for non-response for each of the selected clusters. Response rates are calculated at the cluster level as ratios of the number of interviewed units over the number of eligible units, where units could be household or individual, such as woman or child. The household sampling weight is calculated by dividing the household design weight by the household response rate. The individual sampling weight is calculated by dividing the household sampling weight by the individual response rate. Further information on the sample weights is available in the Sampling Manual.[22]

BDHS 2017/2018 data were analyzed for select childhood undernutrition indicators and took advantage of the Z-score that was already provided in the dataset.

Figure 2.1 summarizes DATA and IFPRI's primary data processing steps for this survey.

[22] The Feed the Future Sampling Manual is available on Agrilinks: https://agrilinks.org/post/feed-future-zoi-survey-methods

Figure 2.1: Summary of data processing steps under the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 in Bangladesh



Source: Constructed by authors.

2.1.8 Limitations of the survey

Bangladesh Demographic and Health Survey (BDHS) 2017/2018 data were used for select nutrition indicators. The 21 Phase 2 ZOI districts were included in the analysis.

IFPRI researchers used the average estimates of poverty from the combined rural Barishal and rural Khulna divisions sample from HIES to measure poverty indicators at the national extreme poverty threshold and national poverty threshold to represent the Feed the Future ZOI because only a small part of the Dhaka division belongs to the ZOI.

2.1.9 ZOI Survey response rates

Table 2.1.1 presents the response rates for the Bangladesh ZOI Baseline Survey 2018/2019. The table presents components and response rates for each group for which a sampling weight was generated: sampled households, women of reproductive age (15-49), primary adult male and female decisionmakers, children under 5 years of age, children under 2 years of age, producers of any targeted commodity, and producers of each targeted commodity separately.

Table 2.1.1: Results of Household and Individual Interviews for the Bangladesh Feed the Future ZOI Baseline Survey 2018/2019, in Total

Response rates	Total
Households	
Number of households selected	2,525
Humber of households occupied	2,525
Number of households interviewed	2,525
Household response rate (%)[a]	100.0
Women of reproductive age (15-49 years)	
Number of eligible women	2,850
Number of eligible women interviewed	2,758
Eligible women response rate (%)[b]	96.8
Primary adult female decisionmakers (18+ years)	
Number of eligible women[c]	2,518
Number of eligible women interviewed	2,509
Eligible women response rate (%)[b]	99.6
Primary adult male decisionmakers (18+ years)	
Number of eligible men	2,228
Number of eligible men interviewed	2,213
Eligible men response rate (%)	99.3
Children under 5 years of age	
Number of eligible children	—
Number of caregivers of eligible children interviewed	—
Eligible children response rate (%)	—
Children under 2 years of age	
Number of eligible children	—
Number of caregivers of eligible children interviewed	—
Eligible children response rate (%)	—

Response rates	Total
Farmers of any targeted value chain commodity[d]	
Number of eligible farmers	2,314
Number of eligible farmers interviewed	2,313
Eligible farmer response rate (%)[b]	100.0
Rice farmers	
Number of eligible farmers	1,598
Number of eligible farmers interviewed	1,597
Eligible farmer response rate (%)[b]	99.9
Fishpond farmers	
Number of eligible farmers	548
Number of eligible farmers interviewed	548
Eligible farmer response rate (%)[b]	100.0
Dairy farmers	
Number of eligible farmers	844
Number of eligible farmers interviewed	844
Eligible farmer response rate (%)[b]	100.0

Note: Residence columns have been removed because the ZOI survey has been conducted in rural areas only.

[a] Household response rates are calculated based on the result codes of Module 1, the household roster, and are defined as the number of households interviewed divided by the number of households occupied. Households that were found to be vacant, not a dwelling unit, or destroyed were considered unoccupied and thus excluded from the response rates.

[b] Individual response rates are calculated based on the result codes in the relevant individual modules (i.e., Modules 6 and 7). These rates are defined as the number of eligible individuals interviewed divided by the number of eligible individuals. Eligibility determination for Modules 6 is initiated in the household roster and confirmed in the respective module. Eligibility determination for Module 7 is initiated in Module 2, *Dwelling characteristics,* and confirmed in Module 7.

[C] The number of eligible women is different from the sample size mentioned in the WEAI module because this includes primary females from non-agricultural households.

[d] The targeted value chains in the Bangladesh 2018/2019 Feed the Future ZOI Survey were rice, fishpond aquaculture, and dairy farming.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

2.1 Measures and reporting conventions used throughout this report

2.1.1 Standard indicator disaggregates

A standard set of indicators disaggregate variables are used in tables throughout this report. This section lists each of the standard disaggregate variables and defines how the variable is calculated.

Age in years

Data on household members' age in years are collected in the household roster. For women 15-49 years of age and children under 6 years of age, more detailed age data are collected in subsequent questionnaire modules to confirm eligibility to respond to the module questions; these more detailed age data are used where available. Age is generally presented in the tables in 5- or 10-year age groups.

Age in months

For measuring selected child nutrition indicators, IFPRI used data from the BDHS 2017/2018. The age of children in months is collected in the child nutrition-focused module of the BDHS 2017/2018

questionnaire,[23] so that the children's parents or primary caregivers can be prompted to provide the most accurate age possible. Children's age in months is presented by monthly age groups as appropriate for the children's dietary intake and anthropometry tables. For example, for the minimum acceptable diet table (**Table 8.3.2**), which presents the minimum acceptable diet indicator for children 6-23 months of age, children's age in months is disaggregated into 6-month age groups as follows: 6-11 months, 12-17 months, and 18-23 months. For the children's anthropometry tables (**Table 9.2.1** and **Table 9.2.2**), which present the prevalence of stunting, wasting, and underweight for all children under 5 years of age, children's age in months is disaggregated into 12-month age groups as follows: 0-11 months, 12-23 months, 24-35 months, 36-47 months, and 48-59 months.

Sex

Sex—male or female—is a standard disaggregate for the tables presenting children's indicators (e.g., children's anthropometry [**Table 9.2.1** and **Table 9.2.2**]), as well as agricultural indicators. The sex of household members is collected in the household roster.

Educational attainment (household)

Household educational attainment reflects the highest level of education attained by any member of the household, as reported in the household roster. This variable is used in tables that present household--level data, and comprises five categories: no education (households with no member who has received formal education); less than primary (households with at least one member who has received formal schooling, but with no member who has completed primary); completed primary (households with at least one member who has completed primary, but with no member who has completed secondary); completed secondary (households with at least one member who has completed secondary, but with no member who has completed any higher formal education); and higher (households with at least one member who has completed formal education higher than secondary—even if only one year). Households are categorized in only one of the five categories.

Educational attainment (individual)

Educational attainment at the individual level reflects the highest level of education attained by individual household members, as reported in the household roster. This variable comprises five categories: no education (those who have not received any formal education); less than primary (those who have received formal education but who have not completed primary); completed primary (those who have completed primary but who have not completed secondary); completed secondary (those who have completed secondary but who have not completed any higher formal education); and higher (those who have completed formal education higher than secondary—even if only for one year).

Gendered household type

Feed the Future disaggregates household-level indicators by gendered household type—that is: (1) households that include both male and female adults, 18 years of age or older; (2) households that include female adults, but no male adults; (3) households that include male adults, but no female adults; and (4) households with only members under 18 years of age (households with children only and no adult members). This approach to conceptualizing household type is distinct from the standard "head of

[23] NIPORT (2020)

household" approach, which is embedded with presumptions about household gender dynamics, and may perpetuate existing social inequalities and prioritization of household responsibilities that may be detrimental to women. This variable is calculated using data on the age and sex of household members, which are collected in the household roster.

Wealth quintile

The asset-based wealth index characterizes households into quintiles according to their wealth index score, which considers various dwelling characteristics and household ownership of various assets, which are collected in Module 2, *Dwelling characteristics*. Wealth quintile is used as a disaggregate for many household-level indicators, as well as some person-level nutrition and agriculture indicators. More details can be found in Section 4.2, and additional information about construction of the wealth index can be found in Appendix 2.2.b.

Poverty status

As described in greater detail in Section 4.1 of this report, poverty status characterizes households as poor if household members live below the poverty threshold—that is, on less than $1.90 per person per day at 2011 purchasing power parity (PPP), or as non-poor if household members live at or above the poverty threshold—that is, on $1.90 or more per person per day (2011 PPP). Poverty status is calculated using data collected in Module 8, *Household consumption expenditure*. Poverty status is used as a disaggregate for many household-level indicators, as well as some person-level nutrition and agriculture indicators.

Shock exposure index

The shock exposure index (SEI) assigns households a score depending on the number and severity of shocks the household experienced during the 12 months preceding the ZOI Survey. For the SEI, disaggregate households are then categorized into one of four categories based on their score: did not experience any shocks (SEI score=0), low (SEI scores 2-4), moderate (SEI scores 5-8), and high (SEI scores 9-50). Households with an SEI score of 0 are assigned to the first category because they did not experience any shocks. The remaining three categories are meant to split households with an SEI score higher than 0 into roughly even categories. The SEI is calculated using data collected in Module 3, *Food security and resilience*. The SEI is used as a disaggregate for many household-level indicators, as well as some person-level nutrition and agriculture indicators. See Section 5.2 for further information on the SEI.

2.1.2 Reporting conventions

This section provides an overview of the conventions used in reporting the descriptive results from the Feed the Future Bangladesh ZOI baseline survey 2018/2019.

- In the tables throughout this report, weighted point estimates and unweighted sample sizes are presented.
- Most estimates are shown to one decimal place, with the specific exceptions of A-WEAI, the five domains of empowerment (5DE), and gender parity index (GPI) indicators, which are shown to two decimal places. Unweighted sample sizes in all tables and the population estimates in Section 1.2.2 tables are shown as whole numbers.

- Values in the tables are suppressed when the unweighted sample size is insufficient to calculate a reliable point estimate (n<30); this is denoted by the symbol "^" in the designated row and an explanatory footnote.
- Tests of difference are performed to determine whether there is an association between the outcome and the indicator disaggregates. Statistically significant differences are designated with asterisks (* indicates a p<0.05, ** indicates a p<0.01, and *** indicates a p<0.001) in tables. For disaggregates that are categorical variables presented in rows, the level of significance is indicated in the "Sig." column of disaggregate heading row, which is usually shaded light blue. In these cases, the "Sig." column is greyed out for the category rows. For disaggregates presented in columns (e.g., many of the agriculture tables), the significance results are displayed in the same row as the estimates.

Analyses are performed in Stata using '*svy*' commands to handle features of data collected through the use of complex survey designs, including sampling weights, cluster sampling, and stratification.

2.1.3 Understanding results tables in this report

Tables in the Feed the Future Bangladesh ZOI baseline survey report present sample-weighted estimates for key indicators, household demographics, and ZOI characteristics (outcomes), both overall and by selected disaggregates, the unweighted sample size (denominator) for each estimate, and the effect of each disaggregate on the outcome. Narrative and figures found throughout this report highlight key findings presented in the tables, but not every finding can be discussed or displayed graphically. For this reason, data users should be comfortable reading and interpreting tables correctly, even without having to consult the text of the report. This is important because users of reports will later cite results in tables without referencing the text.

The following examples and exercises introduce the organization of tables in the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 report and describe how to interpret them.

Example 1: One Binary Outcome; Disaggregates in Rows

Table 5.3.1: Percent of Households in the Bangladesh ZOI that Believe Local Government Will Help the Community Cope with Future Shocks and Stressors, in Total and by Selected Household Characteristics

Household characteristic	Percent	Sig.[a]	Number of households[b,c]
All households	73.8		2,485
Gendered household type		n/s	
Male and female adults	73.7		2,191
Female adults only	73.7		287
Male adults only	^		6
Children only (no adults)	^		1
Household education		*	
No education	64.3		144
Less than primary	71.7		263
Completed primary	73.8		1,347
Completed primary	79.0		347
Completed secondary or higher	74.0		384
Wealth quintile		**	
Highest (wealthiest)	80.0		483
Fourth	72.8		476
Middle	74.6		501
Second	73.8		498
Lowest (poorest)	67.9		527
Poverty status		n/s	
Poor	72.8		220
Non-poor	73.9		2,265
Shock exposure index		**	
Did not experience any shocks	76.5		1,238
Low	75.6		473
Moderate	68.2		489
High	68.2		285

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] Estimates include only households that experienced at least one shock or stressor during the 12 months preceding the ZOI Survey. Estimates exclude households that reported that local government will not need to help the community cope with shocks or stressors in the future.

Note: Estimates are based on de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Step 1: Read the table title and review the footnotes, highlighted in orange in Example 1.[24] Note the unit of analysis—that is, whether the table refers to households or individuals (e.g., women of reproductive age, children under 5 years of age, rice farmers). In this example, the table presents the

[24] Footnotes contain definitions of symbols, abbreviations, and acronyms included in the table, information about significance tests, and notes about specific estimates or denominators, such as inclusion or exclusion criteria.

percentage of households in the ZOI that believe that the local government will help the community cope with future shocks and stressors, in total and by selected household characteristics. The selected household characteristics (i.e., disaggregates or factors of interest), are identified in Step 2.

Step 2: Scan the row headings in the first column, which is highlighted in purple in Example 1. This "Household characteristic" column indicates that estimates are being presented for all households and by five disaggregates: gendered household type, household education, wealth quintile, poverty status, and shock exposure index.[25] What are the household education disaggregate categories? They are: "No education," "Less than primary," "Completed primary 1," "Completed primary 2," and "Completed secondary or higher."

Step 3: Scan the columns in green that contain data. In Example 1, there are three columns that contain data: (1) "Percent," which contains sample-weighted estimates that were generated using household weights; (2) "Sig.," which contains symbols indicating the results of the test of statistical significance assessing the relationship between the disaggregate and the outcome (see footnote "a" and Step 5); and (3) "Number of households," which contains the unweighted number of sampled households used to calculate the indicator.[26]

Step 4: Now that you understand the contents of the table, you can begin to examine the data. Look at the "Percent" and "Number of households" columns. What percentage of all households believe that the local government will help the community cope with future shocks and stressors? Looking at the "Percent" column, we can see that this is 73.8 percent (circled in blue in the "All households" row). How many households are included in the calculation of the indicator? Looking at the "Number of households" column, we can see that there are 2,485 households (also circled in blue in the "All households" row). Footnote "c" indicates that this is the total number of households that experienced at least one shock or stressor during the 12 months preceding the survey and includes households that reported, yes, the local government will help, or no, the local government will not help. These estimates exclude households that reported the local government will not need to help the community cope with shocks or stressors in the future.

What percentage of male and female adult households believe that the local government will help the community cope with future shocks and stressors? This is 73.7 percent (circled in blue in the "Male and female adults" row under the "Gendered household type" row header). How many male and female adult households are in the sample? There are 2,191households (also circled in blue in the same row). For the gendered household type disaggregate, estimates for female adult only and male adult only households are not shown; instead, carets (^) are displayed. When symbols appear in a table, they are defined in a footnote. The caret (^) means that there are not enough observations to obtain a statistically reliable estimate—that is, the number of observations is fewer than 30, so the estimate is suppressed.

[25] Each of these disaggregates is defined in Section 2.2.1.

[26] Sample-weighted estimates are population-representative estimates obtained by applying a sampling weight that accounts for the survey sampling design and non-response among eligible respondents. The unweighted number of households is the sampled number of households included in the denominator of the indicator estimate calculation.

Step 5: How do we interpret the effects disaggregates have on the outcome—that is, is a result likely due to chance (or sampling error) or some factor of interest? Look at the "Sig." (statistical significance) column. As noted in Step 3, the "Sig." column contains symbols indicating the results of the test of statistical significance assessing the relationship between the disaggregates and the outcome or "n/a" if a test of statistical significance could not be performed (not shown in table). A value of "n/s" indicates that the p-value is greater or equal to 0.05; one asterisk (*) indicates that the p-value is less than 0.05 but greater or equal to 0.01; two asterisks (**) indicate that the p-value is less than 0.01 but greater or equal to 0.001; and three asterisks (***) indicate that the p-value is less than 0.001.

- Does belonging to a particular wealth quintile have an effect on the percentage of households that believe that the local government will help the community cope with future shocks and stressors? No—the "Sig." column shows "n/s" (not significant, as defined in footnote "a") circled in red in the wealth quintile disaggregate header row. This indicates that the p-value for the chi-squared test performed to assess the relationship between the binary outcome and the wealth quintile disaggregate is greater than or equal to 0.05, and we can, therefore, say that the results show that wealth quintile does not affect the percentage of households that believe that the local government will help the community cope with future shocks and stressors. In other words, we cannot say that the percentage of households that believe that the local government will help the community cope with future shocks and stressors differs across wealth quintiles; any differences in percentages are likely due to chance or sampling error.
- Does gendered household type have an effect on the same outcome? In the gendered household type disaggregate header row, the "Sig." column shows "n/s" circled in red. Footnote "a" tells us that "n/s" means "not significant." Also, when "Sig." column shows "n/a", the significance is noted as "not applicable." It happens because there is only one category with enough observations to calculate reliable estimates: two of the disaggregate categories have fewer than 30 observations, and one disaggregate category has no observations. A Pearson's chi-squared test, therefore, could not be performed.

NOTE: When carets (^), "n/a," or "n/s" are used in a table, the explanation will be noted under the table in the footnotes.

Example 2: Binary, categorical, and continuous outcomes; disaggregates in columns

Table 3.3.1: Household Dwelling Characteristics in the ZOI, in Total and by Gendered Household Type

Household characteristic	Total	Gendered household type				Sig.[a]
		Male and female adults	Female adults only	Male adults only	Children only	
Percent using solid fuel for cooking (%)[b]	94.2	94.5	92.6	^	^	n/s
Percent with access to electricity (%)	81.3	81.7	79.2	^	^	n/s
Mean number of persons per sleeping room[c]	2.2	2.3	1.9	^	^	***
Household roof materials (%)[d]						n/s
Natural	0.9	0.9	1.4	^	^	
Rudimentary	0.0	0.0	0.0	^	^	
Finished	96.4	96.5	95.5	^	^	
Other	2.7	2.7	3.1	^	^	
Household exterior wall materials (%)[e]						n/s
Natural	11.1	10.9	12.1	^	^	
Rudimentary	0.0	0.0	0.0	^	^	
Finished	88.8	88.9	87.9	^	^	
Other	0.2	0.2	0.0	^	^	
Household floor materials (%)[f]						n/s
Natural	75.8	75.4	77.9	^	^	
Rudimentary	0.0	n/a	n/a	^	^	
Finished	24.2	24.5	22.1	^	^	
Other	0.0	0.1	0.0	^	^	
Number of households	**2,525**	**2,222**	**296**	**6**	**1**	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant; n/a=not applicable.

[b] Solid fuel is defined as charcoal, wood, animal dung, straw/shrubs/grass, and agriculture crop residue. The no food cooked in household categories are removed from percentages.

[c] The average number of persons per sleeping room is a common indicator of crowding (UNDP, 2003).

[d] Natural roof includes no roof, thatch (palm leaf, straw, reed), and sod or bamboo. Rudimentary roof includes wood planks and cardboard. Finished roofs include metal, wood, calamine/cement fiber, ceramic tiles, cement, and roofing shingles.

[e] Natural wall includes no walls, cane/palm/tree trunks, dirt, bamboo with mud, and stone with mud. Rudimentary walls include plywood, cardboard, reused wood, and unbaked bricks. Finished walls include cement, stone with lime/cement, bricks, cement blocks, unbaked bricks covered with plaster, and wood planks/shingles.

[f] Natural floors include earth/sand, dung, and palm leaves. Rudimentary floors include wood planks and bamboo slats. Finished floors include parquet/polished wood, vinyl or asphalt strips, ceramic tiles, cement, and wall-to-wall carpet.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Step 1: Read the title and review the footnotes, highlighted in orange in Example 2. Note the unit of analysis—that is, whether the table refers to households or individuals. In this example, the table is about household dwelling characteristics in the ZOI, in total and by one standard disaggregate: residence.

Step 2: Scan the purple column that shows the indicators presented in Example 2. Unlike Example 1, which presents only one indicator, Example 2 includes multiple indicators, which are listed in the "Household characteristic" column. There are two indicators with binary outcomes (percent using solid fuel for cooking and percent with access to electricity), one indicator that is a mean (mean number of persons per sleeping room), and three indicators with categorical outcomes (household roof materials, household exterior wall materials, and household floor materials). In tables that include disaggregates in columns:

- Indicators with categorical outcomes have a header row that is light blue, and the outcome categories are indented in the white rows beneath the header row. Looking at the first column in Example 2, we can see that the household roof, exterior wall, and floor materials indicators each have four categories: "Natural," "Rudimentary," "Finished," and "Other."
- Indicators with binary or continuous outcomes do not include a header row; the overall estimate and estimates for the disaggregate categories are presented across one row (as shown for the first indicator, "Percent using solid fuel for cooking," in Example 2.

Step 3: Scan the panels containing data.[27] The table includes two panels in green: "Total," and "Gendered household type." The "Total" panel includes one column that shows the estimates for all households in the ZOI. The "Gendered household type" panel includes four columns that present data for the second disaggregate, by male and female adult households, female adult only households, male adult only households, and children only households, and a fifth column that presents the results of the statistical test of significance that assesses the overall relationship between the outcomes and gendered household type.

Step 4: Find the row at the bottom of the table that shows the number of observations. This row shows the denominator for all estimates in each column. In this table, it shows the number of households. How many households are there in total? There are 2,525 households (circled in yellow in the "Total" column). How many of these are female adults only households? There are 296 female adults only households (circled in yellow in the "Female adults only" column).

Step 5: Now that you understand the contents of the table, you can begin to examine the data. Look at the "Total" panel. What is the mean number of persons per sleeping room for all households? Look at the number circled in blue in that indicator row; there are 2.2 persons per sleeping room, and we know from Step 4 that this is out of 2,525 households. Now look at the "Gendered household type" panel. What percentage of female adults only households use solid fuel for cooking? Of the 296 female adults

[27] In tables with disaggregates as columns, a "panel" refers to a set of columns that have all data for a disaggregate. A panel commonly includes an estimate column for each disaggregate category and a significance column. In some tables, the panel may also include a sample size column. There will always be a panel with a single column for the overall estimate of each outcome in the table.

only households in the sample, 92.6 percent use solid fuel for cooking (circled in blue in the "Female adults only" column of that indicator row).

Step 6: How do we interpret the effects of disaggregates on the outcome—that is, is a result likely due to chance (or sampling error) or some factor of interest? When the disaggregates are included in a table as columns, note the following:

- For continuous outcomes (mean number of persons per sleeping room) and binary outcomes (percentage of households using solid fuel for cooking), the statistical significance is noted in the same row showing the outcome.
- For categorical outcomes (e.g., household roof materials), the statistical significance is noted in the light blue row showing the outcome or disaggregate header, and the other rows in the significance column are shaded gray.

Look at the "Sig." column in each disaggregate panel.

- Does gendered household type have an effect on the mean number of persons per sleeping room? Yes—although the sample sizes for male adult only and children only household estimates are too small to report estimates for these categories, we can see from the three asterisks ("***") circled in red in the indicators row that gendered household type does have an effect on the mean number of persons per sleeping room for male and female adult households and female adult only households. Further, because we are comparing only two disaggregate categories, we can say that the mean number of persons per sleeping room is greater for male and female adult households compared to female adult only households, and this difference is significant at the $p<0.001$ level.
- For binary outcomes, the Pearson's chi-square statistical test tells us whether there is a statistically significant relationship between the outcome and disaggregate. Does gendered household type have an effect on the percentage of households that uses solid fuel for cooking? No, Because the value in the "Sig." column is "n/s," we know that the overall p-value for the regression is greater than or equal to 0.05, and we can, therefore, say that the results show that gendered household type does not affect the usage of solid fuel for cooking. In other words, we cannot say that the usage of solid fuel for cooking differs by gendered household type; any difference in percentages for gendered households type is likely due to chance or sampling error.
- For categorical outcomes, the Pearson's chi-square statistical test also tells us whether there is a statistically significant relationship between the outcome and disaggregate. Does gendered household have any effect on the type of floor material households for their dwellings? No, the "n/s" circled in red in the indicator header row indicate that there is no significant effect. The type of floor material used (i.e., natural, rudimentary, finished, or other) is not significantly associated with gendered household type (i.e., Male and female adults, female adults only, Male adults only and children only). However, we cannot say if there is any difference in the types of floor materials for gendered household types without further statistical analysis and testing.

Example 3: Binary outcomes—multi-response questions or multiple yes/no questions within a category; disaggregates in columns

Table 7.1.6: Rice Farmers' Fertilizer Use, Types of Fertilizer, and Timing of Application in the ZOI, in Total and by Farmers' Sex and Age 1

Characteristic or practice	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Applied fertilizer	97.9	99.3	97.8	n/s	97.8	97.9	n/s
Number of rice farmers	**1,597**	**146**	**1,451**		**269**	**1,328**	
Type[b]							
Soil-based organic	12.3	7.6	12.8	*	14.9	11.8	n/s
Soil-based inorganic	97.6	100.0	97.4	***	97.7	97.6	n/s
Organic foliar feeds	2.6	2.1	2.6	n/s	2.7	2.6	n/s
Inorganic foliar feeds	7.6	11.9	7.1	n/s	7.3	7.6	n/s
Timing of application[b]							
Planting	83.6	85.9	83.4	n/s	83.5	83.7	n/s
Early growth stage	82.2	78.5	82.6	n/s	85.2	81.6	n/s
Mid-crop	46.6	48.3	46.4	n/s	45.7	46.7	n/s
Number of rice farmers who applied fertilizer	**1,563**	**145**	**1,418**		**263**	**1,300**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant; n/a=not applicable.
[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.
Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice. 1
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Step 1: Read the title and review the footnotes, highlighted in orange in Example 3. Note the unit of analysis—that is, whether the table refers to households or individuals. In this example, the table is about fertilizer use among rice farmers, in total and by two disaggregates: farmers' sex and age.

Step 2: Scan the purple column that shows the indicators that are presented. In Example 3, they are listed in the "Characteristic or practice" column. Unlike in the first two examples, there are multiple indicators listed under the "Type" and "Timing of application" light blue header rows. These indicators are binary outcomes created from single questions that allow for multiple responses. Because each response option can be considered a separate outcome with the same denominator, they are grouped together and indented under a light blue header row. The first indicator in the table, "Applied fertilizer," is presented without a header row because it was generated from a question that allowed for only one response.

Step 3: Scan the green panels containing data. There are three panels: "Total," "Sex," and "Age." The "Total" panel includes one column that shows the overall data for all *de jure* rice farmers in the ZOI. The "Sex" panel includes two columns that present data broken down by the first disaggregate, by female and male rice farmers, and a third column that presents the results of the statistical tests of significance that assesses the relationship between the outcomes and sex. The "Age" panel includes two columns that present data broken down by the second disaggregate, by farmers who are 15-29 years of age and farmers who are 30 years of age or older, and a third column that presents the results of the statistical test of significance that assesses the relationship between the outcomes and age category.

Step 4: Find the two yellow rows that show the number of observations, or sample sizes, in Example 3. Tables that present disaggregates in columns with estimates calculated for different populations will have multiple sample size rows. The first sample size row shows the denominator (number of rice farmers) for all estimates in each column above that row. This row shows the sample sizes for only the first outcome (applying fertilizer). The second sample size row shows the sample sizes for all estimates in each column beneath the first sample size row and includes only rice farmers who applied fertilizer in the 12 months preceding the survey. How many rice farmers are there in total? There are 1,597 rice farmers (circled in yellow in the "Total" column of first sample size row). How many of those rice farmers applied fertilizer in the 12 months preceding the survey? There are 1,563 rice farmers who applied fertilizer (circled in yellow in the "Total" column of second sample size row)—one rice farmer did not apply fertilizer in the year preceding the survey.

Step 5: Now that you understand the contents of the table, you can begin to examine the data. Look at the "Total" column. What percentage of rice farmers applied fertilizer? Of the 1,597 rice farmers, 97.9 percent applied fertilizer in the 12 months preceding the survey (circled in blue in the "Total" column of the "Applied fertilizer" row). Now look at the "Age" panel. What percentage of rice farmers 15-29 years of age who applied fertilizer used soil-based inorganic fertilizers? Of the 263 farmers 15-29 years of age who applied fertilizer, 97.7 percent used soil-based inorganic fertilizers (circled in blue in the "15-29" column and the "Soil-based inorganic" row).

Note that there is a footnote in the outcome header row for both "Type" and "Timing of fertilizer application." Footnote "b" states that farmers were allowed to provide more than one response, so percentages may not add up to 100 percent.

Step 6: How do we interpret the effects of disaggregates on the outcome—that is, is a result likely due to chance (or sampling error) or some factor of interest? Look at the "Sig." column in each disaggregate panel.

- Does age group have an effect on the percentage of rice farmers who applied fertilizer? No—the significance is denoted by "n/s" (circled in red in "Applied fertilizer" row) indicate that age group has no effect on the percentage of farmers who apply fertilizer.
- Does farmers' sex have an effect on the percentage of rice farmers who applied soil-based inorganic fertilizers, among rice farmers who applied any fertilizer? Yes—the three asterisks is denoted by "***" (circled in red in "Soil-based inorganic" row) indicate that farmers' sex has an effect on the percentage of farmers who applied soil-based inorganic fertilizers and looking at the estimates for the two sex categories, we can say that the percentage of female rice farmers who applied fertilizer is greater than the percentage of male rice farmers who did so, at $p<0.001$.

Because the type of fertilizer used and timing of fertilizer application questions allowed for multiple responses and each response option was converted to a binary outcome, we can perform a statistical test of significance assessing the relationship between each outcome (response option) and disaggregate using a Pearson's chi-squared test. For example, for the timing of fertilizer application, we can say whether farmers' age has an effect on whether farmers applied fertilizer during the planting phase, during the early growth phase, during the mid-crop phase, and during any other phase.

If, however, farmers were asked when they *mainly* applied fertilizer, and farmers had to provide only one response, then a Pearson's chi-squared test would indicate whether there is a statistically significant difference among the three possible outcomes by age, but it would not indicate for which groups the difference is statistically significant.

3 DEMOGRAPHIC CHARACTERISTICS IN THE ZOI

This chapter describes the background characteristics of the ZOI population using data from the Feed the Future Bangladesh ZOI baseline survey 2018/2019, which are assumed to remain relatively static over time.

3.1 Household demographics

Table 3.1.1 presents demographic characteristics of ZOI households for all households and by gendered household type. This table presents the average de jure household size, as well as the average number of de jure household members by key categories, the percentages of de jure adult household members who are male and female, and the percent distribution of households. Estimates are also presented by household education, defined as the highest level of education of any de jure member of the household.

Most households in the sample are categorized as male and female adult households (2,222), with a considerably smaller sample of female adult only households (296). Estimates for male adult only and child-headed households are not reported due to very small sample sizes.

The mean household size is 4.0 persons across all ZOI households. Gendered household type has an effect on mean household size—male and female adult households have a higher household size than female adult only households (4.1 and 3.0 persons, respectively), which is statistically significant at the 0.1 percent level. The majority of households are small (86.8 percent), which suggests less crowding and improved living conditions compared with households that have higher dependency ratios.

Gendered household type is also associated with age composition at the household-level: female adult only households have a higher proportion of children 5-17 years of age than male and female adult households (1.3 versus 1.0 persons, respectively), which is statistically significant at the 0.1 percent level. Moreover, male and female adult households have a slightly higher mean number of adult female household members 18+ years of age than female adult only households (1.4 versus 1.3 persons, respectively), which is statistically significant at the 5 percent level.

Over half of all ZOI households (54.2 percent) have at least one member who has completed primary education. Although there is a higher percentage of female adult only households with at least one member who has completed primary education than male and female adult households, the inverse is true for completed secondary education and higher, where a higher proportion of male and female adult households have at least one member with education at those levels.

Table 3.1.1: Household Demographic Characteristics in the ZOI, in Total and by Gendered Household Type

Household characteristic	All households	Gendered household type				Sig.[a]
		Male and female adults	Female adults only	Male adults only	Children only	
Mean household size	4.0	4.1	3.0	^	^	***
Mean number of children under 2 years of age	0.2	0.2	0.2	^	^	n/s
Mean number of children under 5 years of age	0.4	0.4	0.4	^	^	n/s
Mean number of children 5 years of age or older (5-17 years)	1.0	1.0	1.3	^	^	***
Mean number of youth (15-29 years)	1.0	1.0	0.7	^	^	***
Mean number of women of reproductive age (15-49 years)	1.1	1.1	1.1	^	^	n/s
Mean number of adult male household members[b]	1.2	1.3	0.0	^	^	***
Mean number of adult female household members[b]	1.4	1.4	1.3	^	^	*
Mean number of producers of any targeted commodity[c]	0.9	1.0.	0.4	^	^	***
Percent of adults who are male (%)[b]	43.4	48.9	0.0	^	^	***
Percent of adults who are female (%)[b]	56.7	51.1	100.0	^	^	***
Household size (%)						***
Small (1-5 members)	86.8	85.2	99.0	^	^	
Medium (6-10 members)	13.1	14.7	1.0	^	^	
Large (11 or more members)	0.1	0.1	0.0	^	^	
Number of households (*n*)	**2,525**	**2,222**	**296**	**6**	**1**	
Household education (%)[d]						***
No education	5.8	5.5	8.2	^	^	
Less than primary	10.5	10.1	13.4	^	^	
Completed primary	54.2	53.1	61.6	^	^	
Completed secondary	14.0	14.7	9.0	^	^	
Higher	15.5	16.6	7.8	^	^	
Number of households (*n*)	**2,525**	**2,222**	**296**	**6**	**1**	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.001, *** p<0.001; n/s=not significant.

[b] Feed the Future defines adult as an individual 18 years of age or older. Females and males 15-17 years of age are of reproductive age but are not considered adults by this definition.

[c] Targeted commodities in Bangladesh include rice, fishponds, and dairy cows.

[d] Estimates are based on de jure household members.

Note: Estimates are based on de jure household members, except where noted.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 3.1.2 shows characteristics of the primary adult female and male decisionmakers in the sample households in the ZOI. The primary adult female and male decisionmakers are household members who are 18+ years of age and who self-identify as the primary adult male or primary adult female responsible for both social and economic decisionmaking in the household. When both exist in a single household, primary adult female and male decisionmakers are typically, but not necessarily, husband and wife.

Table 3.1.2 shows the age group, marital status, educational attainment, and participation in economic activity for these household members.

Virtually all primary adult decisionmakers are married (95.4 percent among females and 96.7 percent among males), which corresponds with ubiquitous social norms to formalize a relationship through marriage. As such, no respondents report living in a consensual union and no females report never marrying, with a very negligible percentage of men reporting never wedding (2.7 percent).

A higher proportion of primary female adult decisionmakers completed primary school than their male counterparts (45.2 percent versus 33.4 percent), whereas more males have completed at least secondary school than females. Almost all primary adult decisionmakers in the ZOI are engaged in some form of paid or unpaid economic activity (95.8 percent among females and 98.5 percent among males), which is statistically significant at the 0.1 percent level.

Farming is the most prevalent economic activity across primary adult female and male decisionmakers, with a slightly higher proportion of females engaged in this activity than males (94.3 percent and 89.9 percent, respectively). Although primary female adult decisionmakers are also engaged in non-farm and wage or salaried work in the ZOI (14.9 percent and 12.5 percent, respectively), there are gender disparities in the participation of economic activities, with male participation in these activities between three- to four-times higher. Overall, the association between participation in farm, non-farm, and wage or salaried work among primary adult female and male decisionmakers is statistically significant at the 0.1 percent level.

Table 3.1.2: Characteristics of Primary Adult Decisionmakers in the ZOI, by Sex

Background characteristic	Female (%)	Male (%)	Sig.[a]
Age			
18-24	12.0	3.8	
25-29	12.7	7.2	
30-34	15.0	11.7	
35-39	14.8	13.1	
40-44	11.2	10.7	
45-49	12.7	12.3	
50-54	8.6	10.2	
55-59	6.3	9.7	
60+	6.7	21.3	
Marital status			
Married	95.4	96.7	
Living in a consensual union	0.0	0.0	
Widowed	3.9	0.3	
Divorced or separated	0.8	0.3	
Never married or in a union	0.0	2.7	
Highest educational attainment			
No education	32.1	37.5	
Less than primary	14.7	16.7	
Completed primary	45.2	33.4	
Completed secondary	4.8	5.6	
Higher	3.2	6.8	
Economic activity[b]			
Participates in some form of economic activity	95.8	98.5	***
Participation in economic activity by type[c]			
Farm	94.3	89.9	***
Non–farm	14.9	45.8	***
Wage or salaried	12.5	47.7	***
Number of primary adult decisionmakers (*n*)[d]	**2,509**	**2,216[e]**	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Both paid and unpaid types of economic activity are included. Domestic work, such as caring for children and the elderly or cooking and cleaning, is not included.

[c] Farm work includes food crop farming, cash crop farming, livestock raising, or fishing/fishpond culture; non-farm work includes running small businesses or self-employment; and wage/salaried employment includes both agriculture or non-agriculture-based work that is salaried. Percentages do not add up to 100 percent because individuals can engage in more than one type of economic activity.

[d] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[e] Information on participation in economic activity was not available for 12 primary male adults and 9 primary female adults.

Note: Estimates are based on primary adult decisionmakers who are de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

3.2 Household member education

Table 3.2.1 and **Table 3.2.2** present school attendance and educational attainment in the ZOI. **Table 3.2.1** presents the percentage of all de facto household members between 5 and 24 years of age who currently attend school, in total and by sex. **Table 3.2.2** presents the percentage of household members 10 years of age or older who have completed primary school, in total and by sex. The tables also include sex ratios for school attendance and attainment of primary education.

In Bangladesh, primary education is defined as five years of schooling (grades 1-5) beginning at 6 years of age. A student must pass the first national exam and receive a primary education certificate to complete primary education. Bangladesh's school year takes place from January to December for primary and secondary education. Since the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 was conducted from November to February, the data collection overlapped with the school year. The recall period for school attendance was for the last one year preceding the survey; therefore, the fact that part of the survey was conducted when children were not in school is unlikely to bias the data on school attendance.

A higher percentage of girls 5-14 years of age attended school in the year preceding the survey than boys in the ZOI, yet school attendance among boys 15-24 years of age outpaces girls in the same age group. Notably, school attendance among females 20-24 years of age is half that of males in the same age group. This coincides with the findings presented in **Table 3.1.2**, which show that more women than men obtained primary education, whereas a higher proportion of men completed secondary education than women. The difference in school attendance by sex is statistically significant at the 0.1 percent level.

Table 3.2.1: School Attendance at Time of Survey among Children and Youth 5-24 Years of Age in the ZOI, in Total and by Age and Sex

	Total		Female		Male			
Age (years)	Percent	n	Percent	n	Percent	n	Sig.[a]	Female to male ratio
Age category							***	
5-9	80.3	953	82.1	457	78.6	496		1.0
10-14	93.8	1,027	96.3	495	91.4	532		1.1
15-19	62.4	887	56.8	456	68.5	431		0.8
20-24	23.8	727	16.3	444	35.3	283		0.5

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de facto household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 3.2.2 presents an overview of the completion of primary education in the ZOI, by age and sex. In the ZOI, youth 15-19 years of age have the highest achievement of primary education among all age groups (87.9 percent), which gradually declines as age increases. The percentage of primary school completion among females surpasses males from age groups 10-14 to 35-39, yet men 40+ years of age have higher completion rates. This is indicative of the impact of gender-transformative education policies that were introduced in the last few decades in Bangladesh, which aimed to enhance gender parity in primary education enrollment and attendance. Overall, the difference in completion of primary education among individuals 10+ years of age is statistically significant at the 0.1 percent level.

Table 3.2.2: Completion of Primary Education among Individuals 10 Years of Age or Older in the ZOI, in Total and by Age and Sex

Age (years)	Total		Female		Male		Sig.[a]	Female to male ratio
	Percent	n	Percent	n	Percent	n		
Age category							***	
10-14	45.7	1,027	48.5	495	43.1	532		1.1
15-19	87.9	887	92.5	456	83.0	431		1.1
20-24	83.5	727	89.8	444	74.4	283		1.2
25-29	75.2	692	81.0	408	67.2	284		1.2
30-34	66.0	733	68.9	416	62.1	317		1.1
35-39	52.6	691	55.3	383	49.6	308		1.1
40-44	41.3	531	35.3	292	48.0	239		0.7
45-49	37.6	606	32.2	332	44.0	274		0.7
50-54	29.1	485	21.7	260	37.6	225		0.6
55-59	29.0	432	23.6	209	33.8	223		0.7
60+	24.2	1,003	12.6	422	33.2	581		0.4

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de facto household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

3.3 Dwelling characteristics and living conditions

Table 3.3.1 shows dwelling characteristics of the households in the ZOI. The table presents the percentage of households that have access to electricity and the average number of people per sleeping room, as well as the main roof, exterior wall, and floor materials of households' dwellings. The percentage of households that use solid cooking fuel is also presented. Solid cooking fuels are not considered clean fuels and can have negative health impacts[28]; they include charcoal, wood, animal dung, crop residues, straw, shrubs, or grass.

Table 3.3.1 shows the household dwelling characteristics in the ZOI by residence and gendered household type. Nearly all (94.2 percent) households use solid fuel for cooking, with a slightly greater percentage among male and female adult households than female adult only households, which is similar to the BDHS 2017/2018 rural sample (94.0 percent). Neither solid fuel usage nor access to electricity has any significant difference when disaggregated by gendered household type. 81.3 percent of ZOI households have access to electricity versus 88.7 percent of the BDHS 2017/2018 rural sample. On average, there are 2.2 persons per sleeping room in the ZOI. Although the sample sizes for male adult only and children only household estimates are too small to report for these categories, gendered household type does have an effect on the mean number of persons per sleeping room for male and female adult households and female adult only households (2.3 persons and 1.9 persons, respectively), which is statistically significant at the 0.1 percent level.

Various household dwelling characteristics are similar between the ZOI 2018/2019 sample and the BDHS 2017/2018 rural sample. Virtually all ZOI households (96.4 percent) use finished roof materials,

[28] Smith & Pillarisetti (2015)

which is consistent with the BDHS 2017/2018 rural sample (97.8 percent). Three-quarters of ZOI households (75.8 percent) use natural floor materials, which is similar to the BDHS 2017/2018 rural sample (76.7 percent). One-quarter of households (24.2 percent) use finished floor materials, and 22.6 percent of the BDHS 2017/2018 rural sample use the same. Household dwelling characteristics cannot be reliably derived for male adult only and children only households due to insufficient sample size.

Table 3.3.1: Household Dwelling Characteristics in the ZOI, in Total and by Gendered Household Type

Household characteristic	Total	Gendered household type				Sig.[a]
		Male and female adults	Female adults only	Male adults only	Children only	
Percent using solid fuel for cooking (%)[b]	94.2	94.5	92.6	^	^	n/s
Percent with access to electricity (%)	81.3	81.7	79.2	^	^	n/s
Mean number of persons per sleeping room[c]	2.2	2.3	1.9	^	^	***
Household roof materials (%)[d]						n/s
Natural	0.9	0.9	1.4	^	^	
Rudimentary	0.0	0.0	0.0	^	^	
Finished	96.4	96.5	95.5	^	^	
Other	2.7	2.7	3.1	^	^	
Household exterior wall materials (%)[e]						n/s
Natural	11.1	10.9	12.1	^	^	
Rudimentary	0.0	0.0	0.0	^	^	
Finished	88.8	88.9	87.9	^	^	
Other	0.2	0.2	0.0	^	^	
Household floor materials (%)[f]						n/s
Natural	75.8	75.4	77.9	^	^	
Rudimentary	0.0	0.0	0.0	^	^	
Finished	24.2	24.5	22.1	^	^	
Other	0.0	0.1	0.0	^	^	
Number of households (*n*)	**2,525**	**2,222**	**296**	**6**	**1**	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Solid fuel is defined as charcoal, wood, animal dung, straw/shrubs/grass, and agriculture crop residue. Households in the "no food cooked in household" category are removed from percentages.

[c] The average number of persons per sleeping room is a common indicator of crowding (United Nations Development Programme, 2003).

[d] Natural roof includes no roof, thatch (palm leaf, straw, reed), sod or bamboo and mud. Rudimentary roof includes plastic/polythene and cardboard. Finished roofs include metal, wood, cement/concrete.

[e] Natural wall includes no walls, mud, bamboo, straw, and leaves. Rudimentary walls include plastic/polythene and cardboard. Finished walls include metal, wood, cement/concrete.

[f] Natural floors include earth/sand, dung, and bamboo. There is no category for rudimentary floors. Finished floors include wood and cement/concrete.

Note: Estimates are based on de jure household members

Note: Residence columns have been removed because the ZOI survey was conducted in rural areas only.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

3.4 Water, sanitation, and hygiene

This section presents water, sanitation, and hygiene indicators that align with the Sustainable Development Goals (SDG) definitions.[29] **Table 3.4.1** presents the percentage of households that use an improved water source, use improved sanitation, and practice a correct drinking water treatment method, as well as the percentage of households in which open defecation is practiced.

Drinking water may be contaminated with human or animal feces containing pathogens, or with chemical and physical contaminants with harmful effects on health; therefore, improving water quality is critical to prevent transmission of diarrhea and other diseases. In addition to improving water quality, it is also important to improve accessibility and availability of drinking water, especially for women and girls, who often bear the primary responsibility for collecting water from distant sources.[30] Therefore, in addition to collecting information on types of drinking water and treatment method, the ZOI Survey also collected information on accessibility and availability of drinking water services (i.e., main source of drinking water that the household uses, and time it takes to travel to and get water from the source).

Virtually all (99.0 percent) ZOI households have water available from an identified source all year round and every day in the past two weeks preceding the survey. However, there is a considerably lower proportion of ZOI households that have *improved* water[31] regularly available (44.4 percent), which is defined as being from an improved source, available all year round and the two weeks prior to the survey. Availability of improved water varies by gendered household type: only one-third (34.2 percent) of female adult only households have access compared with male and female adult households (45.8 percent). This difference is statistically significant at the 0.1 percent level. The location of the main water source varies among ZOI households, with the highest proportion of households having the main water source in their own yard/plot (44.3 percent), followed by elsewhere (33.8 percent) and inside the dwelling (22.0 percent). Nearly all ZOI households (96.3 percent) take less than 15 minutes to get water and return home, of which 71.2 percent take less than 5 minutes and one-quarter (25.1 percent) take 6-15 minutes. On average, the main water source is located 67 meters (approximately 220 feet) from ZOI households.

Only 1.7 percent of all ZOI households apply correct drinking water treatment. More than 90.0 percent of households do not take any purification measures at all and consume drinking water directly from the source.

Inadequate sanitation and lack of sanitation are closely associated with diarrheal diseases, which in turn exacerbate malnutrition. Open defecation is when people use fields, forests, open bodies of water, or other open spaces rather than toilets. Open defecation and inadequate sanitation are dangerous because contact with human waste can cause diseases such as cholera, typhoid, hepatitis, diarrhea, worm infestation, and under-nutrition. Although access to a hygienic toilet facility is critical in reducing the transmission of pathogens, sharing of sanitation facilities is also an important consideration, given the

[29] UNSTATS (n.d.)

[30] Core questions on water, sanitation and hygiene for household surveys: 2018 Update. New York: UNICEF/WHO (2018)

[31] For the full definition of improved water, please see footnote b under Table 3.4.1.

negative impacts on dignity, privacy, and personal safety, especially for women and girls.[32] According to the World Health Organization (WHO)/UNICEF Joint Monitoring Programme for Water Supply, Sanitation, and Hygiene, a basic sanitation service consists of a sanitation facility that hygienically separates human excreta from human contact (i.e., an improved sanitation facility) that is not shared with other households.[33]

Among 2,525 ZOI households, two-thirds (66.7 percent) have basic sanitation. Gendered household type does not have a statistically significant effect on sanitation among the surveyed households. Handwashing with soap and water is among the most cost-effective interventions for reducing the transmission of diseases. Research has demonstrated a clear link between handwashing with soap among child caretakers at critical junctures and the reduction of diarrheal disease,[34] a major cause of child morbidity and mortality in developing countries. A handwashing station is a location where people wash their hands. They are fixed locations or movable devices that can be placed in a convenient spot for use. During data collection, the interviewer visited the handwashing facility and observes whether water and soap are present. The soap may be in bar, powder, or liquid form.

Over half (53.3 percent) of ZOI households have soap and water available for household handwashing, with a higher proportion among male and female adult households (54.2 percent) than female adult only households (46.6 percent). This difference is statistically significant at the 1 percent level.

[32] Core questions on water, sanitation and hygiene for household surveys: 2018 Update. New York: UNICEF/WHO (2018)

[33] WHO/UNICEF. JMP Methodology. 2017 Update & SDG Baselines. March 2018. Available at https://washdata.org/sites/default/files/JMP%20methodology-Apr-2018-5.pdf

[34] Ejemot-Nwadiaro, Ehiri, Arikpo, Meremikwu, & Critchley (2015)

Table 3.4.1: Household Water, Sanitation, and Hygiene Characteristics in the ZOI, in Total and by Residence and Gendered Household Type

Indicator	Total (%)	Gendered household type				Sig.[a]
		Male and female adults (%)	Female adults only (%)	Male adults only (%)	Children only (%)	
Use a regularly available improved water source[b]	44.4	45.8	34.2	^	^	***
Use correct water treatment practice or technology[c]	1.7	1.7	1.7	^	^	n/s
Have soap and water at handwashing station on premises[d,i]	53.3	54.2	46.6	^	^	**
Have basic sanitation (improved sanitation, not shared)[e,i]	66.7	67.1	64.3	^	^	n/s
Use improved sanitation, shared[f]	23.1	22.6	25.9	^	^	n/s
Use unimproved sanitation[g]	9.9	9.9	9.8	^	^	n/s
Practice open defecation[h]	0.0	0.0	0.0	^	^	n/a
Number of households (*n*)	**2,525**	**2,222**	**296**	**6**	**1**	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Improved water sources include *piped water into the dwelling*, *piped water into the yard*, *public tap/standpipe*, *tubewell/borehole*, *protected dug well*, *protected spring*, *rainwater*, *bottled water*, *sachet water*, *tanker-truck*, and *cart with small drum* (UNICEF & WHO, 2018). Based on this definition, we indicate improved water sources for Bangladesh using the following categories: *piped water supply inside dwelling premises, piped water supply outside dwelling premises, household's own tube well, ring well inside dwelling premises, rainwater collected inside dwelling premises, and bottled water.* The proportion of the population using safely managed drinking water services is Sustainable Development Goal (SDG) indicator 6.1.1 (UNSD, n.d.). The indicator presented includes an indication of regularity in access to the water source–namely, that (a) water is available from this source all year round and (b) water from this source was available every day in the two weeks preceding the survey.

[c] Correct water treatment practice or technology refers to methods that effectively kill or remove pathogens. This includes *boiling the water*, *adding bleach or chlorine*, *using a water filter* (ceramic, sand, composite), and *solar disinfection* (WHO & UNICEF, 2006). Practices such as *straining through a cloth* and *letting it stand and settle* are not considered effective approaches to water treatment. *Other* is also not considered an effective approach.

[d] A handwashing station is a location where people wash their hands. These can be fixed locations or movable devices that may be placed in a convenient spot for use. The soap may be in bar, powder, or liquid form. The cleansing product must be at the handwashing station or reachable by hand when standing in front of it. The proportion of the population with a basic handwashing facility with soap and water available on premises is SDG indicator 6.2.1b (UNSD, n.d.).

[e] A basic sanitation service consists of a sanitation facility that hygienically separates human excreta from human contact (i.e., an improved sanitation facility) that is not shared with other households. Having an improved sanitation facility is necessary, but it is not sufficient to define a household as having a basic sanitation service (UNICEF & WHO, 2019). The proportion of the population using safely managed sanitation services is SDG indicator 6.2.1a (UNSD, n.d.).

[f] Improved sanitation facilities are those that separate human excreta from human contact; they include the categories *flush to piped sewer system*, *flush to septic tank*, *flush/pour flush to pit latrine*, *composting toilet*, *ventilated improved pit latrine* (only if there is also a slab), and *pit latrine with a slab* (UNICEF & WHO, 2018).

[g] Unimproved sanitation facilities are those that do not adequately separate human excreta from human contact. This includes the following: *flush/pour flush to open drain*, *flush/pour flush to elsewhere*, *pit latrine without a slab/open pit*, *bucket*, and *hanging toilet*. Households that report having no sanitation facility or using the bush or field are considered as using an unimproved sanitation facility (UNICEF & WHO, 2018).

[h] Households that report having no sanitation facility or using the bush or field are considered as practicing open defecation.

[i] Feed the Future phase two ZOI-level indicator.

Note: The gendered household type disaggregate categories are based on de jure household members.

Note: Residence columns have been removed because the ZOI survey was conducted in rural areas only.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

4 HOUSEHOLD ECONOMIC STATUS

This chapter includes a background discussion of monetary poverty in the Feed the Future ZOI in Bangladesh, the poverty indicators, and the wealth index. Appendix A2.2a provides an overview of the methodology used to calculate the poverty indicators, and Appendix A2.2b provides an overview of the methodology used to calculate the wealth index. Additional details are provided in the Guide to Feed the Future Statistics.[35]

The Feed the Future ZOI poverty indicators presented in this chapter include the prevalence of poverty, the depth of poverty of the poor, and the prevalence of people who are "near-poor," or who live between 100 percent and 125 percent of the poverty line. These indicators are presented for the $1.90 poverty line at 2011 PPP (Section 4.1.1), and at Bangladesh's national poverty threshold (Section 4.1.2) and extreme poverty threshold (Section 4.1.3). These results were generated using household data from the Feed the Future Bangladesh ZOI baseline survey 2018/2019. In addition, prevalence of poverty, depth of poverty, and near-poor estimates are presented for Bangladesh's national poverty threshold (Section 4.2), and for Bangladesh's extreme poverty threshold (Section 4.3). These results were generated using the 2016 Household Income and Expenditure Survey (HIES), published by BBS.[36] These results only reflect Barishal and Khulna and exclude ZOI areas in Dhaka.

Bangladesh has seen a rapid decline in poverty since the 1990s. Using the national upper poverty line, which incorporates food and non-food poverty lines generated using the cost of basic needs (CBN) method by BBS from HIES, the incidence of national poverty declined from 56.7 percent to 48.9 percent between 1991/1992 and 2000–a reduction rate of 0.8 percentage points per year. The rate of decline in poverty was faster during the 2000s, with a reduction rate of 1.7 percentage points per year, from 48.9 percent in 2000 to 31.5 percent in 2010. However, the rate of decline in poverty fell to 1.2 percentage points per year between 2010 and 2016, as the rate of poverty decreased from 31.5 percent in 2010 to 24.3 percent in 2016.

Although the poverty rates in rural Bangladesh have historically been higher than urban areas, there has been a faster decline in rural poverty in the past decade compared with urban poverty rates. The rate of poverty in rural areas fell from 52.3 percent in 2000 to 35.2 percent in 2010–a decline of 1.7 percentage points per year–compared with a fall in poverty of 35.2 percent to 21.3 percent in urban areas over the same time period–a decline of about 1.4 percentage points per year.

However, the rate of decline in poverty reduced in both rural and urban areas between 2010 and 2016. The rural poverty rate decreased to 26.4 percent in 2016, and the rate of poverty decline decreased to 1.5 percentage points per year between 2010 and 2016. On the other hand, the urban poverty rate decreased to 18.9 percent in 2016, and the rate of poverty decline fell to 0.4 percentage points per year between 2010 and 2016.

The Household Roster and Household Consumption Expenditure modules of the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 are used to calculate the per capita expenditures and poverty indicators for the $1.90 poverty line at 2011 PPP. The household consumption expenditure

[35] Feed the Future ZOI Survey Methods Toolkit. Available at: https://www.agrilinks.org/post/feed-future-zoi-survey-methods

[36] BBS (2017)

module is similar to the Living Standards Measurement Survey (LSMS), where households' consumption of various food and non-food items is measured to infer household income and well-being. Food and non-food consumption are covered in separate modules in the questionnaire. The consumption expenditure variable is constructed in the following manner: for each food item, households are asked about household consumption from purchases, production, and other sources (e.g., wages, gifts, government programs) in the last week. In general, these consumption levels are valued using prices obtained from households in the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 sample, itself. Non-food items include consumables (e.g., matches, batteries, soap, kerosene), and clothing, education, and transport. Local property taxes are also included since the provision of public goods is often linked to local taxes,[37] and *zakat*, which is linked to wealth. Following current best practice in computing consumption expenditures from household surveys,[38] the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 expenditure aggregate excludes the following costs because these tend to be lump sum, infrequent expenditures: (1) dowry, wedding, *Hajj* (pilgrimage), and funeral costs, which tend to be financed out of savings (or asset disposal); (2) durable goods[39] (e.g., personal computers, electrical appliances); and (3) insurance.

Individuals' per capita consumption expenditures are then derived by dividing total household consumption expenditures by the number of household members. From these data, household consumption expenditure totals are calculated and used as a proxy for household incomes, based on the assumption that a household's consumption is closely related to its income. Note that in this approach, every household member is assumed to have an equal share of the total consumption, regardless of age and other household member characteristics. Household consumption and expenditures are often preferred to income when measuring poverty due to the difficulty in accurately measuring income. According to Deaton, expenditure data are less prone to error, easier to recall, and more stable over time than income data.[40]

Poverty estimates using the national extreme poverty threshold and the national poverty threshold were calculated using HIES 2016. In HIES, household expenditure includes household consumption and other spending by the household. Consumption expenditure of the household is the total value of goods and services explicitly consumed by the household during the reference period. Non-consumption expenditure items include income tax and other taxes, pension, social security contributions, related insurance premium, gifts, and other transfers. Other items included in expenditures are additions to savings and investments.

[37] Deaton and Zaidi (2002)

[38] Deaton and Zaidi (2002)

[39] Durable goods costs are excluded but use value of durable goods is included. For durable goods, data were collected in a manner that allows the calculation of use value per annum/month.

[40] Deaton and Zaidi (2002)

4.1 Measures of poverty in the ZOI

The prevalence of poverty, sometimes called the poverty headcount ratio, is measured by determining the percentage of individuals living below a poverty threshold. Estimates of poverty prevalence are sensitive to the poverty thresholds used to identify the poor. A standardized poverty threshold of $1.90 per person per day in adjusted[41] 2011 USD is used to track global changes in poverty across countries. $1.90 is in effect the global extreme poverty threshold and represents the poverty line typical of the world's poorest countries.[42] Poverty estimates at $1.90 have been generated from the Feed the Future Bangladesh ZOI baseline survey 2018/2019. Poverty estimates are also presented for Bangladesh's national poverty and extreme poverty thresholds, corresponding to the regions under the Feed the Future ZOI. These estimations have been calculated using the HIES 2016.

Although poverty prevalence indicates how *many* individuals are impacted by poverty, it does not speak to how *much* people are impacted by poverty. The depth of poverty of the poor is a useful poverty-related- indicator because it describes the extremity of poverty by estimating the average gap between consumption expenditure levels and the poverty line among the poor.[43] The prevalence and depth of poverty indicators complement each other to present a more complete picture of the poverty situation in the ZOI. A third indicator that provides additional context is the prevalence of people who are "near-poor," or living on 100.0 percent to less than 125.0 percent of the $1.90 2011 PPP poverty line. The applicable "near-poor" line is 125.0 percent of the poverty line, or $2.38 per day at 2011 PPP. Many near-poor households find themselves technically above the poverty line but one adverse event away from falling into poverty. A high prevalence of near-poor individuals can make an agri-food or economic system vulnerable.[44] A reduction in the prevalence of near-poor individuals is, therefore, a positive change in the resilience of the system.

4.1.1 The $1.90 poverty threshold

Poverty prevalence. 10.4 percent of individuals in the ZOI live below the $1.90 poverty threshold, more so among female adult only households (11.4 percent) than male and female adult households (10.3 percent). As expected, the prevalence of poverty decreases with increasing asset-based wealth status. Also, the prevalence of poverty is higher among households with higher shock

[41] Adjustments are made according to PPP conversions. These conversions are established by the World Bank to allow currencies to be compared across countries in terms of how much an individual can buy in a specific country. The $1.90 in 2011 PPP means that $1.90 could buy the same amount of goods in another country as $1.90 could in the United States in 2011.

[42] World Bank. 2015. Poverty & Equality Data FAQs. http://go.worldbank.org/PYLADRLUN0.

[43] This indicator differs from the depth of poverty indicator used by the World Bank and used previously by Feed the Future. As modified, this indicator only tracks the depth of poverty of households under the poverty threshold, rather than including all households and assigning non-poor households a shortfall of zero. Including the poor and non-poor households means the depth of poverty can decrease either because poor households have crossed the poverty threshold or because poor households have become less poor. One of the limitations of removing the non-poor households from the calculation is that it is possible that the depth of poverty of the poor may increase over time, because previously poor households cross the poverty threshold, leaving only households that may have started with deeper levels of poverty. Changes in this indicator must be analyzed in conjunction with changes in the prevalence of poverty indicator to capture that dynamic.

[44] Diwakar, Albert, Vizamos, & Shepherd (2019)

exposure, as measured by SEI. This could mean that households with higher shock exposure are more likely to fall into poverty or that poorer households are more vulnerable to severe shocks.

Depth of poverty of the poor. The depth of poverty of the poor in the ZOI is 13.5 percent of the poverty line, meaning that the average shortfall of the poor from the poverty line is $0.30 2011 PPP. Thus, the average *poor* person in the ZOI lives at 86.5 percent of the poverty line, and his or her average consumption is $1.60 per day (2011 PPP).[45]

The depth of poverty of the poor can indicate the amount of resource transfers that, if perfectly targeted to poor households, would be needed to bring everyone in the ZOI up to the poverty line. With a ZOI population of 30.3 million people, $819,862.1 per day would need to be transferred to the poor to bring their income or expenditures up to the poverty threshold.[46]

Near-poor prevalence. The near-poor prevalence is about 15.0 percent of individuals in the ZOI live at or above the $1.90 poverty threshold but below 125.0 percent of that threshold ($2.38 per day in 2011 PPP).

Table 4.1.1 presents poverty estimates at the $1.90 per person per day (2011 PPP) threshold. This table presents poverty estimates for all households in the ZOI, and disaggregated by household characteristics, including gendered household type, household educational attainment, wealth quintile, and severity of shock exposure.

[45] The average value of consumption of a *poor* person is calculated as follows: (86.5 ÷ 100) * $1.90/day = $1.6435/day.

[46] The average daily cost of raising the income or consumption expenditures of the poor up to the poverty threshold is calculated as follows: (10.4 ÷ 100) * ($1.90/day–$1.64/day) * 30,320,344 = $819,862.1/day. The prevalence of poverty in the ZOI is 10.4 percent; the poverty threshold is $1.90/day, the average consumption among the poor is $1.64/day, and the population is 30,320,344.

Table 4.1.1: Poverty Indicators at the $1.90 (2011 PPP) per Person per Day Threshold in the ZOI, in Total and by Selected Household Characteristics

	Prevalence of poverty[a]		Prevalence of near-poor[c]			Depth of poverty of the poor[e]		
Household characteristic	Percent	Sig.[b]	Percent	Sig.[b]	Number of households (*n*)[d]	Percent of poverty line	Sig.[b]	Number of households (*n*)[d]
All households	10.4		15.0		2,525	13.5		223
Gendered household type		n/s		n/s			n/s	
Male and female adults	10.3		15.2		2,222	13.5		193
Female adults only	11.4		12.2		296	13.6		30
Male adults only	^		^		6	^		0
Children only (no adults)	^		^		1	^		0
Household education		***		***			n/s	
No education	15.6		22.1		146	15.1		17
Less than primary	19.4		18.0		265	13.2		45
Completed primary	11.7		17.1		1,368	13.6		131
Completed secondary	6.8		11.7		354	12.7		18
Higher	3.1		7.5		392	13.8		12
Wealth quintile		***		***			n/s	
Highest (wealthiest)	1.5		4.7		493	13.8		5
Fourth	7.1		14.2		486	8.9		30
Middle	10.5		18.7		503	11.3		44
Second	13.9		18.0		511	15.4		58
Lowest (poorest)	19.0		19.2		532	15.0		86
Shock exposure index		*		n/s			n/s	
Did not experience any shocks	10.2		15.1		1,263	12.7		107
Low	6.8		12.7		480	12.6		29
Moderate	11.7		16.2		494	17.2		48
High	14.7		16.0		288	11.7		39

^ Results not statistically reliable, n<30

[a] The prevalence of poverty is the percentage of individuals living below the $1.90 2011 PPP per person per day poverty threshold.

[b] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[c] The prevalence of near-poor is the percentage of individuals living at or above the $1.90 per person per day poverty threshold (2011 PPP) but below 125 percent of that threshold, or $2.38 per day.

[d] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[e] The depth of poverty of the poor measures, on average, how far the consumption of the poor is below the $1.90 (2011 PPP) per person per day poverty threshold.

Note: Indicator estimates and disaggregate categories based on individual household members (i.e., gendered household type, household education, wealth quintile, and shock exposure index) are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

4.1.2 The national poverty threshold

This section presents poverty estimates in rural Barishal and rural Khulna divisions of Bangladesh (areas corresponding to the majority of Feed the Future ZOI in Bangladesh) at the national poverty threshold. The national poverty threshold is the national upper poverty line, which is the summation of the food poverty line and the upper non-food allowance, as calculated by BBS using HIES.

HIES 2016, the most recent national survey conducted by the BBS, was used to assess the poverty status of rural Barishal and rural Khulna divisions at the national poverty threshold for those regions.

According to BBS (2010 and 2016), the poverty lines are estimated using the CBN method. This method is used to calculate the cost of obtaining a consumption bundle believed to be adequate for basic consumption needs. The CBN method is used to generate food and non-food poverty lines, which represent the minimum per capita expenditure that a person needs to be able to afford basic needs.

The food poverty line is based on the cost of consuming a bundle of 11 food items that are needed to meet a minimum nutritional requirement of 2,122 kcal /day for one person. These 11 food items include (1) coarse rice, (2) wheat, (3) pulses, (4) milk, (5) oil, (6) meat, (7) fish, (8) potatoes, (9) vegetables, (10) sugar, and (11) fruits. The cost of this food basket is both spatially and temporally updated using Törnqvist food price indexes. The non-food allowance is estimated by taking the median amount spent on non-food items by a reference group of households whose total per capita expenditure is close to the food poverty line.

The food poverty line plus the upper non-food allowance is equal to the upper poverty line, referred to as the national poverty line in this report. For more details on national poverty lines, please see Appendix C of the HIES 2016 Final Report published by BBS.

Poverty prevalence. The prevalence of poverty is calculated by identifying households with per capita monthly expenditure below the upper poverty line in the year of the HIES, in rural Barisal and rural Khulna divisions, respectively. The upper poverty line for rural Barishal division was 2,056 taka per person per month in 2016. The upper poverty line for rural Khulna division was 2,019 taka per person per month in 2016.[47]

At the national poverty threshold, 26.7 percent of the households in rural Khulna and rural Barishal divisions live below the upper poverty line. The prevalence of poverty is higher in households with lower levels of educational attainment.

Depth of poverty of the poor. The depth of poverty of the poor in rural Khulna and rural Barishal is 18.9 percent of the poverty line. Thus, the average poor person in rural Barishal and Khulna lives at 81.1 percent of the poverty line. Similar to the prevalence of poverty, the depth of poverty among the poor is higher in households with lower educational attainment.

Near poor prevalence. The near poor prevalence in rural Khulna and rural Barishal divisions in 2016 is 20.3 percent. The prevalence of near poor is higher among households with lower levels of

[47] BBS (2017)

educational attainment. This means that, overall, households with no educational attainment and households with less than primary education experience greater poverty and are at a higher risk of falling into poverty.

Since the poverty estimates presented in **Table 4.1.1**, at $1.90 (2011 PPP) are computed from the Feed the Future Bangladesh ZOI baseline survey 2018/2019, and the poverty estimates presented in **Table 4.1.2** at the national poverty threshold are computed from HIES 2016, these estimates are not directly comparable. However, overall, there are similarities for the disaggregation by educational attainment– that is, under both sets of poverty estimations, households with lower levels of educational attainment experience more poverty, and are at a greater risk of falling below the poverty line.

Table 4.1.2 presents poverty estimates at the national poverty threshold for rural Khulna and rural Barishal divisions of Bangladesh from HIES 2016. Similar to the $1.90 per day poverty table, this table presents poverty estimates for all households in the region and disaggregated by household characteristics, including gendered household type and household educational attainment.

Data on wealth quintile and shock exposure are taken from the Feed the Future Bangladesh ZOI baseline survey 2018/2019, whereas the poverty indicators at the national poverty threshold of Bangladesh are estimated from HIES 2016; therefore, these poverty indicators cannot be analyzed by these disaggregates.

Table 4.1.2: Poverty Indicators at the National Poverty Threshold of Bangladesh in rural Barishal and rural Khulna Divisions per Person per Month in the ZOI, in Total and by Selected Household Characteristics

	Prevalence of poverty[a]		Prevalence of near-poor[c]			Depth of poverty of the poor[e]		
Household characteristic	Percent	Sig.[b]	Percent	Sig.[b]	Number of households (*n*)[d]	Percent of poverty line	Sig.[b]	Number of households (*n*)[d]
All households	26.7		20.3		**7,903**	18.9		1,912
Gendered household type		n/s		n/s			n/s	
Male and female adults	26.8		20.4		7,235	18.7		1,776
Female adults only	24.1		16.9		591	22.2		124
Male adults only	19.1		20.4		76	^		12
Children only (no adults)	^		^		1	^	^	0
Household education		***		***			***	1,912
No education	31.5		23.2		662	23.1		181
Less than primary	41.7		21.3		854	23.6		308
Completed primary	30.9		22.0		4,096	17.8		1,135
Completed secondary	16.6		20.4		985	16.7		151
Higher	11.9		13.9		1,305	17.7		137
Wealth quintile		n/a		n/a			**n/a**	
Highest (wealthiest)	—		—		—	—		—
Fourth	—		—		—	—		—
Middle	—		—		—	—		—
Second	—		—		—	—		—
Lowest (poorest)	—		—		—	—		—
Shock exposure index		n/a		n/a			n/a	
Did not experience any shocks	—		—		—	—		—
Low	—		—		—	—		—
Moderate	—		—		—	—		—
High	—		—		—	—		—

— = Data are not available

n/a=not applicable

^ Results not statistically reliable, n<30

[a] The prevalence of poverty is the percentage of individuals living below the 2056 taka in rural Barishal division and 2019 taka in rural Khulna division per person per month poverty threshold.

[b] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[c] The prevalence of near-poor is the percentage of individuals living at or above the 2056 taka in rural Barishal division and 2019 taka in rural Khulna division per person per month poverty threshold but below 125 percent of that threshold.

[d] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[e] The depth of poverty of the poor measures, on average, how far the consumption of the poor is below the 2056 taka in rural Barishal division and 2019 taka in rural Khulna division per person per month poverty threshold.

Notes: Upper poverty line for rural Barisal and rural Khulna divisions were used for calculating the estimates in this table. The upper poverty line is the summation of the food poverty line and the upper non-food allowance. The upper poverty line for rural Barishal division was 2056 *taka* per person per month in 2016. The upper poverty line for rural Khulna division was 2019 *taka* per person per month in 2016 (BBS 2016). The wealth quantile and shock exposure index were not calculated because the required data are not available in the Household Income and Expenditure Survey (HIES), 2016.
Source: Household Income and Expenditure Survey (HIES) 2016.

4.1.3 The national extreme poverty threshold

The food poverty line plus the lower non-food allowance is equal to the lower poverty line, referred to as national extreme poverty line in this report. The lower non-food allowance is obtained by taking the median amount spent for non-food items by a group of households whose per capita total expenditure is close to the food poverty line. Similar to the poverty estimations at the national poverty threshold, presented in **Table 4.1.2**, poverty estimations at the national extreme poverty threshold are calculated from HIES 2016 for rural Khulna and rural Barishal divisions. The lower poverty line in rural Barishal in 2016 was 1,778 taka per person per month, whereas the lower poverty line in rural Khulna in 2016 was 1,677 taka per person per month.

Poverty prevalence. The prevalence of poverty at the national extreme poverty threshold in the region is 13.8 percent. The disaggregation by household educational attainment suggests the rate of poverty is higher among households with lower educational attainment.

Depth of poverty of the poor. The depth of poverty for the poor at the national extreme poverty threshold in the region is 16.4 percent. Although prevalence of poverty is similar for both male and female adult households and female adult only households, the depth of poverty is much higher for the latter. This suggests that among those in female adult households that are below the lower poverty line, the severity of their economic state is higher than those below the poverty line in male and female adult households. Poor households with lower educational attainment also experience greater depth in poverty compared with those with higher educational attainment.

Near-poor prevalence. 17.3 percent of non-poor households in the region are near the national extreme poverty line. The risk of falling into poverty is higher for non-poor households with lower levels of educational attainment compared with households that have higher levels of educational attainment.

Table 4.1.3 presents poverty estimates at the national extreme poverty threshold for rural Khulna and rural Barishal division from HIES 2016. Similar to the two previous poverty tables, this table presents extreme poverty estimates for all households in the region, as well as disaggregated by household characteristics, including gendered household type and household educational attainment.

Table 4.1.3: Poverty Indicators at the National Extreme Poverty Threshold of Bangladesh in Rural Barishal and Rural Khulna Divisions per Person per Month, in Total and by Selected Household Characteristics

Household characteristic	Prevalence of poverty[a]		Prevalence of near-poor[c]		Number of households (*n*)[d]	Depth of poverty of the poor[e]		Number of households (*n*)[d]
	Percent	Sig.[b]	Percent	Sig.[b]		Percent of poverty line	Sig.[b]	
All households	13.8		17.3		7,903	16.4		980
Gendered household type		n/s		*			n/s	
Male and female adults	13.8		17.5		7,235	16.2		903
Female adults only	13.8		13.4		591	21.1		69
Male adults only	14.4		7.5		76	16.1		8
Children only (no adults)	^		^		1	^		0
Household education		***		***			***	
No education	19.0		18.9		662	20.2		104
Less than primary	26.3		20.6		854	20.0		182
Completed primary	15.2		20.5		4,096	15.4		555
Completed secondary	7.5		13.0		985	15.2		71
Higher	6.2		9.0		1,305	13.9		68
Wealth quintile		n/a		n/a			n/a	
Highest (wealthiest)	n/a		n/a		n/a	n/a		n/a
Fourth	n/a		n/a		n/a	n/a		n/a
Middle	n/a		n/a		n/a	n/a		n/a
Second	n/a		n/a		n/a	n/a		n/a
Lowest (poorest)	n/a		n/a		n/a	n/a		n/a
Shock exposure index		n/a		n/a			n/a	
Did not experience any shocks	n/a		n/a		n/a	n/a		n/a
Low	n/a		n/a		n/a	n/a		n/a
Moderate	n/a		n/a		n/a	n/a		n/a
High	n/a		n/a		n/a	n/a		n/a

n/a=not applicable. ^ Results not statistically reliable, n<30

[a] The prevalence of poverty is the percentage of individuals living below the 1778 taka in rural Barishal division and 1677 taka in rural Khulna division per person per month poverty threshold.

[b] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[c] The prevalence of near-poor is the percentage of individuals living at or above the 1778 taka in rural Barishal division and 1677 taka in rural Khulna division per person per month poverty threshold but below 125 percent of that threshold

[d] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[e] The depth of poverty of the poor measures, on average, how far the consumption of the poor is below the 1778 taka in rural Barishal division and 1677 taka in rural Khulna division per person per month poverty threshold.

Notes: Lower poverty line for rural Barishal and rural Khulna divisions were used for calculating the estimates in this table. The lower poverty line is the summation of food poverty line and the lower non-food allowance. The lower poverty line for rural Barishal division was 1778 taka per person per month in 2016. The lower poverty line for rural Khulna division was 1677 taka per person per month in 2016 (BBS 2017). There is one missing observation for the education variable in the HIES 2016 dataset. Hence, the sum of the households by education is 7,902.

Source: Household Income and Expenditure Survey (HIES), 2016.

4.2 Asset-based wealth index and comparative wealth index

Asset ownership can be used to predict a household's long-term welfare—its capacity to earn income and withstand shocks in the future. The number and type of assets a household owns is associated with household resilience across national contexts,[48,49] and asset-based wealth indices have increasingly been used as alternatives to income and consumption expenditure-based measures for several reasons, including the following: (1) they are more stable measures of socioeconomic well-being, (2) they are able to better detect differences in equity, and (3) they are easier to collect and require shorter interviews.[50,51,52]

The asset-based wealth index was calculated using data on household characteristics from Module 2, *Dwelling characteristics*, in the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 questionnaire. The index comprises the following variables: presence of domestic servants in the household; agricultural land ownership and amount of land; number of people per sleeping room; house ownership; drinking water source; type of sanitation facility; floor material; roof material; wall material; cooking fuel; type and number of farm animals; household possessions, including large and small durable goods; and whether any member of the household holds a bank account. A wealth score is generated for each surveyed household, and then households are grouped into quintiles based on their relative distribution. Appendix 2.2b contains additional information about the methodology used to calculate the wealth index.

Table 4.2.1 presents the wealth quintiles for the population living in the Feed the Future ZOI. Estimates in **Table 4.2.1** are shown for the de jure household population, as well as disaggregated by household characteristics, including gendered household type, household educational attainment, poverty status, and severity of shock exposure.

Disaggregation of the wealth index by gendered household type reveals that a greater proportion of households with female adults only fall in the lower end of the asset-based wealth index quintiles, compared with households containing both male and female adults. Around 31.2 percent of households with female adults only belong in the lowest quintile compared with around 19.2 percent of households with both male and female adults. On the other hand, while households with both adult male and adult female occupy 20.2 percent of the fourth quintile and 20.6 percent of the fifth quintile, households with female adults only occupy 14.0 percent of the fourth quintile and 14.1 percent of the fifth quintile. This indicates that households with female adults only may be economically and financially less stable compared with households with both male and female adults.

Other levels of disaggregation show a pattern that is expected–that is, households with lower educational attainment have greater concentration in the lower quintiles compared with households with higher educational attainment. For instance, 40.0 percent of households with no educational attainment are in the lowest wealth quintile, while 40.6 percent of households with higher levels of

[48] Boukary, Diaw, & Wünscher (2016)
[49] Phadera, Michelson, Winter-Nelson, & Goldsmith (2019)
[50] Chakraborty, Fry, Behl, & Longfield (2016)
[51] Dekker (2006)
[52] Filmer & Pritchett (2001)

educational attainment occupy the highest wealth quintile. This shows that education is a strong determinant of wealth.

Disaggregation by poverty status shows that 37.9 percent of poor households are in the lowest wealth quintile, whereas only 2.3 percent of poor households are in the highest wealth quintile. Conversely, non-poor households are distributed more evenly across the quintiles. Disaggregation by SEI shows that households with a moderate to high score are concentrated more towards the lower wealth quintiles.

Table 4.2.1: Percent Distribution of Households in the ZOI by Quintile According to the Bangladesh Asset-based Wealth Index, in Total and by Selected Household Characteristics

Household characteristic	Wealth quintile					Sig.[a]	High/low ratio	Number of households (*n*)[b]
	Lowest	Second	Middle	Fourth	Highest			
All households	**20.7**	**20.0**	**20.0**	**19.5**	**19.8**		**1.0**	**2,525**
Gendered household type						***		
Male and female adults	19.2	19.7	20.3	20.2	20.6		1.1	2,222
Female adults only	31.2	22.8	18.0	14.0	14.1		0.5	296
Male adults only	^	^	^	^	^		^	6
Children only (no adults)	^	^	^	^	^		^	1
Household education						***		
No education	40.0	23.1	18.7	11.9	6.3		0.2	146
Less than primary	34.3	25.6	19.1	14.9	6.2		0.2	265
Completed primary	22.8	21.5	21.8	19.5	14.5		0.6	1,368
Completed secondary	10.7	17.8	16.6	22.0	33.0		3.1	354
Higher	6.0	12.2	18.1	23.1	40.6		6.8	392
Poverty status						***		
Poor	37.9	26.1	20.1	13.7	2.3		0.1	223
Non-poor	19.0	19.5	20.0	20.0	21.5		1.1	2,302
Shock exposure index						n/s		
Did not experience any shocks	20.7	19.2	21.2	16.6	22.4		1.1	1,263
Low	17.4	21.6	17.6	22.6	20.9		1.2	480
Moderate	24.2	21.1	18.2	20.7	15.9		0.7	494
High	20.2	19.3	22.3	24.8	13.4		0.7	288
Number of households (*n*)	**532**	**511**	**503**	**486**	**493**			

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

Note: Indicator estimates and disaggregate categories based on individual household members (i.e., gendered household type, household education, and poverty status) are calculated using de jure household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Although the wealth index is useful for studying economic inequalities in a particular country at a given time, it cannot be directly compared across countries or over time. Hence, Rutstein and Staveteig (2014) developed a methodology to calculate a comparative wealth index (CWI) that allows for direct comparison of economic status across countries and over time. Feed the Future adopted the CWI methodology to develop its ZOI-level indicator: the percent of households below the threshold of the poorest quintile of the asset-based comparative wealth index.

This indicator reflects the percentage of households in the Feed the Future ZOI whose ownership (or lack thereof) of selected assets places the household below a fixed threshold that defines the poorest quintile (bottom 20.0 percent) in the comparative baseline wealth index that was used to create a cross-nationally, cross-temporally comparable asset-based wealth index. The use of a fixed threshold across ZOIs is possible because the CWI indicator is calculated relative to the reference wealth index. This means that the CWI scores can be compared across ZOI Surveys and over time.

Constructing the CWI indicator involves calculating the wealth index for the selected reference survey—the 2017 Senegal DHS—just as was done for Bangladesh using ZOI Survey data. It also involves calculating anchoring points—four of which are based on unmet basic needs and three[53] of which are based on asset ownership—for both the reference survey and ZOI Survey.[54] The wealth index scores for the households sampled for the ZOI Survey are then converted into comparable CWI scores using the anchoring points calculated for the ZOI Survey and the reference survey. Finally, the percentage of households below the comparative threshold for the poorest quintile of the reference survey is calculated using the reference survey quintile cutoffs.

Table 4.2.2 presents the percentage of households by comparative wealth quintile. In particular, the percentage of households that falls below the comparative threshold for the poorest quintile of the asset-based CWI in the ZOI is 0.5 percent. The majority of households (70.7 percent) in the Bangladesh ZOI, however, fall in the second quintile of the comparative wealth index. Estimates in **Table 4.5** are shown for all households as well as disaggregated by household characteristics, including gendered household type, household educational attainment, poverty status, and severity of shock exposure.

[53] Although there are four asset ownership based anchoring points, only three were used for Bangladesh since the anchoring point for ownership of a car/truck was not appropriate for rural Bangladesh.

[54] The reference country quintile cutoffs and anchoring points are calculated only once but used for the CWI indicator across all ZOI Surveys.

Table 4.2.2: Percent Distribution of Households in the ZOI by Quintile According to the Comparative Wealth Index, in Total and by Selected Household Characteristics

Household characteristic	Wealth quintile					Sig.[a]	High/low ratio	Number of households (*n*)[b]
	Lowest	Second	Middle	Fourth	Highest			
All households	**0.6**	**70.7**	**23.6**	**4.4**	**0.7**		**1.3**	**2,525**
Gendered household type						**		
Male and female adults	0.5	69.8	24.3	4.6	0.8		1.6	2,222
Female adults only	1.0	77.1	18.8	3.1	0.0		0.0	296
Male adults only	^	^	^	^	^		^	6
Children only (no adults)	^	^	^	^	^		^	1
Household education						***		
No education	2.7	83.3	12.6	1.4	0.0		0.0	146
Less than primary	1.5	85.6	12.6	0.4	0.0		0.0	265
Completed primary	0.5	76.3	20.6	2.4	0.2		0.4	1,368
Completed secondary	0.0	57.1	34.6	6.9	1.4		—	354
Higher	0.0	48.8	35.7	12.9	2.6		—	392
Poverty status						***		
Poor	1.3	91.1	7.8	0.0	0.0		0.0	223
Non-poor	0.5	68.7	25.2	4.8	0.8		1.6	2,302
Shock exposure index						*		
Did not experience any shocks	0.9	69.1	23.2	6.2	0.7		0.9	1,263
Low	0.4	68.1	27.4	3.4	0.6		1.6	480
Moderate	0.2	74.5	21.8	2.5	1.0		5.5	494
High	0.3	75.4	22.5	1.4	0.4		1.0	288
Number of households (*n*)	**15**	**1,794**	**589**	**109**	**18**			

— = Data are not available

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

Note: Indicator estimates and disaggregate categories based on individual household members (i.e., gendered household type, household education, and poverty status) are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

5 RESILIENCE

According to the USAID definition, resilience is "the ability of people, households, communities, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth."[55] Based on this definition, household resilience is the ability of a household to mitigate, adapt to, and recover from shocks and stresses. The shocks and stresses are events and trends that impact well-being outcomes and future resilience capacities.

Resilience measurement comprises measures related to shocks and stressors experienced, coping capacities, and well-being outcomes.[56] No single indicator measures resilience. This chapter presents shock exposure and severity statistics in Section 5.1, followed by findings on four key Feed the Future ZOI-level resilience indicators: (1) the ability to recover from shocks and stresses index; (2) the proportion of households that believe local government will respond effectively to future shocks and stresses; (3) the proportion of households participating in group-based savings, micro-finance, or lending programs; and (4) the index of social capital at the household level.

Although information on shocks and stressors is specific to the resilience chapter, and capacities related to local government response, social capital, and savings are also reflected in this chapter, other capacities and well-being outcomes are captured in other report chapters. For example, decisionmaking capacities are captured in the A-WEAI module, coping strategies used during period of food shortages are captured in the food security module, and well-being outcomes are included in the chapters about poverty, food security, and nutrition.

5.1 Shock exposure and severity

Respondents to the resilience and food security module of the ZOI Survey were asked whether their households experienced 16 shocks or stressors during the 12 months preceding the survey. For any experienced, the respondents were asked to rate the severity of the shock or stressor on the household's income and food consumption using the same four-point scale for each. This information is used to calculate the SEI. Because each surveyed household did not experience the same types of shocks and stressors of the same severity, it is necessary to create the SEI as a measure of the household's ability to recover from the shocks and stressors that it experienced. In other words, SEI is a weighted average of the incidence of each shock, weighted by perceived severity of the shock.

Table 5.1.1 presents the percentage of households that were exposed to each of the 16 shocks and stressors included in the survey during the year preceding the survey. The table also presents the perceived severity of each shock or stressor on the household's income and food consumption, among the households that experienced it.

The most common shocks experienced by the ZOI households are severe illness in the family (29.87 percent), followed by too much rain (16.41 percent), disease affecting livestock (6.10 percent), and sharp increases in food prices (5.44 percent).

[55] USAID (2012)

[56] Resilience resources can be found on REAL (FSNNETWORK n.d.).

Among the households that experienced the negative shock of severe illness in family, 56.44 percent report that the impact of this shock was severe to extremely severe on household income, and 40.21 percent report that the impact of this shock was severe to extremely severe on household food consumption.

Table 5.1.1: Percent of Households in the ZOI Exposed to Each Shock or Stressor and Perceived Severity of Shocks on Household Income and Food Consumption During the 12 Months Preceding the Survey

		Perceived impact on income				Perceived impact on food consumption				
Shock or stressor	Experienced	Not severe	Somewhat severe	Severe	Extremely severe	Not severe	Somewhat severe	Severe	Extremely severe	Number of households (*n*)
Too much rain	16.41	7.81	48.98	32.37	10.94	21.20	47.78	23.53	7.49	2,525
Too little rain	2.68	4.55	64.26	26.80	4.39	20.90	53.71	22.52	2.88	2,525
Erosion of land	0.81	4.83	33.63	23.59	37.95	37.80	33.48	14.21	14.50	2,525
Loss of land	0.83	4.91	29.11	42.64	23.34	28.75	42.96	23.70	4.58	2,525
Sharp increase in food prices	5.44	5.94	62.46	27.27	4.33	8.88	58.75	28.05	4.33	2,525
Belongings stolen or destroyed	3.13	2.54	44.38	31.64	21.43	27.89	40.63	17.61	13.87	2,525
Unable to access crop inputs	1.22	3.32	58.02	32.36	6.30	35.68	31.95	29.17	3.20	2,525
Disease affecting crops	2.93	15.16	42.35	26.02	16.46	34.39	42.31	17.94	5.36	2,525
Pests affecting crops	1.98	16.15	47.69	25.99	10.16	28.36	47.35	16.17	8.12	2,525
Theft of crops	0.44	18.29	36.58	9.15	35.98	36.58	27.44	9.15	26.84	2,525
Unable to access livestock inputs	0.40	29.85	29.85	30.22	10.07	49.63	40.30	10.07	0.00	2,525
Disease affecting livestock	6.10	14.54	43.61	21.53	20.32	47.38	36.34	5.81	10.48	2,525
Animals stolen	0.28	27.90	43.26	28.84	0.00	43.26	42.32	14.42	0.00	2,525
Unable to sell crops, livestock, etc., at fair price	1.27	9.56	44.19	27.45	18.80	34.60	55.96	3.07	6.38	2,525
Severe illness in family	29.87	5.64	37.92	34.44	22.00	23.45	36.35	26.08	14.13	2,525
Death in household	1.94	22.79	26.41	14.12	36.67	47.31	10.11	12.18	30.40	2,525
Number of households (*n*)	**2,525**									

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 5.1.2 categorizes households by their SEI score—that is, the number and severity of shocks and stressors that they experienced during the 12 months preceding the survey. The SEI ranges from 0 (if the household did not experience any shocks or stressors) to 128 (if the household experienced all 16 shocks or stressors at the highest level of severity). The SEI in the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 ranges from 2 to 50. The SEI scores have then been ranked into three categories–low, medium, and high.

The average number of shocks experienced by households in the ZOI is 0.8. On average, respondents considered the shocks that their households experienced to have a somewhat severe impact on their household's food consumption. Among 2,525 ZOI households, half of the households (50.0 percent) did not experience any shocks. Gendered household type has an effect on households that did not experience any shocks at the 1 percent level.

Table 5.1.2: Percent Distribution of Households in the ZOI by SEI Score, in Total and by Gendered Household Type

			Gendered household type				
Indicator	SEI scores	Total	Male and female adults	Female adults only	Male adults only	Children only	Sig.[a]
Shock severity							
Did not experience any shocks	0	50.0	86.0	13.5	^	^	**
Low	2 – 4	19.0	88.9	10.9	^	^	n/s
Moderate	5 – 8	19.6	90.4	9.6	^	^	n/s
High	9 – 50	11.4	91.7	8.3	^	^	n/s
Number of households (*n*)		2,525	2,222	296	6	1	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: The gendered household type disaggregate categories are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

5.2 Ability to recover from shocks and stresses index

In cross-sectional surveys, it is challenging to collect information on "actual recovery;" therefore, the ZOI survey collected information on the Ability to Recover from Shocks and Stresses Index (ARSSI), a proxy indicator for "actual recovery" that captures a household's self-perceived ability to recover from the shocks and stresses that occur in the ZOI. The index comprises two components: (1) a base ability to recover component that captures how households are currently able to meet food needs relative to the past year, and (2) a forward-looking component that captures how households expect to be able to manage shocks and stresses in the future. The ARSSI corrects the ability to recover index for differences in shock exposure among households and is therefore comparable across households.

The ARSSI includes the typical types of shocks and stressors that occur in the ZOI, such as loss of a family member, loss of income, hunger, drought, flood, conflict, or similar events, and is based on data regarding the shocks and stressors that households experienced in the year prior to the survey and their perceived ability to meet food needs the following year.

Table 5.2.1 presents the mean ARSSI score and households' self-perceived ability to meet their food needs—at the time of the survey and over the next year—for all households and by household characteristics, including gendered household type, household educational attainment, wealth quintile, and poverty status.

In the Feed the Future ZOI, the mean ARSSI is 5.52, which is high on the adjusted Ability to Recover (ATR) I.e., ARSSI scale of 1.93 to 7.83. ARSSI is similar for households with female adults only and households consisting of both male and female adults. This indicates that resilience does not differ by gendered household type. Furthermore, ARSSI does not vary much across all types of disaggregations, including household educational attainment, wealth status, and poverty status.

Although statistically insignificant, results show that households with higher levels of educational attainment are better able to meet food needs at the time of the survey and have a greater perceived ability to meet food needs over the next year compared to households with lower levels of educational attainment. Similarly, households at the upper wealth quintiles are better able to meet food needs at the time of the survey and have a higher perceived ability to do so in the year following the survey than households at the lower wealth quintiles. Over half (59.5 percent) of poor households that have experienced a negative shock report that they perceive their ability to meet food needs at the time of the survey to be better compared to 70.1 percent of non-poor households. Non-poor households have a slightly greater projected ability to meet food needs over the next year than poor households (79.2 percent and 74.2 percent, respectively), although this difference is not statistically significant.

Table 5.2.1: Mean ARSSI Scores and Households' Self-Perceived Ability to Meet Their Food Needs—at the Time of the Survey and over the Next Year, Compared to Before Shock Exposure, in Total and by Selected Household Characteristics

Household characteristic	Mean ARSSI score	Sig.[a]	Percent of households able to meet household food needs								Number of households (*n*)[b,c]
			At time of survey				Over next year				
			Better	Same	Worse	Sig.[a]	Better	Same	Worse	Sig.[a]	
All households	**5.52**		**69.13**	**24.61**	**6.26**		**78.72**	**17.06**	**4.22**		**1,261**
Gendered household type		n/s				n/s				n/s	
Male and female adults	5.51		69.24	24.50	6.26		78.64	16.93	4.43		1,135
Female adults only	5.54		68.71	24.95	6.34		80.09	17.57	2.34		125
Male adults only	^		^	^	^		^	^	^		1
Children only (no adults)	^		^	^	^		^	^	^		0
Household education		n/s				n/s				n/s	
No education	5.29		62.11	30.22	7.67		67.23	24.87	7.90		76
Less than primary	5.56		72.06	23.75	4.19		76.28	19.50	4.22		143
Completed primary	5.52		67.98	26.16	5.86		80.31	16.03	3.66		682
Completed secondary	5.55		71.72	22.74	5.53		79.85	15.72	4.42		184
Higher	5.51		71.52	18.81	9.67		78.33	17.11	4.56		176
Wealth quintile		n/s				n/s				n/s	
Highest (wealthiest)	5.49		70.98	21.04	7.98		80.35	14.96	4.68		214
Fourth	5.56		70.82	23.74	5.44		80.50	14.76	4.74		278
Middle	5.64		73.26	22.53	4.21		81.79	14.83	3.38		237
Second	5.39		64.25	29.37	6.38		72.43	23.06	4.52		266
Lowest (poorest)	5.50		66.93	25.60	7.47		79.00	17.27	3.73		266
Poverty status		n/s				*				n/s	
Poor	5.38		59.52	30.19	10.29		74.17	19.75	6.08		116
Non-poor	5.53		70.10	24.04	5.86		79.18	16.79	4.03		1,145

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] Estimates include only households that experienced at least one shock or stressor during the 12 months preceding the ZOI Survey.

Note: Disaggregates based on individual household members (i.e., gendered household type, household education, wealth index, and poverty status) are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

5.3 Resilience capacities

There are multiple sources of resilience that Feed the Future calls resilience capacities—the four elements of risk reduction strategies (i.e., prevention, mitigation, coping, and recovery) support the absorptive, adaptive, and transformative capacities that are essential to strengthen resilience. Many of these are captured in other parts of this report, such as input into decisionmaking, decisionmaking autonomy, and coping strategies during times of food shortages. This section presents three additional resilience capacities that research has shown to strengthen resilience and improve adaptation and recovery from shocks and stresses:[57,58,59,60,61] local government response; participation in group-based savings, micro-finance, or lending programs; and social capital.

5.3.1 Proportion of households that believe local government will respond effectively to future shocks and stresses

Believing in the ability of one's local government to respond to shocks and stresses is a proxy for trust, legitimacy, and effectiveness of local institutions and leadership. Such belief and trust contribute to transformative resilience capacity, or the enabling environment that supports—or limits—people's ability to prevent or mitigate the impact of, deal with, and recover from shocks and stresses. The indicator reflects the proportion of households in the ZOI that believe their local government will help the community cope with difficult times (illustrated by a shock known to the community, such as drought or flood) in the future. Local government responsiveness can refer to either local leaders or institutions. **Table 5.3.1** presents the indicator results for all households and by household characteristics, including gendered household type, household educational attainment, wealth quintile, poverty status, and severity of shock exposure. Nearly three-quarters of ZOI households (73.8 percent) believe that the local government will help the community cope with future shocks and stresses.

Households with higher educational attainment believe that local government will help the community cope with future shocks and stresses compared to households with lower educational attainment. Similar trends are observed by wealth quintile: household belonging to higher wealth quintiles believe in government aid in times of future shocks and stresses compared to lower wealth quintiles. On the contrary, households that experienced more severe shocks have less conviction in local government assistance during future shocks and stresses compared to households that experienced no or low shocks.

[57] Mercy Corps (n.d.)
[58] Oxfam International (2017)
[59] Vaughan (2018)
[60] WHO Regional Office for Europe (2017)
[61] To understand whether these resilience capacities actually strengthen resilience, a resilience analysis needs to be done. More information about resilience analyses can be found in the Food Security and Nutrition Network resource library at: https://www.fsnnetwork.org/resilience-and-resilience-capacities-measurement-options.).

Table 5.3.1: Percent of Households in the ZOI that Believe Local Government Will Help the Community Cope with Future Shocks and Stresses, in Total and by Selected Household Characteristics

Household characteristic	Percent	Sig.[a]	Number of households (*n*)[b,c]
All households	73.8		2,485
Gendered household type		n/s	
Male and female adults	73.7		2,191
Female adults only	73.7		287
Male adults only	^		6
Children only (no adults)	^		1
Household education		*	
No education	64.0		144
Less than primary	71.7		263
Completed primary	73.8		1,347
Completed secondary	79.0		347
Higher	74.0		384
Wealth quintile		**	
Highest (wealthiest)	80.0		483
Fourth	72.8		476
Middle	74.6		501
Second	73.8		498
Lowest (poorest)	67.9		527
Poverty status		n/s	
Poor	72.8		220
Non-poor	73.9		2,265
Shock exposure index		**	
Did not experience any shocks	76.5		1,238
Low	75.6		473
Moderate	68.2		489
High	68.2		285

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] Estimates include only households that experienced at least one shock or stressor during the 12 months preceding the ZOI Survey. Estimates exclude households that reported that local government will not need to help the community cope with shocks or stressors in the future.

Note: Disaggregates based on individual household members (i.e., gendered household type, household education, wealth index, and poverty status) are calculated using de jure household members.

Estimates exclude households that reported local government will not need to help the community cope with shocks or stresses in the future.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

5.3.2 Proportion of households participating in group-based savings, micro-finance, or lending programs

This indicator helps track the financial inclusion of households in the ZOI. Financial inclusion allows for lower day-to-day transaction costs (e.g., mobile money), the ability to grow savings to ease the burden of stressors and shocks, and access to credit to invest. Group-based savings programs are formal or informal community programs that serve as a mechanism for people in poor communities, with otherwise limited access to financial services, to pool their savings. The specific composition and function of the savings groups group vary and can include rotating disbursement as well as accumulating savings models. According to the World Bank, microfinance can be defined as approaches to provide financial services to households and micro-enterprises that are excluded from traditional commercial banking services. Typically, participants are low-income, self-employed, or informally employed individuals, with no formalized ownership titles on their assets and with limited formal identification papers.[62,63,64]

Table 5.3.2 presents the percentage of households participating in group-based savings, micro-finance, or lending programs. A household is considered to be participating if any member of the household saved money with or took a loan or borrowed cash or in-kind from a group-based savings, microfinance, or lending program in the 12 months preceding the survey. Findings are shown for all households and by household characteristics, including gendered household type, household educational attainment, wealth quintile, poverty status, and severity of shock exposure. Households with no female adults were excluded from this analysis.

Half of all ZOI households (50.7 percent) participate in some form of group-based savings, micro-finance, or lending program. Female only households participate less in group-based savings, micro-finance, or lending programs compared to households with male and female adults. Households with higher educational attainment participate more in these programs than households with no education. Specifically, participation is the highest among households where any member of the household completed primary schooling (55.3 percent). Households belonging to lower wealth quintiles participate more in these programs compared to households in higher wealth quintiles.

[62] Beck (2015)
[63] World Bank FINDEX: http://www.worldbank.org/en/programs/globalfindex
[64] Cull & Morduch (2017)

Table 5.3.2: Percent of Households in the ZOI Participating in Group-based Savings, Micro-finance, or Lending Programs, in Total and by Selected Household Characteristics

Household characteristic	Percent	Sig.[a]	Number of households (*n*)[b]
All households	**50.7**		**2,518**
Gendered household type		***	
Male and female adults	52.4		2,222
Female adults only	38.4		296
Male adults only	n/a		n/a
Children only (no adults)	n/a		n/a
Household education		***	
No education	30.6		146
Less than primary	50.3		264
Completed primary	55.3		1,362
Completed secondary	48.8		354
Higher	44.4		392
Wealth quintile		***	
Highest (wealthiest)	37.8		493
Fourth	49.2		484
Middle	53.7		503
Second	56.9		509
Lowest (poorest)	55.8		529
Poverty status		n/s	
Poor	51.1		223
Non-poor	50.7		2,295
Shock exposure index		n/s	
Did not experience any shocks	50.7		1,257
Low	48.4		479
Moderate	52.2		494
High	52.4		288

n/a=not applicable

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. Additionally, all households with no female adults were excluded from this analysis. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

Note: Disaggregates based on individual household members (i.e., gendered household type, household education, wealth index, and poverty status) are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

5.3.3 Index of social capital

Social capital has been shown to be an important source of resilience across different shocks and stresses, geographies, and populations. *Bonding social capital* relates specifically to the ability of households to provide support to and receive support from other households in the same community, whereas *bridging social capital* relates to the ability of households to provide support to and receive support from other households living outside of their community. The stronger the reciprocal obligation networks, the more likely it is that a household will be able to successfully manage shocks and stresses.

The index of social capital measures the ability of households in the ZOI to draw on social networks to get support to reduce the impact of shocks and stresses on their households. It measures both the degree of bonding among households in their own community and the degree of bridging between households in the area to households outside their own community. If household responses indicate that they have reciprocal, mutually reinforcing relationships through which household members can receive and provide support during times of need, they are considered to have social capital. The indicator is constructed by averaging two sub-indices: one measuring bonding social capital and one measuring bridging social capital.

Table 5.3.3 presents the index of social capital results overall, and by sub-index (i.e., bonding and bridging social capital) for all households and by household characteristics, including gendered household type, household educational attainment, wealth quintile, poverty status, and severity of shock exposure.

The mean social capital score is 66.8, social bonding score is 72.1, and bridging score is 61.5. When disaggregated by household educational attainment, the score was highest among households with less than primary educational attainment (68.3) and lowest for households with no education (60.3). Mean social capital index score varies significantly across different SEI categories. Households with high shock exposure have the lowest score (60.2) and households that did not experience any shocks have the highest mean social capital index score (68.9).

Table 5.3.3: Mean Social Capital Index Scores in the ZOI, in Total and by Selected Household Characteristics

Household characteristic	Total		Bonding		Bridging		Number of households (*n*)
	Score	Sig.[a]	Score	Sig.[a]	Score	Sig.[a]	
All households	**66.8**		**72.1**		**61.5**		**2,525**
Gendered household type		n/s		n/s		n/s	
Male and female adults	66.7		72.0		61.4		2,222
Female adults only	67.2		72.1		62.2		296
Male adults only	^		^		^		6
Children only (no adults)	^		^		^		1
Household education		*		n/s		n/s	
No education	60.3		66.6		54.0		146
Less than primary	68.3		73.6		63.0		265
Completed primary	67.8		73.5		62.1		1,368
Completed secondary	64.8		69.5		60.1		354
Higher	66.6		70.5		62.6		392
Wealth quintile		n/s		n/s		n/s	
Highest (wealthiest)	66.0		70.4		61.5		493
Fourth	67.3		72.3		62.2		486
Middle	67.2		72.9		61.5		503
Second	67.6		73.1		62.1		511
Lowest (poorest)	66.0		71.7		60.3		532
Poverty status		n/s		n/s		n/s	
Poor	66.3		71.4		61.1		223
Non-poor	66.9		72.2		61.6		2,302
Shock exposure index		***		**		**	
Did not experience any Shocks	68.9		73.6		64.2		1,263
Low	68.2		74.7		61.8		480
Moderate	64.0		69.4		58.5		494
High	60.2		65.8		54.6		288

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Disaggregates based on individual household members (i.e., gendered household type, household education, wealth index, and poverty status) are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

6 WOMEN'S EMPOWERMENT IN AGRICULTURE

This chapter presents findings related to the A-WEAI. Although women play a prominent role in agriculture, they face persistent economic and social constraints. Closing the gender gap in agriculture is critical to achieving Feed the Future's objectives of increasing agricultural productivity and efficiency, reducing hunger and malnutrition, and achieving food security.

6.1 Overview

The WEAI is the first-ever measure to directly capture women's empowerment and inclusion in the agriculture sector, and it was originally developed to track changes in women's empowerment that occur as a direct or indirect result of Feed the Future's programming.[65] Following its widespread uptake, the WEAI was improved and streamlined to make it less time-consuming and expensive to collect, resulting in the Abbreviated WEAI (A-WEAI).[66] All five domains of the original WEAI are retained, but the 10 indicators in the original WEAI are reduced to six in the A-WEAI.

The A-WEAI survey module is administered to the primary adult male decisionmaker and the primary adult female decisionmaker (18 years of age or older) in each household so that the relative empowerment of women and men in the same household can be compared. The primary adult male and female decisionmakers self-identify as the man or woman who makes more social and economic decisions than other men or women, respectively, in the household; this information is collected as part of the household roster information.[67] Households are excluded from responding to questions in the A-WEAI modules if there is only a self-identified primary adult male decisionmaker and no self-identified primary adult female decisionmaker, or if there are no adults 18 years of age or older.

The A-WEAI comprises two sub-indices: the 5DE and the GPI. The A-WEAI applies the same weights to the 5DE and the GPI as the original WEAI. The 5DE is weighted 90 percent, and the GPI is weighted 10 percent.

The A-WEAI score is calculated as: *A-WEAI score = 0.9(5DE) + 0.1(GPI)*

The 5DE score captures two elements: (1) the percentage of women who are empowered and (2) the average percentage of indicators that compose the 5DE in which disempowered women have adequate achievements.

[65] Alkire (2013)

[66] For more information, please refer to the Instructional Guide for the Abbreviated Women's Empowerment in Agriculture Index.

[67] The only respondents to the A-WEAI survey module are primary adult decisionmakers in the household and, therefore, are not representative of the entire female and male adult populations in the ZOI. It is thus essential to remember that the A-WEAI data reflect only the primary adult female and male decisionmakers when interpreting the data. However, to streamline the text of this report, the generic terms "woman," "female," "man," and "male" will be used henceforth. When used, they refer to the primary adult female or male decisionmakers from whom the data were collected.

The formula to calculate the 5DE score is as follows:[68] $5DE\ score = H_e + H_n\ (A_d)$

Where:

H_e = percentage of women who are empowered

H_n = percentage of disempowered women

A_d = is the average percentage of indicators in which disempowered women have adequate achievements

The 5DE score can be improved by increasing the percentage of empowered women or, for those women who are disempowered, by increasing percentage of women among the disempowered who achieve adequacy in the indicators that compose the 5DE.

The 5DE is composed of five domains: (1) decisions about agricultural production, (2) access to and decision-making power about productive resources, (3) control over use of income, (4) leadership in the community, and (5) time allocation. Each domain of the 5DE is equally weighted at one-fifth. The decisions about agricultural production, control over use of income, leadership in the community, and time allocation domains are composed of a single indicator, and thus these domains and the corresponding indicator carry the same weight: one-fifth. The access to and decision-making power about productive resources domain also has a weight of one-fifth but is composed of two indicators: ownership of assets, with a weight of two-fifteenths, and access to and decisions on credit, with a weight of one-fifteenth.

The indicators that compose the 5DE measure whether an individual reaches a certain threshold for that indicator, defined as achieving adequacy. An individual who has adequate achievements in 80 percent of the indicators that compose the 5DE (equivalent to four of the five A-WEAI domains) is identified as empowered.[69] These indicators are also used to compute an inadequacy score for each individual, which is the weighted average of the indicators (0=adequate; 1=inadequate), and is used in the GPI calculation. **Table 6.1.1** presents the 5DE domains, indicators, and adequacy cut-offs. Appendix 2.3 presents more information, including the survey questions and criteria used to determine adequacy for each 5DE indicator.

[68] The Guide to Feed the Future Statistics calculates the 5DE as: 5DE score = 1 – (H_p x A_p), where H_p = the number of disempowered respondents in the ZOI (respondents whose disempowerment score is greater than 0.2) divided by the total population of respondents in the ZOI with complete 5DE indicator data; and A_p = the average inadequacy score of disempowered women (i.e., the average censored inadequacy score).

[69] In the original WEAI, an individual has to achieve adequacy in four of the five WEAI domains OR in 80 percent of the weighted WEAI indicators. The A-WEAI is composed of fewer indicators, and therefore an individual must achieve adequacy in four out of five domains to reach the 80 percent threshold for empowerment.

Table 6.1.1: A-WEAI Domains, Indicators, and Definitions of Adequacy

Domain	Indicator	Definition of indicator adequacy
Production	Input in productive decisions	Adequate if, for at least one activity, an individual decides alone; OR participates and has input into some, or most or all decisions regarding the activity; OR someone else decides but feels she/he could decide to a medium or high extent if she/he wanted to
Resources	Ownership of assets	Adequate if individual owns—alone or jointly—at least one large asset or at least two small asset types
	Access to and input into decisions on credit	Adequate if individual—alone or jointly—makes decisions about at least one source of credit accessed by her household[a]
Income	Control over use of income	Adequate if individual participates in and has input in some, most, or all decisions about income generated from an activity; OR she/he makes decisions, has input in decisions, or feels she/he could make decisions (if desired) about employment or major household expenditures (excluding minor expenditures)
Leadership	Group membership	Adequate if individual is an active member of at least one group[b]
Time	Workload	Adequate if individual worked less than 10.5 hours during the previous day[c]

[a] Respondents who live in households that did not access credit are considered inadequate on access to credit and decisions on credit.
[b] Respondents who report that no groups exist in their communities or who are not aware of any groups in their community are considered adequate in group membership.
[c] Respondents who reported the 24 hours preceding the survey as being an atypical workday are excluded.
Source: Adapted from Malapit, et al. (2015)

The A-WEAI survey questions that are administered to the primary female decisionmaker and used to determine empowerment status and calculate the inadequacy score are also administered to the primary male decisionmaker in the same household and used to determine his empowerment status and inadequacy score. The GPI is the second sub-index of the A-WEAI and is calculated using these data for the primary female and male decisionmakers in households that have both.

The GPI measures the extent of inequality in empowerment in a household between the primary male decisionmaker and the primary female decisionmaker. The GPI excludes households that lack both a primary male decisionmaker and a primary female decisionmaker. A household is considered to lack gender parity if the primary female decisionmaker is disempowered and her inadequacy score is higher than that of the primary male decisionmaker. The GPI comprises two components: (1) proportion of gender parity-inadequate households; and (2) the average empowerment gap, which is the average normalized percentage gap in the censored inadequacy score of women and men in households that do not have gender parity.

The average normalized empowerment gap (I_{GPI}) is calculated as:

$$I_{GPI} = (\text{inadequacy score}_{woman} - \text{inadequacy score}_{man})/(1 - \text{inadequacy score}_{man})$$

Note the empowerment gap is normalized because each household has a different threshold for gender parity that is based on the man's inadequacy score in each household. The average empowerment gap is normalized by dividing each difference in inadequacy scores by the maximum possible gap for women, which is 1 (i.e. complete inadequacy) minus the male's inadequacy score.

The GPI score is calculated as: $GPI = 1 - (H_{GPI} \times I_{GPI})$

Where:

H_{GPI} = percentage of women without gender parity

I_{GPI} = average normalized empowerment gap

The GPI score can be improved by increasing the percentage of women who have gender parity or, for those women who are less empowered than men, by reducing the empowerment gap between the primary male and female decisionmakers in the same household.

This chapter presents findings on the A-WEAI, and the indices and indicators that compose the index. For additional details on calculating the A-WEAI, please refer to the *Feed the Future Guide to Statistics*.[70]

6.2 Summary of A-WEAI results

This section presents the following A-WEAI results for women and men: (1) A-WEAI scores, disaggregated by age group; (2) 5DE scores, representing the percentage of individuals achieving empowerment; (3) GPI scores, including percentage of women achieving gender parity; and (4) average empowerment gap.

Table 6.2.1 presents an overview of the A-WEAI, 5DE, and GPI scores, disaggregated by age group.

The A-WEAI score for all women is 0.89. When disaggregated by age category, the A-WEAI score is higher for women who are 30 years of age and above than women 18-29 years of age, which is statistically significant at the 5.0 percent level. Women's 5DE score is slightly higher than men's, although the difference is not statistically significant. Women are slightly ahead of men in achieving empowerment (68.3 percent for women and 65.9 percent for men). The average adequacy score is similar for women and men (64.8 for women and 64.1 for men).

Women's overall gender parity score is 0.95, and the proportion of women achieving gender parity is 79.1 percent. Empowerment is slightly higher among women 30+ years of age than women 18-29 years of age (79.9 percent versus 76.5 percent). The average empowerment gap is 0.22.

[70] Zalisk et al. (2019)

Table 6.2.1: A-WEAI, 5DE, and GPI Scores, and Average Empowerment Gap

Statistic	Female	Male	Sig.[a]
A-WEAI score	0.89		
Age category			*
18-29	0.87		
30+	0.90		
5DE score	0.89	0.88	n/s
Percent of individuals achieving empowerment	68.3	65.9	n/s
Percent of weighted indicators in which disempowered individuals have adequate achievements (i.e., average adequacy score)	64.8	64.1	n/s
Number of individuals	**2,327**	**2,008**	
GPI score	0.95		
Percent achieving gender parity	79.1		
Age category			n/s
18-29	76.5		
30+	79.9		
Average empowerment gap	0.22		
Number of dual-adult households	**1,992**		

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on primary adult decisionmakers who are de jure household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 6.2.2 presents the percentage of females and males achieving empowerment disaggregated by age, education, and poverty status. Analyzing empowerment by child feeding practices such as exclusive breastfeeding and children who have received a minimum acceptable diet is not possible because data on child feeding practices are taken from the BDHS; therefore, these estimates are not presented and are denoted as not applicable in the table.[71]

When empowerment is disaggregated by age and sex, the percentage of empowerment is higher for females of both age groups than for males. Overall, more older men and women are empowered than younger men and women. The difference in empowerment by age category in statistically significant at the 0.1 percent level.

Among individuals with relatively lower educational attainment levels–that is, up to completion of primary education, there is a higher proportion of women that has achieved empowerment compared with men. Educational attainment and empowerment do not have a direct positive association: women and men who have completed up to secondary education or less are more empowered than women and

[71] The education disaggregate was selected because it was positively associated with women's empowerment scores when data were analyzed under the Feed the Future phase one. Additional details can be found in the WEAI Baseline Report. No clear relationship with poverty was found at baseline; however, it is important to understand how empowerment status varies for individuals in households living above or below the USD $1.90 poverty line. Further analysis should be considered on the basis of these results. All disaggregates should align with the indicator definitions presented in the Feed the Future Indicator Handbook.

men with higher than secondary education. Although empowerment is slightly higher among non-poor than poor, the difference is not statistically significant.

Table 6.2.2: Empowerment by Sex, Age, Poverty Status, Region, and Child Feeding Behavior

	Female		Male		
Characteristic	**Percent**	**N**	**Percent**	**N**	**Sig.[a]**
Age category					***
18-29	66.2	556	59.4	199	
30+	69.0	1,771	66.7	1,809	
Education					n/s
No education	64.7	752	65.3	758	
Less than primary	74.0	351	69.0	343	
Completed primary	70.5	1,047	65.8	664	
Completed secondary	66.3	107	68.8	109	
Higher	49.9	70	59.7	134	
Poverty status					n/s
Poor	63.2	209	62.4	173	
Non-poor	68.8	2,118	66.3	1,835	
0-5 month old exclusively breastfed[b]					n/a
Yes	n/a	n/a			
No	n/a	n/a			
6-23 month old with minimum acceptable diet [b]					n/a
Yes	n/a	n/a			
No	n/a	n/a			

n/a=not applicable

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Data on child feeding practices was taken from BDHS; therefore, analyzing empowerment by these disaggregates is not possible.

Note: Estimates are based on primary adult decisionmakers who are de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

6.3 A-WEAI domain and indicator results

Empowerment is a complex and multidimensional concept. Aggregating the different dimensions of empowerment into a single index to generate the A-WEAI score provides a simple way to communicate the status of women's empowerment in agriculture, to compare those scores across countries and over time, and to analyze the relationship of women's empowerment in agriculture to other outcome of interest, such as hunger and malnutrition. A-WEAI scores also provide incentives for decisionmakers to reduce the prevalence and intensity of disempowerment.

Based on the A-WEAI methodology, empowerment in agriculture occurs when a woman has adequate achievements across the five domains that compose the index. Therefore, decomposing the A-WEAI and examining the individual indicators in each domain is critical for identifying the greatest constraints to empowerment, designing policies and programs to reduce those constraints, and understanding how and why those constraints change over time.

This section presents A-WEAI results disaggregated by age and decomposed by: (1) average percentage of individuals achieving adequacy across the six A-WEAI indicators; (2) contribution of each indicator to

empowerment; and (3) percentage of individuals with adequate achievements in each A-WEAI indicator, using censored headcount ratios. Examining censored headcount ratios help focus attention on those indicators that are the biggest constraints to empowerment *among the* disempowered. Uncensored headcount ratios present indicator results *regardless of empowerment status* by identifying those indicators that report the lowest percentages achieving adequacy.[72]

Table 6.3.1 presents the average percentage of women and men achieving adequacy across the six A-WEAI indicators. The purpose of reporting on the average percentage of women achieving adequacy across the six A-WEAI indicators overall, which is a Feed the Future context indicator, and for the individual indicators is two-fold: (1) to bring greater attention to the composition of empowerment and disempowerment, and (2) to identify the individual indicators that present the greatest constraints to empowerment for women and men.

More males achieve higher adequacy score across the six A-WEAI indicators than females (21.7 percent and 18.8 percent, respectively), although the difference is not statistically significant. There is also no statistically significant difference in adequacy by age category between males and females.

Table 6.3.1: Average Percent of Primary Adult Decisionmakers Achieving Adequacy across the Six A-WEAI Indicators, by Sex and Age

	Female		Male		
A-WEAI indicator	**Percent**	**N**	**Percent**	**n**	**Sig.[a]**
Average percentage (censored headcount ratio)	18.8	2,327	21.7	2,008	n/s
Age category					
18-29	19.3	556	25.6	199	n/s
30+	18.6	1,771	21.2	1,809	n/s

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Notes:

Estimates are based on primary adult decisionmakers who are de jure household members.

The Feed the Future ZOI context indicator, "Average percent of women achieving adequacy across the six indicators of the A-WEAI," is calculated as the sum of the censored headcount ratios for primary adult female decisionmakers for each of the six A-WEAI indicators, divided by six (the number of indicators.) It shows the average across the six indicators of proportion of primary adult female decisionmakers in the ZOI population who are disempowered but still achieved adequacy in an individual A-WEAI indicator.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

5DE is composed of two components: (1) the percentage of empowered individuals and (2) the percentage of disempowered individuals multiplied by the mean adequacy score of the disempowered (i.e., the average percentage of indicators that compose the 5DE in which disempowered women have adequate achievements). **Figure 6.1** presents the comparison of the contribution of each indicator by sex to the second component of the 5DE—disempowered but adequate—to illustrate which indicators present the greatest constraints to empowerment among men and women identified as disempowered.

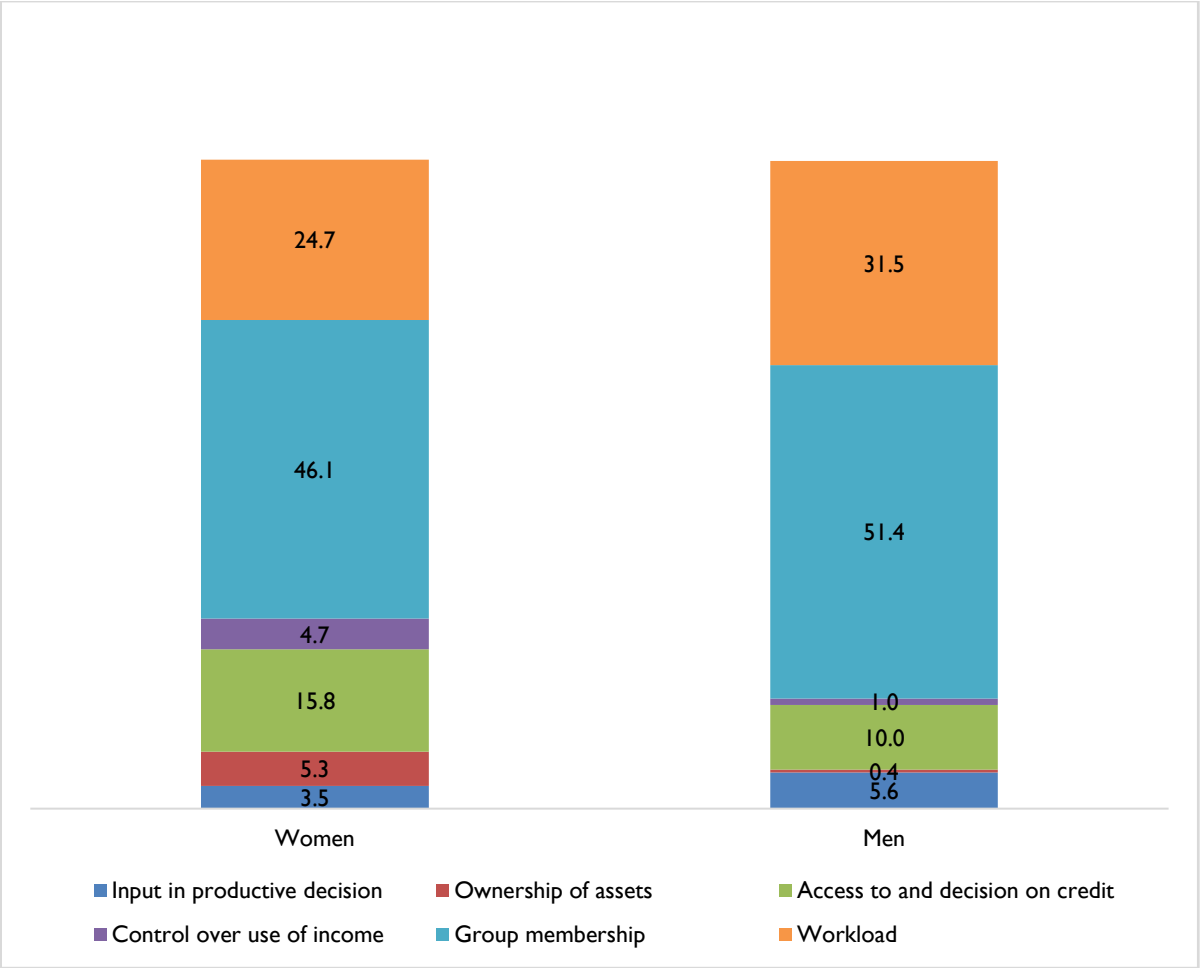
[72] The censored headcount ratios present results from respondents who are disempowered and have adequate achievements in a given indicator, divided by the total number of respondents. Uncensored headcount ratios present results from all individuals achieving adequacy in a given indicator, regardless of empowerment status, divided by the total number of respondents. Indicator results using uncensored headcount ratios can be found in Appendix 1.2.

The decisions about agricultural production, control over use of income, leadership in the community, and time allocation domains are composed of a single indicator, and thus these domains and the corresponding indicator carry the same weight: one-fifth. The access to and decision-making power about productive resources domain also has a weight of one-fifth but is composed of two indicators: ownership of assets with a weight of two-fifteenths and access to and decisions on credit with a weight of one-fifteenth.

The indicator weights are important to consider in the calculation of the 5DE and the overall A-WEAI, which is an aggregated, standardized index score that allows for cross-country comparability. However, the purpose of decomposing the "disempowered but adequate" component of the 5DE is to draw attention to the indicators for which low percentages of disempowered individuals achieve adequacy (censored adequacy headcounts) or contribute proportionally less than the indicator's weight to the "disempowered but adequate" component of the 5DE. Increasing the percentage of disempowered individuals who achieve adequacy in these indicators will increase the 5DE.

Figure 6.1 shows that group membership and workload both contribute a percentage greater than their assigned weights for both women and men. The percentage contribution of group membership is 46.1 percent for women and 51.4 percent for men. Workload contributes 24.7 percent for women and 31.5 percent for men. Access to and decisions on credit also contributes more than its assigned weight for both women and men (15.8 percent and 10.0 percent, respectively). Input into productive decisions, ownership of assets and control over use of income contribute less than their assigned weights for both men and women. Input into productive decisions contributes 5.6 percent for men and 3.5 percent for women. The contribution of ownership of assets is 5.3 percent and control over use of income is 4.7 percent for women. For men, the contribution of ownership of assets and control over use of income is 0.4 percent and 1.0 percent, respectively.

Figure 6.1: Percent Contribution of the Six A-WEAI Indicators to Adequacy among the Disempowered, by Sex (Censored Adequacy Headcount Ratio)



Note: Estimates are based on primary adult decision-makers who are de jure household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 6.3.2 presents the censored headcount ratios of individuals achieving adequacy in each indicator, disaggregated by sex and age.

Slightly less than one-third of women are disempowered and have adequate achievements in input in productive decisions (29.3 percent), control over income (28.7 percent), and ownership of assets (27.9 percent), and around 4 percent have adequate achievements in access to and decisions on credit (4.6 percent) and group membership (4.4 percent). For disempowered men, the domain with the highest achievement is ownership of assets (33.7 percent), followed by control over income (33.3 percent), input in productive decisions (30.7 percent), workload (15.4 percent), access to and decisions on credit (14.7 percent), and lastly group membership (2.3 percent).

Men have higher adequacy than women in four A-WEAI indicators, namely in (1) input in productive decisions, (2) ownership of assets, (3) access to and decisions on credit, and (4) control over income. The differences between men and women in ownership of assets and access to and decisions on credit

are statistically significant at the 0.1 percent level, and statistically significant at the 1 percent level for control over income. Compared with men, women have higher achievement in group membership and workload, and this difference is statistically significant at the 1 percent level for group membership only.

Across nearly all six A-WEAI indicators (except workload for women), women and men who are 18-29 years of age achieved higher adequacy than those 30+ years of age.

Table 6.3.2: Percent of Primary Adult Decisionmakers with Adequate Achievement in Each A-WEAI Indicator Using Censored Headcount Ratios, by Sex and Age

	Female		Male		
A-WEAI indicator	Percent	n	Percent	N	Sig.[a]
Input in productive decisions	29.3	2,327	30.7	2,008	n/s
18-29	30.1	556	35.7	199	n/s
30+	29.0	1,771	30.1	1,809	n/s
Ownership of assets	27.9	2,327	33.7	2,008	***
18-29	29.5	556	39.6	199	*
30+	27.3	1,771	33.0	1,809	***
Access to and decisions on credit	4.6	2,327	14.7	2,008	***
18-29	5.6	556	12.5	199	*
30+	4.2	1,771	15.0	1,809	***
Control over income	28.7	2,327	33.3	2,008	**
18-29	29.0	556	38.6	199	*
30+	28.6	1,771	32.7	1,809	**
Group membership	4.4	2,327	2.3	2,008	**
18-29	6.7	556	3.5	199	n/s
30+	3.7	1,771	2.1	1,809	*
Workload	17.8	2,327	15.4	2,008	n/s
18-29	14.9	556	23.5	199	*
30+	18.6	1,771	14.5	1,809	**

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on primary adult decisionmakers who are de jure household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

6.4 Descriptive statistics for A-WEAI domains and indicators

The following section presents more granular information and statistics on data collected in the A-WEAI module. The sub-sections are organized by A-WEAI domains.

6.4.1 Production

Adequacy in *production* is measured by input into decisions about agricultural activities in which an individual participates. Respondents are considered adequate in production if they make decisions alone, have input into most or all decisions, or feel that they could make decisions if they wanted to for at least one agricultural activity.

Table 6.4.1 presents the percentages of women and men who are involved in agriculture-related activities (i.e., food crop farming, cash crop farming, and livestock raising, or fishing), non-farm economic activities, and wage or salaried employment to capture the breadth of economic activities in which

individuals are engaged. The table also presents the percentages of women and men who have input into the decisions made about specific activities.

Participation in different economic activities is lower among women than men for all activities, except food crop farming. All the differences in participation by sex are statistically significant. Across all economic activities, there is a higher proportion of men who have input into decisions about activities than women. Again, all the differences in the percentages of men and women giving inputs into decisions about activities are statistically significant.

Table 6.4.1: Participation in Economic Activities and Input in Decisionmaking on Production, by Sex

	Participates in activity			Has input into decisions about activity[a]				
	Female[b]	Male[c]		Female[b,d]		Male[c,d]		
Economic activity	(%)	(%)	Sig.[d]	%	n	%	N	Sig.[e]
Any economic activity	99.7	99.7	n/s	96.5	2,320	97.2	2,002	n/s
Food crop farming	81.1	74.4	***	83.5	1,887	96.8	1,494	***
Cash crop farming	54.1	59.5	**	80.0	1,257	97.5	1,193	***
Livestock raising	49.7	52.9	***	89.3	1,152	94.1	1,060	***
Fishing or fishpond culture	17.2	23.6	***	76.6	404	95.9	477	***
Non-farm economic activities	15.3	46.3	***	88.3	357	96.1	934	***
Wage or salaried employment	12.2	46.7	***	93.8	285	97.9	937	*
Number of individuals (*n*)	2,327	2,008						

[a] Having input means that the individual reported having input into most or all decisions regarding the activity.
[b] Estimates exclude households that do not have a primary adult female decisionmaker who is a de jure household member or that have missing or incomplete indicator data.
[c] Estimates exclude households that do not have a primary adult male decisionmaker who is a de jure household member or that have missing or incomplete indicator data.
[d] Estimates exclude individuals who do not participate in an activity or report that no decision was made.
[e] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on primary adult decisionmakers who are de jure household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

6.4.2 Resources

Adequacy in *resources* is measured by two indicators: (1) ownership of assets, and (2) access to and decisions related to credit. Respondents are considered adequate in asset ownership if they own, alone or jointly, at least two small asset types or one large asset. Respondents are considered adequate to access to credit if they decide alone or jointly whether to borrow cash or in-kind or what to do with the money or item borrowed. **Table 6.4.2** presents the findings for ownership of assets.

Overall, there is a higher proportion of men who solely or jointly own productive resources than women, except for two types of assets: (1) chickens, ducks, turkeys, and pigeons; and (2) small consumer durables. The maximum difference in ownership between males and females is related to means of transportation (90.4 percent vs. 6.4 percent, respectively) and the difference is statistically

significant at the 0.1 percent level. Similarly, women have very low ownership of agricultural land, non-agricultural land, fishpond or fishing equipment, and mechanized farm equipment compared with men. All differences in ownership of productive resources by sex of primary adult decisionmaker are statistically significant at the 0.1 percent level.

Table 6.4.2: Ownership of Productive Resources, Any Household Member and by Sex of Primary Adult Decisionmaker

Productive resource	Someone in the household owns item[a] (%)	Female owns solely or jointly[a,b] (%)	Male owns solely or jointly[a,c] (%)	Sig.[d]
Agricultural land	77.3	12.9	76.6	***
Large livestock	47.7	49.4	91.2	***
Small livestock	38.8	71.2	73.9	n/s
Chickens, ducks, turkeys, and pigeons	84.2	93.6	36.6	***
Fishpond or fishing equipment	41.5	15.9	96.4	***
Non-mechanized farm equipment	93.1	37.3	97.9	***
Mechanized farm equipment	22.0	15.9	98.4	***
Non-farm business equipment	25.9	22.5	92.1	***
House or other structures	99.6	17.5	93.0	***
Large consumer durables	95.2	65.9	96.3	***
Small consumer durables	100.0	96.1	70.5	***
Cell phone	97.4	53.3	88.5	***
Non-agricultural land	8.6	13.8	88.8	***
Means of transportation	54.5	6.4	90.4	***
Number of households (*n*)	2,327	2,327	2,008	

[a] Estimates exclude households that have no primary adult decisionmaker or that have missing or incomplete indicator data. Respondents who indicated "not applicable" are also excluded.
[b] Estimates exclude households that do not have a primary adult female decisionmaker who is a de jure household member or that have missing or incomplete indicator data.
[c] Estimates exclude households that do not have a primary adult male decisionmaker who is a de jure household member or that have missing or incomplete indicator data.
[d] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 6.4.3 and **Table 6.4.4** show the second indicator of the *resources* domain—access to and decisionmaking on credit. **Table 6.4.3** presents the percentage of women who report that a member of their household received any loan in the 12 months preceding the survey—overall and disaggregated by source. The percentages of households with primary adult female decisionmakers who received an in-kind loan or credit (e.g., food items or raw materials) or a cash loan are also presented. The in-kind and cash loan categories are not mutually exclusive; a household could have received both types of loans. For women living in households that received a loan, the table also presents the percentages who report having contributed to the decision to take the loan or the decisions on how to use the loan. Note that the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 did not collect data on credit access via group-based micro-finance, nor were households asked whether credit was not needed under the A-WEAI module; therefore, we did not report these data in **Tables 6.4.3** and **Table 6.4.4**.

Over three-quarters (75.7 percent) of women reported that someone in their household received a loan. The major source of credit is NGOs, followed by credit from friends or relatives. Nearly all households received a loan in the form of cash (75.5 percent), whereas very few households received in-kind loans (1.1 percent). Most women (81.8 percent) in the ZOI report contributing to credit decisions. Over three-quarters (80.3 percent) of women helped decide whether to borrow credit, and 77.2 percent of women contributed to deciding how to use loans.

Table 6.4.3: Credit Access among Women, by Source

Characteristic	Any source (%)	Credit source[a]						
		NGO (%)	Informal lender (%)	Formal lender (%)	Friends or relatives (%)	Group-based micro-finance (%)	Informal credit/ savings groups (%)	No credit needed (%)
Household received a loan								
Any loan	75.7	54.3	13.2	7.9	38.0	—	1.2	—
In-kind loan	1.1	0.2	0.3	0.1	0.6	—	0.1	—
Cash loan	75.5	54.1	13.0	7.8	37.6	—	1.1	—
Number of households (*n*)[b]	2,327	2,327	2,326	2,326	2,326	—	2,317	—
Woman contributed to credit decision								
Any decision	81.8	83.2	69.9	67.8	78.5	—	^	—
On whether to borrow	80.3	81.4	68.9	66.7	76.8	—	^	—
On how to use loan	77.2	77.4	64.0	62.9	75.0	—	^	—
Number of households that received a loan (*n*)[c]	1,762	1,264	309	185	883	—	28	—

— = Data are not available

^ Results not statistically reliable, n<30

NGO=nongovernmental organization

[a] Percentages sum to more than 100 percent because loans may have been received from more than one source.

[b] Estimates exclude households that do not have a primary adult female decisionmaker who is a de jure household member or that have missing or incomplete indicator data.

[c] Estimates exclude households that do not have a primary adult female decisionmaker who is a de jure household member, that did not receive a loan, or that have missing or incomplete indicator data.

Note: Estimates are based on primary adult female decisionmakers who are de jure household members.

Source: Feed the Future Bangladesh ZOI 2018/2019

Table 6.4.4 presents credit access for men in the ZOI. Over three-quarters of men (78.0 percent) report that someone in their household received a loan, over half of whom received a loan from NGOs (52.0 percent). Similar to women, more men report having access to cash loans compared to in-kind loans. However, more men than women report that they could decide whether to take a loan and how to use it.

Table 6.4.4: Credit Access among Men, by Source

Characteristic	Any source (%)	Credit source[a] NGO (%)	Informal lender (%)	Formal lender (%)	Friends or relatives (%)	Group-based micro-finance (%)	Informal credit/ savings groups (%)	No credit needed (%)
Household received a loan								
Any loan	78.0	52.0	15.8	13.5	33.3	—	3.9	—
In-kind loan	0.6	0.1	0.2	0.2	0.2	—	0.1	—
Cash loan	77.9	51.9	15.7	13.4	33.1	—	3.8	—
Number of households (*n*)[b]	**2,008**	**2,007**	**2,006**	**2,007**	**2,008**	**—**	**2,004**	**—**
Man contributed to credit decision								
Any decision	96.4	95.9	96.0	96.7	96.9	—	96.1	—
On whether to borrow	95.4	94.0	95.6	95.6	96.3	—	94.8	—
On how to use loan	96.0	95.3	95.0	96.7	96.6	—	94.8	—
Number of households that received a loan (*n*)[c]	**1,568**	**1,045**	**320**	**273**	**671**	**—**	**77**	**—**

— = Data are not available

NGO=non-governmental organization

[a] Percentages sum to more than 100 percent because loans may have been received from more than one source.

[b] Estimates exclude households that do not have a primary adult male decisionmaker who is a de jure household member or that have missing or incomplete indicator data.

[c] Estimates exclude households that do not have a primary adult male decisionmaker who is a de jure household member that did not receive a loan, or that have missing or incomplete indicator data.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

6.4.3 Income

Adequacy in *income* is measured by input into decisions related to income and expenditures. Respondents are considered adequate if they have substantial input into most or all decisions or feel that they can make a decision for at least one economic activity or major household expenditures. **Table 6.4.5** shows the percentages of women and men who have input into the decisions made regarding the use of income derived from an activity.

Overall, a slightly higher proportion of men have input into decisionmaking on the use of income than women, and the difference is statistically significant at the 1 percent. For example, only 82.3 percent of women have input into how to use income from food crop farming compared with 96.4 percent of men. Similar trends are observed for income from cash crop farming, livestock raising, fishing or fishpond culture, and non-farm economic activities. There is a similar percentage of women and men that report having inputs on deciding how to use income from wage or salaried employment (94.8 percent and 97.9 percent, respectively).

Regarding major household expenditures, a higher proportion of men (98.6 percent) have inputs into decisions compared with women (88.1 percent).

All differences in inputs into decisionmaking on the use of income and major household expenditure by sex are statistically significant at the 0.1 percent level, except for non-farm economic activities and wage or salaried employment, which are statistically significant at the 1 percent and 5 percent levels, respectively.

Table 6.4.5: Input into Decision making on Use of Income and Major Household Expenditures, by Sex

Economic activity	Female[a]		Male[b]		Sig.[c]
	Percent	N	Percent	N	
Any economic activity	98.8	2,320	99.7	2,002	**
Food crop farming	82.3	1,862	96.4	1,493	***
Cash crop farming	78.4	1,254	97.3	1,193	***
Livestock raising	85.5	1,118	94.9	1,056	***
Fishing or fishpond culture	72.6	400	96.7	476	***
Non-farm economic activities	88.5	357	96.2	934	**
Wage or salaried employment	94.8	285	97.9	937	*
Major household expenditures	88.1	2,261	98.6	1,809	***

[a] Estimates exclude households that do not have a primary adult female decisionmaker who is a de jure household member or households that have missing or incomplete data. Estimates also exclude respondents who do not participate in the activity or who report that no decision was made regarding the activity.

[b] Estimates exclude households that do not have a primary adult male decisionmaker who is a de jure household member or that have missing or incomplete data. Estimates also exclude respondents who do not participate in the activity or who report that no decision was made regarding the activity.

[c] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: "Having input" means that the individual reported having input into most or all decisions regarding the use of income generated from the activity.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

6.4.4 Leadership

Adequacy in *leadership* is measured through an individual's active involvement with community groups. Respondents are considered adequate if they are active members of at least one community group. **Table 6.4.6** shows the percentages of women and men who are active members of groups in their community.

There are stark disparities between men's and women's group membership in the ZOI, with women's group membership 1.7-times higher than men's (61.4 percent and 35.9 percent, respectively). This difference in group membership by sex is statistically significant at the 0.1 percent level.

Women's membership in credit or micro-finance groups is higher than men's (46.6 percent and 17.1 percent, respectively) and the difference is statistically significant at the 0.1 percent level. Nearly one-quarter (23.4 percent) of women in the ZOI are members of a religious group compared with only 13.3 percent of men. This difference is statistically significant at the 0.1 percent level.

Table 6.4.6: Group Membership, by Sex

Type of group	Is an active group member: Female[a,b] (%)	Male[a,c] (%)	Sig.[d]
Any group	61.4	35.9	***
Agricultural producer's group	0.7	2.6	***
Water users' group	8.6	6.6	n/s
Forest users' group	0.3	0.1	n/s
Credit or micro-finance group	46.6	17.1	***
Mutual help or insurance group	0.5	1.4	*
Trade and business association	0.3	1.8	***
Civic or charitable group	0.4	0.3	n/s
Local government	1.1	3.0	***
Religious group	23.0	13.3	***
Other women's group	0.6		
Other	0.0	0.0	n/a
Number of individuals (*n*)	**2,327**	**2,008**	

n/a=not applicable

[a] The denominator for these percentages includes all interviewed individuals, even those who reported that no group exists or that they are unaware of the existence of a group in their community. These individuals, who report that none of the groups exist or who are unaware of any groups, are counted as having inadequate achievement of this empowerment indicator.

[b] Estimates exclude households that do not have a primary adult female decisionmaker who is a de jure household member or that have missing or incomplete data

[c] Estimates exclude households that do not have a primary adult male decisionmaker who is a de jure household member or that have missing or incomplete data.

[d] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

6.4.5 Time

Adequacy in the last domain, *time*, assesses the workloads of women and men, as measured using a time allocation log. Respondents are considered adequate if they spend 10.5 hours or less performing work activities in a 24-hour period. **Table 6.4.7** shows the percentages of women and men who performed the listed activities the day prior to the survey and the average number of hours that they spent performing each activity. The percentages indicate those individuals who reported performing the activity, irrespective of the length of time that they spent performing the activity. The average hours spent performing an activity is the average across all individuals, assigning zero hours to individuals who did not perform an activity. Note that individuals who reported that the hours worked the day prior to the ZOI Survey were not normal are excluded from the results.

Virtually all men and women report participating in daily life activities such as sleeping, eating, and personal care, with a similar time devoted to these activities irrespective of sex. Both men and women spend, on average, around 9 hours sleeping and 1 hour eating daily. Very few adult males and females report going to school and doing homework, and a marginal percentage of men and women report exercising (5.0 percent of women and 6.1 percent of men). More men participate in employment work, own business/work, shopping, and travelling compared with women, and these differences are statistically significant at the 0.1 percent level. However, a higher proportion of women participate in farming, livestock raising, and fishing, weaving, sewing textile care, social activities and hobbies and

religious activities than men, and the difference is statistically significant at the 0.1 percent. Women were also more engaged than men in domestic work, such as cooking and caring for children, which is in line with the gender norms and conventions of Bangladesh. This difference is statistically significant at the 0.1 percent level.

Women spend more time than men on home-bound activities, such as domestic work, cooking, and caring for children and elderly which is statistically significant at 0.1 percent level. Men spend more time than women on livelihood activities and those activities that require going outside the home, such as working as employed, own business work, farming, shopping, and travelling and commuting and the difference is statistically significant at the 0.1 percent level.

Table 6.4.7: Time Allocation, by Sex

	Participated in activity (%)[a]			Mean hours devoted (hh:mm)[b]		
Activity	**Female[c]**	**Male[d]**	**Sig.[e]**	**Female[c]**	**Male[d]**	**Sig.[e]**
Sleeping and resting	100.0	100.0	n/s	9:12	9:24	*
Eating and drinking	99.7	98.6	n/s	1:17	1:14	n/s
Personal care	99.8	98.3	n/s	1:24	1:08	***
School, including homework	3.2	3.9	n/s	0:02	0:03	n/s
Work as employed	3.5	23.0	***	0:10	1:39	***
Own business work	4.9	27.9	***	0:07	2:04	***
Farming, livestock, fishing	73.4	59.2	***	1:31	2:46	***
Shopping, getting services	5.1	26.5	***	0:03	0:25	***
Weaving, sewing, textile care	10.3	0.7	***	0:14	0:01	***
Cooking	91.7	0.2	***	2:04	0.00	***
Domestic work, including fetching water and collecting fuel	98.4	21.0	***	3:10	0:25	***
Care for children, adults, elderly	57.7	13.1	***	1:15	0:09	***
Traveling (not for work or school)	24.9	69.1	***	0:17	0:56	***
Watching TV, listening to radio, reading	29.4	23.9	**	0:31	0:23	***
Exercising	5.0	6.1	n/s	0:03	0:04	n/s
Social activities and hobbies	83.5	72.8	***	1:56	2:10	*
Religious activities	55.4	42.9	***	0:58	0:44	***
Other	1.2	1.8	n/s	0:01	0:03	*
Number of individuals (*n*)	**2,327**	**2,008**		**2,327**	**2,008**	

[a] The percentages indicate those individuals who reported performing the activity, irrespective of the length of time that they spent performing the activity.

[b] The average hours spent performing an activity is the average across all individuals, assigning zero hours to individuals who did not perform an activity.

[c] Estimates exclude primary adult female decision-makers who are not de jure household members or who have missing or incomplete data.

[d] Estimates exclude primary adult male decision-makers who are not de jure household members or who have missing or incomplete data.

[e] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7 TARGETED AGRICULTURE VALUE CHAINS

This chapter presents the results for the targeted value chains—rice, fishpond aquaculture, and dairy farming—included in the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019, including background information about each value chain and its farmers, the use of agriculture technologies and management practices, and the yield. Individuals responsible for making management decisions about one or more rice plot, one or more fishpond, or one or more herd of dairy cows during the year preceding the ZOI Survey were eligible to respond to the corresponding survey modules. Throughout this chapter, these interviewed individuals are referred to as farmers. There may be more than one farmer of a specific value chain in the same household if the farmers were responsible for different plots of rice, different fishponds, or different herds of dairy cows. Multiple farmers in the same household, therefore, may have been interviewed about the same value chains. In addition, the same farmer may have been responsible for more than one targeted value chain; in which case, the same farmer may have been interviewed about multiple value chains.

Results for each targeted value chain are presented across all farmers of that value chain and disaggregated by sex and age (15-29 years and 30 years or older). Group-wise tests of differences were run to compare the use of practices and technologies between male and female farmers and youth and non-youth farmers. Statistically significant results are indicated in the tables and discussed in the narrative.

Knowing what management practices and technologies farmers use to cultivate their crops and raise their fish or livestock fosters a better understanding of what farmers are already doing well and what they could do better to increase their productivity. Collecting information about management practices and technologies that farmers use through the ZOI Survey enables an examination of practices and technologies beyond those who have directly participated in Feed the Future programming. Promoted improved management practices or technologies are those supported through Feed the Future as a way to increase agriculture productivity or support stronger and better-functioning systems. In all tables in this chapter, improved technologies promoted by Feed the Future in Bangladesh are indicated with a superscript (‡).

Yields of products from targeted agricultural value chains are a key driver of agricultural productivity. Yield can serve as a proxy for the productivity of these value chains and the impacts of interventions when its trend is evaluated over time. Improving smallholders'[73] yield of agricultural commodities contributes to increasing agricultural gross domestic product, can increase income when other components of agricultural productivity (e.g., post-harvest storage, value addition and processing, markets) are in place, and can therefore contribute to increasing sustainable productivity and reducing

[73] A smallholder is one who holds 5 hectares or less of arable land. In the Bangladesh context, crop farmers are disaggregated into four farm size groups according to the size of their operated farm land: (1) marginal farmers (operating less than 0.5 acres of land); (2) small farmers (operating 0.5 to 1.49 acres of land); (3) medium farmers (operating 1.5 to 2.49 acres of land); and (4) large farmers (operating 2.5 acres or more of land). In terms of hectare, smallholders are defined as those operating less than 0.61 hectares. Large farmers operate only 1 hectare of more and. Farmers holding 5 hectares or less arable land virtually include all farm households in the Bangladesh ZOI sample.

poverty. Collecting information about yield through the ZOI Survey enables an examination of outcomes that have scaled beyond those who have directly participated in Feed the Future programming to have an effect at the ZOI level.

7.1 Rice cultivation

7.1.1 Cultivation of rice in Bangladesh

Feed the Future targets the rice value chain in Bangladesh. Rice is the staple food and a mainstay of the Bangladeshi diet, representing 64.3 percent of total caloric intake and 50.9 percent of total protein intake in national rural Bangladesh.[74] The rice sector contributes half of the agricultural GDP.[75] About 75.0 percent of the total cropped area is rice. Thus, rice plays a vital role in agriculture and the livelihood of the people of Bangladesh.

There are three rice-growing seasons in Bangladesh: (1) aus, (2) aman, and (3) boro. Aus is the pre-monsoon rice-growing season under rainfed conditions. Aus rice is sown March-April and harvested between July and August. The monsoon-season rainfed rice is aman, which is planted in two ways: (1) direct-seeding (broadcast or b. aman) with aus in March-April, and (2) transplanted (t. aman) in July-August. Both types are harvested from November-December. Boro is the dry-season irrigated rice planted from December-early February and harvested April-June.[76] In 2018/2019, the total production of rice in Bangladesh was 36.4 million metric tons of milled rice, of which boro rice accounted for 53.8 percent; aman rice, 38.6 percent; and aus rice, 7.6 percent.[77]

Currently, USAID/Bangladesh is supporting various activities in strengthening rice productivity. For example, ACDI/VOCA's Rice and Diversified Crops (RDC) activity (2016-2021) aims to increase incomes and improve food security and nutrition in the Feed the Future ZOI through systemic market changes that promote a diversified farm management approach oriented to intensified rice production that yields a higher-value, and nutrient-rich product.[78] The RDC activity is targeting 500,000 farmers in the Feed the Future ZOI, and includes non-rice crops, such as pulses and oilseeds.

7.1.2 Farmers' background

Table 7.1.1 presents the age and education characteristics of rice farmers in the ZOI. Most rice farmers are male (90.8 percent). Among all age groups, the highest proportion of rice farmers is 60+ years of age (17.8 percent). Most rice farmers (89.3 percent) completed primary education or less, with slightly over one-third (36.6 percent) having no education. Education characteristics of male and female rice farmers are similar.

[74] Ahmed et al. (2021)
[75] BRRI (2011)
[76] Shelley et al. (2016)
[77] Ahmed & Bakhtiar (2020)
[78] ACDI/VOCA (n.d.)

Table 7.1.1: Age and Education of Rice Farmers in the ZOI, in Total and by Farmers' Sex

Background characteristic	Total (%)	Sex			Number of rice farmers (*n*)
		Male (%)	Female (%)	Sig.[a]	
Total	100.0	100.0	100.0		1,597
Age				***	
15-19	3.6	3.6	3.4		58
20-24	5.1	5.2	4.8		82
25-29	8.1	7.6	13.7		129
30-34	11.5	11.2	15.0		183
35-39	13.0	12.3	19.9		208
40-44	9.8	9.3	14.4		156
45-49	11.8	11.7	13.0		189
50-54	8.7	9.0	5.5		139
55-59	10.5	11.0	5.4		168
60+	17.8	19.1	4.8		285
Education				n/s	
No education	36.6	36.9	34.2		585
Less than primary	17.1	17.1	17.2		274
Completed primary	35.6	35.2	39.6		568
Completed secondary	4.9	5.0	0.0		79
Higher	5.7	5.8	0.0		91
Number of rice farmers (*n*)	**1,597**	**1,451**	**146**		

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.1.2 presents information about why farmers cultivated rice—that is, for consumption, for market, or for both. Over half (55.3 percent) of rice farmers cultivate rice for home consumption and to sell in the market. 43.3 percent are subsistence farmers who produce rice for home consumption only. A negligible share of farmers (1.4 percent) produce rice only for the market. There are statistically significant differences in reasons for cultivating rice by sex at the 5 percent level: over half of female rice farmers (52.2 percent) cultivate rice for consumption only. The inverse is true for male rice farmers: most (56.1 percent) grow rice for both home consumption and market sale. Growing rice for home sustenance and the market was more common among both farmers 15-29 years of age (53.6 percent) and 30+ years of age (55.7 percent) than consumption only.

Table 7.1.2: Reasons for Cultivating Rice in the ZOI, in Total and by Farmers' Sex and Age

Reason for rice cultivation	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Reason				*			n/s
Consumption only	43.3	52.2	42.4		45.3	42.9	
Market only	1.4	0.7	1.5		1.1	1.4	
Consumption and market	55.3	47.1	56.1		53.6	55.7	
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.1.3 presents the percent distribution of rice farmers in the ZOI by total land used for rice cultivation during the growing season prior to the ZOI Survey. The table illustrates that virtually all surveyed rice farmers in the Bangladesh ZOI are smallholder farmers who cultivate 5 hectares or less of arable land, and the majority (68.4 percent) cultivate less than 0.5 hectares. Farmers' sex has an effect on area cultivated in the ZOI, with differences statistically significant at the 0.1 percent level. Specifically, there is a higher proportion of female rice farmers (82.1 percent) that cultivate less than 0.5 hectares compared with male rice farmers (67.0 percent). There are minimal differences in the percent distribution of total area cultivated by age, with about two-thirds (69.9 percent) of farmers 15-29 years of age and 30+ years of age (68.1 percent) cultivating less than 0.5 hectares.

Table 7.1.3: Percent Distribution of Rice Farmers in the Bangladesh ZOI by Total Area Cultivated, in Total and by Farmers' Sex and Age

Area Cultivated	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Hectares of land				***			n/s
<0.5	68.4	82.1	67.0		69.9	68.1	
≥0.5-<1.0	22.3	13.8	23.1		18.7	23.0	
≥1.0-<2.5	8.9	4.1	9.3		11.4	8.3	
≥2.5-<5.0	0.4	0.0	0.4		0.0	0.5	
≥5.0-<7.5	0.1	0.0	0.1		0.0	0.1	
≥7.5-<10.0	0.0	0.0	0.0		0.0	0.0	
≥10.0	0.0	0.0	0.0		0.0	0.0	
Number of rice farmers	**1,597**	**146**	**1,451**		**269**	**1,328**	

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s= not significant

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.3 Application of management practices and technologies by rice farmers

This section examines the management practices and technologies that farmers used to grow rice. In all tables, Feed the Future-promoted improved management practices and technologies are indicated with a double dagger (‡).

7.1.1.1 Land preparation and management practices

Proper land preparation practices are important to provide the necessary conditions for improved soil health and successful crop growth. Land preparation includes the approaches that farmers take to prepare their plots for planting, including plowing or zero tillage practices. Improved land management practices increase soil fertility and enhance water-use efficiency to improve overall plot productivity. Land management includes crop rotation practices and approaches farmers take to soil and water management and irrigation of their plots. Globally, water-use efficiency in irrigation of crop plots is low. Raised-bed planting with trench irrigation, as well as bunding or terracing can significantly increase water-use efficiency.[79,80] Using appropriate irrigation techniques, minimizing soil disturbances, using surface mulch, and crop rotation help boost crop yields.[81] Rice farmers may choose to grow complementary crops such as vegetables alongside rice. Such intercropping enhances soil nutrition and fertility by adding much-needed nitrogen to the soil, increases resource-use efficiency, and discourages weeds, pests, and other crop diseases.[82]

Table 7.1.4 shows the land preparation practices, planting practices, and cropping practices that rice farmers used in the ZOI. It presents the types of agricultural production and management practices of rice farmers in the Bangladesh ZOI. Agricultural production and management practices are relatively consistent across all rice farmers, irrespective of farmers' sex and age. For instance, among the types of land preparation practices, plowing is nearly universal (98.1 percent) among rice farmers in the ZOI, irrespective of sex or age. Some rice farmers use multiple plowing methods concurrently, with the most prevalent being power tillers (91.1 percent), followed by hand tillage (42.0 percent), and tractors (8.7 percent). For those adopting the hand tillage method, farmers tended to use ploughs and manually prepared the land. Around 27.2 percent of rice farmers rotate their crops to maintain the soil structure and nutrients versus 72.2 percent who do not rotate. Among the1,597 rice farmers, most (86.8 percent) use soil bands and trenches, with minimal variation by farmers' age and sex.

Irrigation plays a crucial role in increasing rice production in Bangladesh as it enables farmers to grow boro rice during the dry winter season, and thus increases cropping intensity and eases the land constraint. 69.6 percent of the rice farmers use a pump system for irrigation, which includes shallow tubewells, deep tubewells, and low-lift pumps. Groundwater is the source of irrigation for shallow tubewells and deep tubewells and surface water for low-lift pumps. Only 2.4 percent of farmers use gravity-flow canal irrigation for rice cultivation. Slightly less than half of the farmers (45.7 percent) grow rice without irrigation—they depend on rainfall as the source of water for the two predominantly rain-

[79] Solh, Braun, & Tadesse (2014)
[80] Djagba et al. (2014)
[81] FAO (2016)
[82] Wilkins (2008)

fed rice crops—aus and aman. A higher proportion of rice farmers 30+ years of age use rainfed water than 15-29-year-old rice farmers. This difference is statistically significant at the 0.1 percent level.

Table 7.1.4: Land Preparation, Planting Practices, and Management Practices Used by Rice Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Practice	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Land preparation[b]				n/a			n/a
Hand weeding	16.0	18.6	15.7	n/a	15.7	16.0	n/s
Plowing[b]	98.1	99.3	98.0	*	98.9	98.0	n/s
Hand tillage	42.0	46.4	41.6	n/s	44.8	41.5	n/s
Animal traction	14.4	13.3	14.5	n/s	17.4	13.8	n/s
Power tiller	91.1	93.8	90.8	n/s	93.2	90.6	n/s
Tractor	8.7	6.2	8.9	n/s	7.5	8.9	n/s
Zero tillage[b]	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Slash and plant	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Burn and plant	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Herbicide and plant	0.0	0.0	0.0	n/a	0.0	0.0	n/a
None	1.3	0.0	1.4	n/s	0.7	1.4	n/s
Crop rotated				n/s			n/s
Yes, rotated	27.2	17.9	28.2		27.7	27.1	
No, did not rotate	72.2	82.1	71.2		71.6	72.3	
No, left plot fallow	—	—	—		—	—	
Soil and water management[b]				n/a			n/a
Terracing	8.3	16.7	7.5	n/a	6.8	8.6	n/a
Mulching	—	—	—	—	—	—	—
Soil bands, trenches	86.8	86.4	86.9	n/s	89.4	86.3	n/s
Adding lime to soil	1.1	0.7	1.1	n/s	1.1	1.1	n/s
None	10.3	6.0	10.7	n/s	6.9	11.0	*
Irrigation[b]				n/a			n/a
Drip irrigation	—	—	—	—	—	—	—
Gravity system	2.4	1.4	2.5	n/s	3.4	2.2	n/s
Aspiration	—	—	—	—	—	—	—
Pump system	69.6	68.4	69.7	n/s	77.0	68.3	*
Axial Flow Pump[‡]	1.0	0.7	1.0	n/s	1.1	0.9	n/s
By hand	0.0	0.0	0.0	n/a	0.0	0.0	n/a
None (rainfed)	45.7	44.8	45.7	n/s	37.8	47.2	**
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

— = Data are not available

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.1.2 Use of inputs

This section presents information on rice farmers' inputs, including seed, fertilizer, manure, training, information, and decisionmaking for growing rice.

Certain hybrids of rice seed are more drought- and heat-tolerant than traditional rice and will produce greater yields when grown in very warm or drought-prone climates.[83] **Table 7.1.5** shows where farmers obtained their rice seeds and the type of rice seeds they used by rice farmers. Some farmers use multiple seed varieties. With this said, most rice farmers in the Bangladesh ZOI (84.3 percent) use improved open-pollinated rice seed varieties, followed by hybrid (17.7 percent), and then traditional varieties (17.0 percent), with about one-fifth of farmers using multiple varieties of seeds. Although there are minimal differences in the types of seeds female and male rice farmers use, there is a slightly higher proportion of farmers 30+ years of age who use traditional varieties compared with rice farmers 15-29 years of age (17.9 percent and 12.7 percent, respectively).

Rice farmers report a variety of seed sources. About one-third (30.4 percent) do not purchase the seeds they use because they save their own seeds or receive seeds from friends or family at no cost. More male rice farmers report using seeds that they do not purchase compared with female rice farmers (31.1 percent and 24.2 percent, respectively). Over one-quarter (27.8 percent) of farmers receive their seeds from cash-based agriculture dealers, irrespective of sex or age. Among rice farmers who purchase seeds from friends or family (15.1 percent), there are slight differences by sex and age: there is a higher proportion of female rice farmers (23.6 percent) than male (14.2 percent) and farmers 15-29 years of age (18.3 percent) than farmers 30+ years of age (14.4 percent).

[83] Edmeades (2015)

Table 7.1.5: Seed Types and Seed Sources Used by Rice Farmers in the ZOI, in Total and by Farmers' Sex and Age

Characteristic or practice	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Seed type[b]				n/s			*
Unimproved or local open-pollinated varieties (traditional)	17.0	10.8	17.6		12.7	17.9	
Improved open-pollinated varieties (modern)	84.3	87.1	84.0		83.8	84.4	
Hybrid	17.7	13.7	18.1		21.6	16.9	
Main seed source[b]				n/s			n/s
Own saved/friend or relative (not purchased)	30.4	24.2	31.1		28.3	30.9	
Friend or relative (purchased)	15.1	23.6	14.2		18.3	14.4	
Ag dealer (cash)	27.8	27.5	27.8		28.8	27.6	
Ag dealer (voucher)	0.0	0.0	0.0		0.0	0.0	
Market or non-ag dealer	26.0	22.6	26.4		23.8	26.5	
Aid distribution	0.4	1.4	0.3		0.4	0.4	
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Application of inorganic or organic fertilizers such as manure and crop residues plays an important role in soil health. Fertilizers help correct soil macro- and micro-nutrient deficiencies in many regions and promote crop growth.[84] Inorganic, or mineral or chemical, fertilizers are often too expensive for smallholder farmers and are frequently locally unavailable. Organic inputs can be used in place of or alongside mineral fertilizers, through improved waste recycling, crop residue composting, animal manure, and intercropping or crop rotation with legumes, trees, and shrubs.[85,86]

Table 7.1.6 shows rice farmers' fertilizer use and practices in the Bangladesh ZOI, by sex and age. Almost all rice farmers (97.9 percent) apply fertilizers. Farmers report multiple types of fertilizer used. The most commonly used fertilizer is soil-based inorganic fertilizer (97.6 percent), followed by soil-based organic (12.3 percent). Sex has an effect on the percentage of rice farmers that use soil-based inorganic and soil-based organic fertilizers, and these effects are statistically significant at the 0.1 percent and 5 percent, respectively Conversely, age does not have an effect on fertilizer application.

Rice farmers apply fertilizer multiple times throughout cultivation. Most farmers apply fertilizers during the planting (83.6 percent) and early growth stage (82.2 percent), whereas slightly less than half (46.6

[84] Lal (2010)

[85] FAO (2016)

[86] Snapp, Mafongoya, & Waddington (1998)

percent) apply fertilizers during the mid-crop stage. Rice farmers' sex and age do not have an effect on whether farmers apply fertilizer during any phase of cultivation.

Table 7.1.6: Rice Farmers' Fertilizer Use, Types of Fertilizer, and Timing of Application in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Characteristic or practice	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Applied fertilizer	97.9	99.3	97.8	n/s	97.8	97.9	n/s
Number of rice farmers	1,597	146	1,451		269	1,328	
Type[b]							
Soil-based organic	12.3	7.6	12.8	*	14.9	11.8	n/s
Soil-based inorganic	97.6	100.0	97.4	***	97.7	97.6	n/s
Organic foliar feeds	2.6	2.1	2.6	n/s	2.7	2.6	n/s
Inorganic foliar feeds	7.6	11.9	7.1	n/s	7.3	7.6	n/s
Timing of application[b]							
Planting	83.6	85.9	83.4	n/s	83.5	83.7	n/s
Early growth stage	82.2	78.5	82.6	n/s	85.2	81.6	n/s
Mid-crop	46.6	48.3	46.4	n/s	45.7	46.7	n/s
Number of rice farmers who applied fertilizer (*n*)	**1,563**	**145**	**1,418**		**263**	**1,300**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Animal manure supplies beneficial nutrients to growing rice plants and improves soil fertility. Adequate quantities of animal manure for agricultural use may not be locally available and must be purchased elsewhere.

Table 7.1.7 presents information related to rice farmers' use of manure, including the percentage who use animal manure, how the manure was applied to fields, and the manure's source. Among rice farmers, 12.8 percent applied animal manure. The percentages of farmers 15-29 years of age and 30+ years of age who applied animal manure are similar. All of the rice farmers who applied animal manure did so by hand (100.0 percent), and most got the manure from their own animals (88.1 percent).

Table 7.1.7: Manure Sources and Application Practices Used by Rice Farmers in the ZOI, in Total and by Farmers' Sex and Age

Characteristic or practice	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Applied animal manure[‡]	12.8	11.8	12.9	n/s	13.1	12.8	n/s
Number of rice farmers (*n*)	1597	146	1451		269	1328	
Method of application				n/s			n/s
Left on field after animals grazed	0.0	^	0.0		0.0	0.0	
By hand	100.0	^	100.0		100.0	100.0	
By machine	0.0	^	0.0		0.0	0.0	
Source				n/a			n/s
Own animals	88.1	^	88.0		82.9	89.2	
Given, did not purchase	8.0	^	8.1		11.6	7.2	
Purchased	10.4	^	9.8		17.1	9.0	
Number of rice farmers who applied manure (*n*)	**202**	**17**	**185**		**35**	**167**	

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Crop loss due to pests, weeds, and diseases can be substantial for smallholder farmers, with an estimated 31–50 percent loss of rice crops worldwide from these factors.[87] There are different pests that affect crops at varying stages of rice cultivation in Bangladesh.[88] Shelley et al. (2016) identified the following common rice pests in Bangladesh: the brown plant hopper, rice stem borer, green leaf hopper, white-backed plant hopper, rice gall midge, rice hispa, and rice leaf folder. In addition, Rahaman, Khandakar, and Jahan (2018) interviewed 120 farmers in three rice-growing districts in Bangladesh, who identified spiders, dragonflies, birds, snakes, frogs, and different types of beetle and flies as predominant rice pests. Major diseases that can undermine rice productivity include bacterial leaf blight, sheath blight, leaf blast, sheath blast, tungro, and stem rot. In sum, there is a variety of pests and diseases, which may affect rice productivity and yields in the Bangladesh ZOI.

Crop losses may be prevented or minimized through adequate prevention and management measures. Herbicides and manual removal may be used to control weeds, and pesticides, insecticides, and fungicides may be used to manage pests and crop diseases. There are also several favorable and effective non-chemical approaches to rice pest control[89]. Integrated pest management is an encouraged "problem-avoiding" approach to pest management that seeks to minimize pesticide use and control

[87] Oerke (2005)

[88] Alam (2016)

[89] FAO (2016)

pests through cultural, manual, and biological means.[90] Intercropping and crop rotation is a particularly effective non-chemical measure for pest and weed management.[91]

Table 7.1.8 presents rice farmers' pest and weed management practices. Rice farmers in the Bangladesh ZOI report an array of pest and weed management practices. Most rice farmers (61.6 percent) use routine chemical pest management to prevent infestation. Half of rice farmers (50.5 percent) use chemical pest management practices to respond to attacks. A slightly higher proportion of female rice farmers use routine pest management compared with male farmers, whereas there is a slightly higher percentage of male rice farmers that respond to attacks compared with female rice farmers. There is a sizeable percentage (18.1 percent) of farmers that do not practice any chemical pest management.

Most rice farmers (66.1 percent) use a labor-intensive weed management practice—that is, pulling by hand. About half (48.0 percent) of rice farmers weed using a hoe. Sex has an effect on the percentage of rice farmers who use a hoe to manage weeds, which is statistically significant at the 1 percent level, with a slightly higher proportion of male rice farmers than females using this method (49.4 percent and 34.2 percent, respectively). Other weed management practices include applying herbicide, practiced by one-quarter (26.9 percent) of rice farmers; slashing (13.6 percent). Few rice farmers (7.6 percent) do not practice weed management.

[90] FAO (2011)

[91] Oswald & Ransom (2001)

Table 7.1.8: Pest and Weed Management Practices Used by Rice Farmers in the ZOI, in Total and by Farmers' Sex and Age

Management practice	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Chemical pest management[b]				n/s			n/s
Preventative (routine)	61.6	68.0	60.9		64.0	61.1	
Response to attack	50.5	44.7	51.1		51.7	50.3	
None	18.1	17.6	18.1		15.5	18.6	
Weed management[b]							
Herbicide applied‡	26.9	19.9	27.6	*	27.2	26.8	n/s
Weeding with hoe	48.0	34.2	49.4	**	45.8	48.4	n/s
Intercropping	0.3	0.7	0.3	n/s	0.4	0.3	n/s
Mulching	—	—	—	—	—	—	—
Slashing	13.6	10.4	13.9	n/s	7.8	14.7	**
Pull by hand	66.1	67.6	65.9	n/s	70.1	65.3	n/s
None	7.6	10.5	7.4	n/s	7.3	7.7	n/s
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

— = Data are not available

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.1.3 Harvesting and waste reuse practices

This section presents information on the harvesting, drying, and shucking techniques used by rice farmers. Waste reuse practices, that is, how farmers use the leftover rice husks, stalks, and cobs after harvesting, are also presented.

Harvesting is done when the rice has reached maturity and can be accomplished mechanically or manually by hand. Rice cobs may be shucked or left in the husk before transport and drying. After harvest, rice must be dried to reduce moisture content, prevent deterioration of the grain, and allow for safe storage.[92] Proper drying techniques are important to protect the rice from rodents and pests, prevent uneven drying, and prevent slow rates of drying, which may result in mold growth.[93]

Table 7.1.9 presents the harvesting techniques used by rice farmers in the ZOI. Virtually all rice farmers (97.4 percent) harvest rice by hand, usually with a sickle or scythe, with minimal differences by sex or age. Rice farmers use a range of drying methods. Nearly two-thirds of rice farmers (63.7 percent) dry rice by laying it on the ground covered with cow dung. Sex has an effect on the percentage of rice farmers who do this method, which is statistically significant at the 1 percent level: more male rice farmers apply this method than female rice farmers (64.8 percent versus 53.1 percent). Other common

[92] FAO (2003)

[93] Shepherd (1999)

drying methods include laying rice on the bare ground (58.1 percent of rice farmers) and leaving rice to dry on plants (24.6 percent). Most rice farmers (91.1 percent) use a threshing machine.

Table 7.1.9: Harvesting, Drying, and Threshing Methods Used by Rice Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Method	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Harvesting method				n/s			n/s
By hand	97.4	96.0	97.5		97.1	97.4	
By machine	0.2	0.0	0.3		0.4	0.2	
Some by hand, some by machine	0.0	0.0	0.0		0.0	0.0	
Not yet harvested	2.3	0.0	2.2		0.0	2.3	
Drying method[b]							
Laid on bare ground	58.1	59.5	57.9	n/s	58.3	58.0	n/s
Laid on ground covered with cow dung	63.7	53.1	64.8	**	66.0	63.2	n/s
Laid on ground covered with straw	—	—	—	—	—	—	—
Left to dry on plant	24.6	28.5	24.2	n/s	25.0	24.5	n/s
Laid on tarpaulins	2.6	6.9	2.2	**	2.2	2.7	n/s
Used drying yard with cemented ground	2.0	0.0	2.2	n/s	1.9	2.1	n/s
Used drying racks	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Used solar dryers	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Used mechanized dryers	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Did not dry	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Threshing method[b]							
By hand	0.0	0.0	0.0	n/a	0.0	0.0	n/a
With sticks	4.5	2.7	4.6	n/s	4.1	4.5	n/s
With a machine	91.1	88.0	91.4	n/s	91.2	91.1	n/s
Did not thresh	4.8	9.2	4.3	**	5.1	4.7	n/s
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

— = Data are not available

n/a=not applicable

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Rice residues have many valuable uses. Stalks, husks, and cobs that are unable to be sold or consumed can be used directly in the field as organic fertilizer or mulch, in food preparation, as animal feed, and as a source of energy or fuel.[94]

Table 7.1.10 presents information on how rice crop residues are used by rice farmers in the Bangladesh ZOI. Rice farmers report a range of uses for rice straw. Over half of rice farmers (57.3 percent) harvest and feed the rice straw residue to their animals. More male rice farmers (58.1 percent)

[94] El-Mashad, Loon, Zeeman, Bot, & Lettinga (2003)

undertake this practice than female rice farmers (49.6 percent), and this difference is statistically significant at the 1 percent level. One-quarter (25.6 percent) of rice farmers sell the rice straw to others after harvest; there are no statistically significant differences by sex or age. Less commonly reported practices include using rice straw as fuel for fire, bedding for livestock, or burned in the field. The Feed the Future Bangladesh ZOI Baseline Survey 2018/2019did not collect data on rice husk use or rice cob use; therefore, these data are not presented in the table.

Table 7.1.10: Use of Crop Residues by Rice Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Waste reuse practice	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Rice straw use[b]							
Burned in the field	6.3	7.5	6.2	n/s	7.4	6.1	n/s
Incorporated back into soil	0.6	0.7	0.6	n/s	0.4	0.6	n/s
Used as bedding for own livestock	7.3	2.8	7.8	*	5.1	7.8	n/s
Used as fuel for fire	9.7	6.7	10.0	n/s	8.3	9.9	n/s
Left in field for grazing animals	0.5	0.0	0.5	n/s	0.0	0.6	n/s
Harvested and fed to own animals	57.3	49.6	58.1	*	53.8	58.1	n/s
Harvested and sold to others	25.6	28.9	25.2	n/s	28.0	25.1	n/s
Rice husks use[b]							
Used for own food preparation	—	—	—	—	—	—	—
Sold or traded for food preparation	—	—	—	—	—	—	—
Used as fuel for fire	—	—	—	—	—	—	—
Fed to own animals	—	—	—	—	—	—	—
Sold or traded with others as animal feed	—	—	—	—	—	—	—
Did not use	—	—	—	—	—	—	—
Rice cobs use[b]							
Used as fuel for fire	—	—	—	—	—	—	—
Fed to own animals	—	—	—	—	—	—	—
Sold or traded with others as animal feed	—	—	—	—	—	—	—
Did not use	—	—	—	—	—	—	—
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

— = Data are not available

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.1.4 Storage practices

This section presents information on rice storage practices, including the use of various containers and storage locations. Storage serves several purposes in the rice post-harvest process. It protects against excessive heat, ground- and rainwater, insects, rodents, birds, and harmful micro-organisms, and helps ensure that the rice retains its nutritional value.[95]

[95] Shepherd (1999)

Table 7.1.11 presents information on how farmers store and transport their harvested rice in the ZOI. 39.7 percent of rice farmers in the ZOI report that their rice is attacked by insects, rodents, or disease while in storage. Three-quarters of rice farmers (74.9 percent) store rice in bags, most of which are single-layer woven bags (63.6 percent of rice farmers). One-third (29.3 percent) of rice farmers store and transport rice in buckets, with a slightly higher proportion of male farmers doing this than females (30.0 percent and 23.0 percent, respectively). Rice farmers mostly store their harvested rice in their house (83.3 percent), followed by granaries (29.9 percent). There are minimal variations of these methods by sex or age.

Table 7.1.11: Methods of Storing and Transporting Rice in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Storage or transport method	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Storage or transport containers				n/s			n/s
Buckets	29.3	23.0	30.0		30.0	29.2	
Drums	3.5	4,1	3.5		4.0	3.4	
Bags[b]	74.9	77.6	74.6		73.0	75.2	
Single-layer woven bags	63.6	61.1	63.8	n/s	59.3	64.5	n/s
Two- or three-layer woven bags	10.0	15.9	9.4	*	12.6	9.5	n/s
Hermetic bags	8.6	15.1	7.9	**	10.4	8.2	n/s
Did not put in containers	0.0	0.0	0.0		0.0	0.0	
Storage location[b]							
Residential house	83.3	85.2	83.1	n/s	84.2	83.1	n/s
Cribs	1.6	0.0	1.7	n/s	2.6	1.4	n/s
Granaries	29.9	27.2	30.2	n/s	31.2	29.7	n/s
Warehouses	0.3	0.0	0.3	n/s	0.4	0.2	n/s
Storage silos	0.2	0.0	0.2	n/s	0.4	0.2	n/s
Other constructed stores	0.9	0.7	0.9	n/s	1.5	0.8	n/s
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.1.5 Training, record keeping, information sources, and decisionmaking

Farmers may receive training on agricultural production, markets, and inputs, the use of fertilizers, pesticides, and herbicides, and integrated pest management. Farmers may also receive agricultural information from many sources both within and outside their communities. **Table 7.1.12** presents the percentages of rice farmers who received training on the use of inorganic fertilizers, pesticides, and herbicides, and farmers' main sources of information for how to grow their crops well.

Very few rice farmers have been trained on using or applying inorganic fertilizers (6.7 percent), pesticides (5.9 percent), or herbicides (6.3 percent). Instead, two-thirds of rice farmers receive information informally from friends or neighbors, with similar percentages reported across sex and age.

One-quarter of rice farmers receive information from agro-input dealers (26.7 percent), whereas a smaller percentage receive information from agriculture extension workers (7.7 percent).

Table 7.1.12: Record Keeping, Training Received, and Main Information Sources among Rice Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Topic or source	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Keeps written records	—	—	—	—	—	—	—
Training[b]							
Use and application of inorganic fertilizer	6.7	4.8	6.9	n/s	6.7	6.8	n/s
Use and application of pesticides	5.9	6.2	5.8	n/s	5.6	5.9	n/s
Use and application of herbicides	6.3	6.9	6.2	n/s	6.7	6.2	n/s
Main information source				n/s			n/s
Friend or neighbor	64.8	61.5	65.1		67.3	64.3	
Agro-input dealer	26.7	26.7	26.7		25.4	27.0	
Agriculture extension worker	7.7	9.8	7.5		6.3	8.1	
School	0.1	0.0	0.1		0.0	0.1	
Radio program	0.0	0.0	0.0		0.0	0.0	
Television	0.1	0.0	0.1		0.4	0.1	
Mobile phone messaging	0.3	0.7	0.3		0.7	0.2	
Internet	0.0	0.0	0.0		0.0	0.0	
Number of rice famers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

— = Data are not available

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

In households with multiple household members, farming decisions may be made by one person or two or more individuals jointly. **Table 7.1.13** presents the percent distribution of rice farmers by who made key production decisions—that is, the type of seed to plant and whether to use fertilizer. The Feed the Future Bangladesh ZOI Baseline Survey 2018/2019did not collect data on who decided whether to irrigate; therefore, these data are not presented.

Two-thirds of female rice farmers (63.8 percent) decide which type of seed to plant and whether to use fertilizer (65.8 percent) on their own. In comparison, a greater proportion of male rice farmers made decisions on their own, both in terms of which seed to plant (80.8 percent) and which fertilizer to use (83.9 percent) than female rice farmers.

Table 7.1.13: Percent Distribution of Who Made Key Rice Production Decisions in the ZOI, by Farmers' Sex

Decisionmakers	Type of seed to plant		Whether to use fertilizer		Whether to irrigate	
	Percent	Sig.[a]	Percent	Sig.[a]	Percent	Sig.[a]
Female farmers		n/a		n/a		
Self alone	63.8		65.8		—	
Partner/spouse alone	1.4		0.7		—	
Self and partner together	21.8		16.4		—	
Self and other (could also include partner)	34.9		30.8		—	
Other	0.0		2.8		—	
Number of female rice farmers (*n*)	**146**		**146**		—	
Male farmers		n/a		n/a		
Self alone	80.8		83.9		—	
Partner/spouse alone	0.1		0.2		—	
Self and partner together	9.9		6.8		—	
Self and other (could also include partner)	18.7		15.2		—	
Other	0.5		0.6		—	
Number of male rice farmers (*n*)	**1,451**		**1,451**		—	

— = Data are not available

n/a=not applicable

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and farmers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.1.6 Other promoted practices

This section examines rice farmers' use of other improved management practices and technologies promoted by Feed the Future in the Bangladesh ZOI. USAID Bangladesh promotes some other practices and technologies in Bangladesh which was not described in the previous sections such as use of combined harvesters for harvesting crops, use of transplanter for planting seedlings and access to finance through agent banking or retail micro merchants.

Table 7.1.14 presents the percent distribution of rice farmers by who used these practices by sex and age group.

A very low percentage of rice farmers have adopted combined harvesters for harvesting rice and rice transplanters in the ZOI (0.2 percent and 0.3 percent of the rice farmers in the ZOI, respectively). Comparatively, access to finance through agent banking or retail micro merchants is more prevalent among rice farmers, as less than half of all ZOI rice farmers have adopted this promoted practice.

Table 7.1.14: Use of other promoted practices and technologies in the ZOI, in Total and by Farmers' Sex and Age

Use of other promoted practices and technologies	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Combined harvesters	0.2	0.0	0.2	n/s	0.0	0.2	n/s
Transplanter	0.3	1.4	0.2	*	0.8	0.2	n/s
Access to finance through agent banking or retail micro merchants	45.0	44.7	45.0	n/s	49.0	44.2	n/s
Number of rice farmers (*n*)	**1,597**	**146**	**1,451**		**269**	**1,328**	

7.1.4 Use of improved management practices and technologies

This section examines rice farmers' use of improved management practices and technologies promoted by Feed the Future in the Bangladesh ZOI.

Table 7.1.15 shows the percentage of rice farmers in the ZOI who apply one or more improved management practices or technologies promoted by Feed the Future in Bangladesh during the 12 months preceding the ZOI survey. The table also includes the percentage of rice farmers in the ZOI who use promoted improved management practices and technologies by category.

Rice farmers apply an array of promoted improved management practices and technologies in the Bangladesh ZOI. 84.9 percent of rice farmers applied one or more promoted improved management practices and technology. Although farmers' age does not have a statistically significant effect on the application of these practices, farmers' gender does have an effect: more than three-quarters (79.0 percent) of female rice farmers apply improved practices and technologies compared with 85.5 percent of male rice farmers. This difference is statistically significant at the 5 percent level.

The leading improved management practices and technologies applied by rice farmers in the ZOI include soil-related fertility and conservation (49.8 percent), other (45.3 percent), and marketing and distribution (43.2 percent). For the latter, a higher proportion of male rice farmers (44.2 percent) participate in marketing and distribution than female rice farmers (33.7 percent). This difference is statistically significant at the 5 percent level. The difference between male and female rice farmers in applying pest and disease management is also statistically significant at the 5 percent level.

Table 7.1.15: Percentage of Rice Farmers in the ZOI Who Applied One or More Promoted Improved Management Practices and Technologies by Category, in Total and by Farmers' Sex and Age

Category	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Across all categories	84.9	79.0	85.5	*	87.0	84.5	n/s
Crop genetics[b]	9.4	13.2	9.0	n/s	7.5	9.8	n/s
Cultural practices[c]	3.9	2.8	4.1	n/s	2.6	4.2	n/s
Natural resource or ecosystem management[d]	—	—	—	—	—	—	—
Pest and disease management[e]	26.9	19.9	27.6	*	27.2	26.8	n/s
Soil-related fertility and conservation[f]	49.8	49.8	50.3	n/s	54.7	48.9	n/s
Irrigation[g]	1.0	0.7	1.0	n/s	1.1	0.9	n/s
Water management, non-irrigation-based[h]	—	—	—	—	—	—	—
Climate adaptation or climate risk management[i]	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Post-harvest, handling and storage[j]	—	—	—	—	—	—	—
Marketing and distribution[k]	43.2	33.7	44.2	*	42.7	43.3	n/s
Value-added processing[l]	—	—	—	—	—	—	—
Other[m]	45.3	45.4	45.3	n/s	49.4	44.4	n/s
Number of rice farmers (n)	**1,597**	**146**	**1,451**		**269**	**1,328**	

— = Data are not available
n/a = not applicable
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Use of HYV, hybrid, and fine rice varieties promoted by Feed the Future Bangladesh
[c] Seeds are planted in rows or some in rows and some randomly broadcast
[d] No promoted practices by the country mission in this category
[e] Use of herbicide
[f] Use of organic/compost fertilizer and micronutrients (Zinc, Gypsum)
[g] Use of Axial Flow Pumps
[h] No promoted practices by Feed the Future Bangladesh in this category
[i] Data on the promoted practice value-added processing by the ZOI survey were not collected.
[j] No promoted practices by Feed the Future Bangladesh in this category; therefore, data were not collected on this category.
[k] Sold from homestead and procurement hub (markets)
[l] No promoted practices by Feed the Future Bangladesh in this category.
[m] Use of combined harvester, transplanter, access to finance through agent banking/micro merchants
[n] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.
Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.1.16 shows the percent distribution of rice farmers in the ZOI who used promoted improved management practices and technologies by the number used. Surveyed rice farmers in the ZOI implement 3 or fewer promoted improved management practices and technologies at 2018/2019 baseline. Less than one-third (30.0 percent) of rice farmers apply 2 improved management practices and technologies, followed by 26.8 percent who employ 1. There is a slightly higher proportion of male rice farmers who apply these improved techniques compared with female rice farmers, although this difference is not statistically significant.

Table 7.1.16: Percent Distribution of Rice Farmers by Number of Promoted Improved Management Practices and Technologies Used in the ZOI, in Total and by Farmers' Sex and Age

Promoted improved practice or technology	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Number used				n/s			n/s
0	15.1	21.0	14.5		13.0	15.6	
1	26.8	25.1	27.0		23.7	27.5	
2	30.0	32.4	29.7		35.2	28.9	
3	21.1	17.4	21.5		22.5	20.8	
4	6.6	3.5	6.9		5.6	6.7	
5	0.3	0.0	0.4		0.0	0.4	
6	0.1	0.7	0.1		0.0	0.2	
7	0.0	0.0	0.0		0.0	0.0	
8+	0.0	0.0	0.0		0.0	0.0	
Number of rice farmers (*n*)	1,597	146	1,451		269	1,328	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.5 Rice yields

Yield is a measure of total production per unit of area planted. For rice, yield at the farmer level is the weight of rice, in kilograms, harvested in the season preceding the survey divided by the area, in hectares, planted in the season preceding the survey. Total production is the amount that is produced, regardless of how it was ultimately used. It also includes any post-harvest loss (i.e., post-harvest loss is not subtracted from total production.) To compute average farmer yield in the ZOI, rice yield is first calculated for each farmer and then averaged across farmers. Dividing the total production of sampled farmers by the total area planted by sampled farmers gives the area-weighted average yield of rice in the ZOI.

Table 7.1.17 presents the total production in metric tons, total production units in hectares, and the area-weighted average yield of rice in metric tons per hectare for the season preceding the ZOI survey. The table also presents the average production (in metric tons), average units of production (in hectares), and the average yield of rice per farmer for the same time period. Production and yield are expressed in terms of milled rice using a conversion rate of 67.0 percent of milled rice per unit of paddy. The results are disaggregated by farm size—smallholder and non-smallholder—and then further by sex and age.

About 4.2 million (4,249,224) rice farmers in the ZOI produced 5.0 million (5,020,313.7) metric tons of rice on 1.7 million (1,653,125.8) hectares of land. The average yield per farmer is 3.1 metric tons of rice per hectare among the surveyed farmers. A slight difference is found between the younger and older farmers, as the yield for younger farmers is 0.1 metric ton per hectare higher than the farmers 30+ years of age. A similar trend is observed between female and male farmers: female farmers report higher yields than male farmers, as well as higher adoption of improved management practices and techniques.

Differences between smallholders and non-smallholders could not be estimated since there were very few non-smallholder farmers in the ZOI sample.

Table 7.1.17: Rice Yield in the ZOI during the Season Preceding the Survey, by Farm Size and Farmers' Sex and Age

Background characteristic	Area-weighted			Average per farmer			Sig.[a]	Number of rice farmers
	Production (mt)	Units of production (ha)	Yield (mt/ha)	Production (mt)	Units of production (ha)	Yield (mt/ha)		
Total	5,020,313.7	1,653,125.8	3.0	1.2	0.4	3.1		1,591
Sex							n/s	
Female	271,195.6	86,353.2	3.1	0.7	0.2	3.2		144
Male	4,749,118.1	1,566,772.5	3.0	1.2	0.4	3.1		1,447
Age							n/s	
15-29 years	656,654.4	205,613.8	3.2	1.0	0.3	3.2		269
30+ years	4,363,659.3	1,447,512.0	3.0	1.2	0.4	3.1		1,322
Farm size								
Smallholder	4,907,337.5	1,616,484.1	3.0	1.2	0.4	3.1		1,589
Sex							n/s	
Female	271,195.3	86,353.1	3.1	0.7	0.2	3.2		144
Male	4,636,142.1	1,530,131.0	3.0	1.2	0.4	3.1		1,445
Age							n/s	
15-29 years	656,652.5	205,613.6	3.2	1.0	0.3	3.2		269
30+ years	4,250,685.0	1,410,870.5	3.0	1.0	0.4	3.1		1,320
Non-smallholder								
Sex							n/a	
Female	^	^	^	^	^	^		0
Male	^	^	^	^	^	^		2
Age							n/a	
15-29 years	^	^	^	^	^	^		0
30+ years	^	^	^	^	^	^		2

n/a=not applicable

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator (average yield per farmer) and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.1.18 presents the average amount of harvested rice consumed by farmers' own households, among all households; and the average amount of rice harvested and sold by farmers, among households that sold their rice. All the estimates generated in the table below are based on a 12-month recall period preceding the survey. Therefore, the estimates represent amounts per year.[b]

On average, male smallholder rice farmers consumed, harvested, and sold more rice than female rice farmers. This difference is statistically significant at the 1 percent level.

Table 7.1.18: Average Amount of Rice in Kilograms Consumed by Farmers' Own Households and Sold by Farmers in the ZOI by Farm Size, in Total and by Farmers' Sex and Age

Use of rice	Average amount consumed[a] (kg)	Sig.[b]	Number of rice farmers	Average amount harvested who sold (kg)	Average amount sold (kg)	Sig.[b]	Number of rice farmers who sold rice
Total	428.8		1,597	3202.6	1,308.9		686
Sex		**				n/s	
Female	318.0		146	2,722.7	1,172.5		49
Male	440.0		1,451	3,239.6	1,319.4		637
Age		n/s				n/s	
15-29 years	437.9		269	3,339.1	1,394.0		114
30+ years	427.0		1,328	3,175.3	1,291.8		572
Farm size							
Smallholder	428.8		1,595	3,171.0	1,296.8		685
Sex		**				n/s	
Female	318.0		146	2,722.7	1,172.5		49
Male	440.0		1449	3,205.6	1,306.4		636
Age		n/s				n/s	
15-29 years	437.9		269	3,339.1	1,394.0		114
30+ years	426.9		1,326	3,137.3	1,277.3		571
Non-smallholder							
Sex		n/a				n/a	
Female	^		0	^	^		0
Male	^		2	^	^		1
Age							
15-29 years	^		0	^	^		0
30+ years	^		2	^	^		1

n/a=not applicable

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator (average amount consumed and average amount sold) and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Data collection recall period was from December 1, 2017, to November 30, 2018.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.1.19 presents the main buyers of harvested rice in the ZOI Survey. Over half (57.3 percent) of rice farmers who sold rice sold at the farm gate or at home. Rice farmers 15-29 years of age sold more at the local farm gate than those 30+ years of age (87.1 percent and 70.1 percent, respectively). For smallholder rice farmers in the ZOI, the village market is a major point of sale, both in farmers' own locality (19.0 percent) or outside (25.7 percent).

Table 7.1.19: Main Buyers of Rice Produced in the ZOI by Farm Size, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Main point of sale of rice	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Total[b]				n/s			**
Farm Gate (Home)	73.0	75.8	72.7		87.1	70.1	
Village market (within own village)	18.9	16.3	19.1		17.4	19.3	
Village market (outside own village)	25.7	18.4	26.2		14.2	28.0	
Town Market	4.9	4.0	5.0		3.4	5.2	
Total number of farmers who sold rice (*n*)	**686**	**49**	**637**		**114**	**572**	
Farm size							
Smallholder[b]				n/s			**
Farm Gate (Home)	72.9	75.8	72.7		87.1	70.1	
Village market (within own village)	19.0	16.3	19.2		17.4	19.3	
Village market (outside own village)	25.7	18.4	26.3		14.2	28.0	
Town Market	4.9	4.0	5.0		3.4	5.2	
Number of smallholder farmers who sold rice (*n*)	**685**	**49**	**636**		**114**	**571**	
Non-smallholder				n/a			n/a
Farm Gate (Home)	^	^	^		^	^	
Village market (within own village)	^	^	^		^	^	
Village market (outside own village)	^	^	^		^	^	
Town Market	^	^	^		^	^	
Number of non-smallholder farmers who sold rice (*n*)	1	0	1		0	1	

n/a=not applicable

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.6 Agrometeorological context

Understanding the agrometeorological context (specifically, rainfall, temperature, and greenness during the main growing season) allows a better understanding of the agricultural data collected in the ZOI Surveys. For example, when analyzing combined temperature and precipitation data with Normalized Difference Vegetation Index (NDVI) data, the reasons for measured yield levels and the degree of change in crop productivity that Feed the Future interventions may have contributed to can be more clearly understood. Farmers' decisionmaking about area planted and input use is also influenced by and can be better understood with information about the agrometeorological context.

Rainfall (Standardized Precipitation Index)

Rainfall is one of the primary factors affecting crop productivity, especially for rainfed agriculture. Lower or less than optimum crop yields are usually associated with lower than normal (or higher than normal) rainfall conditions. The rainfall indicator presented here measures by how much the total amount of rainfall during the main growing season within the Feed the Future ZOI deviated from the 30-year climatological average – also known as the Standardized Precipitation Index (SPI). The following categories obtained from The National Drought Mitigation Center[96] illustrate how the amount of rainfall and its relevance to context can be interpreted:

Standardized Precipitation Index Values	
2.00 and above	Extremely wet
1.50 to 1.99	Very wet
1.00 to 1.49	Moderately wet
-0.99 to 0.99	Near normal
-1.00 to -1.49	Moderately dry
-1.50 to -1.99	Severely dry
-2.00 and below	Extremely dry

Temperature (Total number of heat stress days above 30°C)

Air temperature influences plant growth through photosynthesis and respiration, affects soil temperature, and impacts the amount of available water in the soil. When temperatures exceed 30°C, especially during certain growth phases (e.g., flowering and seed development), crop yields can be negatively impacted. Assessing the number of days on which temperatures exceed 30°C during the main growing season in conjunction with precipitation data can help determine if temperature was a factor affecting crop yield. This indicator measures the total number of heat stress days where air temperatures exceeded 30°C during the main growing season within the Feed the Future ZOI. The total number of days above 30°C during the main growing season is compared to the prior 10-year average number of days that exceeded 30°C during the main growing season.

Greenness (Normalized Differential Vegetation Index)

NDVI represents the greenness of plants covering a landscape or field, and serves as a proxy for photosynthetic activity in plants. Photosynthesis is the process that captures solar energy and converts it

[96] National Drought Mitigation Center website: https://drought.unl.edu/droughtmonitoring/SPI.aspx

to biomass, driving primary productivity of the entire food chain. The indicator of greenness used by Feed the Future measures by how much the normal NDVI values during the main growing season within the Feed the Future ZOI deviated from a rolling 10-year average NDVI during that season.

Data from vegetated areas will yield positive values for NDVI. As the amount of green vegetation increases in a pixel,[97] NDVI increases in value up to nearly 1.0. In contrast, bare soil and rocks typically produce lower NDVI values close to 0. Water, clouds, and snow produce negative NDVIs.

NDVI Range	**Type of land cover**
-1.00 to 0.00	Barren surfaces (rock, soil) and water, snow, ice and clouds
0.01 to 0.49	Vegetation cover
0.50 to 0.69	Dense vegetation
0.70 to 0.99	Very dense and green vegetation

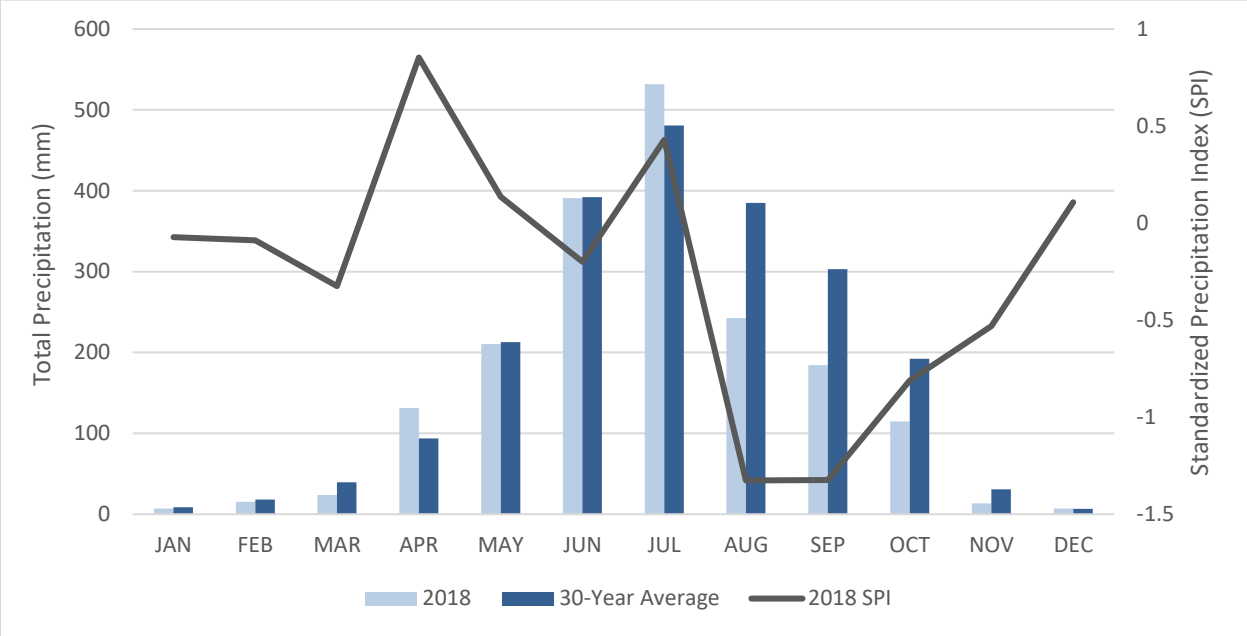
Bangladesh has three cropping seasons: (1) Kharif-1, or summer season (mid-March to mid-July); (2) Kharif-II, or monsoon season (mid-July to mid-November); and (3) Rabi, or dry season (mid-November to mid-March). The three cropping seasons correspond to the three rice-growing seasons: (1) Kharif-I for aus rice; (2) Kharif-II for aman rice; and (3) Rabi for boro rice. The 2018 growing season for rice just prior to the implementation of the survey was aman, running from July-November.

The graphs presented in **Figure 7.1a-c** show the trends in rainfall, temperature, and greenness indicators for the Bangladesh ZOI in 2018.

Figure 7.1a shows the rainfall indicators represented by total precipitation and SPI values in 2018 in the Bangladesh ZOI. The total precipitation between May-June was on par with the 30-year climatological average, slightly higher than the average in July, and considerably lower than the average between August-November. The SPI values suggest near normal precipitation in July, moderately dry between August-September, and near normal between October-November.

[97] From the NASA Earth Observatory website: "Satellite imagery is made up of tiny squares, each a different color or shade of grey. These squares are called pixels—short for picture elements—and represent the relative reflected light energy recorded for that part of the image. Each pixel represents a square area on an image that is a measure of the sensor's ability to resolve (see) objects of different sizes. Higher resolution (smaller pixel area) means that the sensor is able to discern smaller objects. By adding up the number of pixels in an image, you can calculate the area of a scene. For example, if you count the number of green pixels in a false color image, you can calculate the total area covered with vegetation."
URL: https://earthobservatory.nasa.gov/features/RemoteSensing/remote_06.php

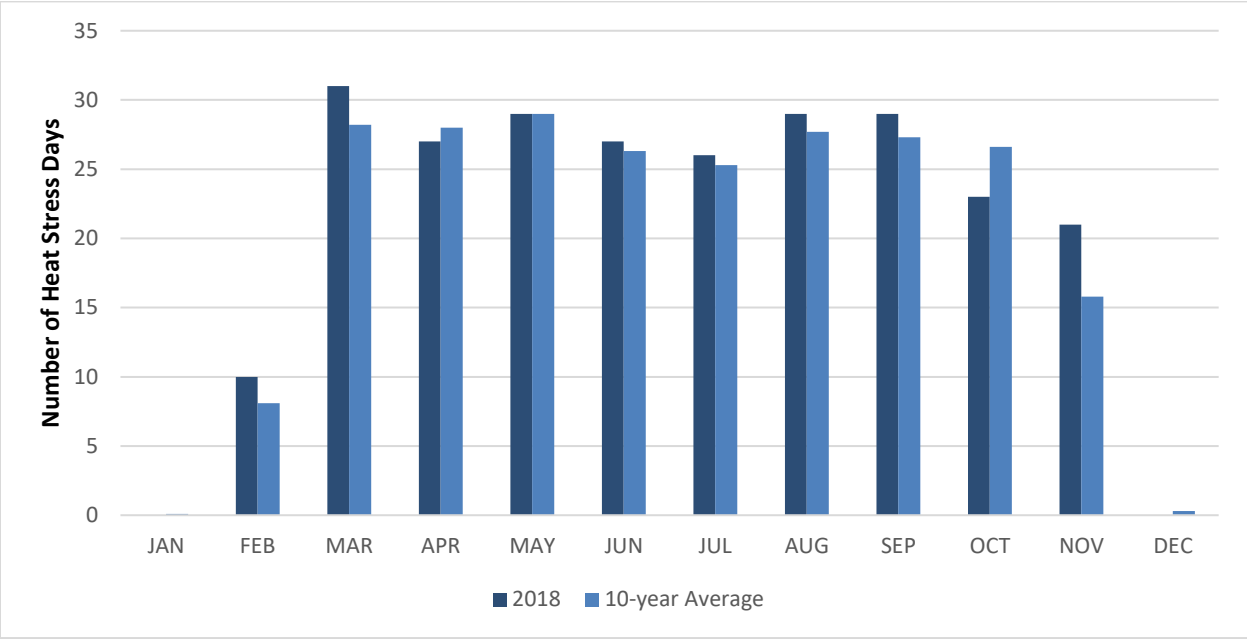
Figure 7.1a: Rainfall and the Standardized Precipitation Index for the Bangladesh Zone of Influence in 2018 relative to the 30-year average



Precipitation data source: https://developers.google.com/earth-engine/datasets/catalog/UCSB-CHG_CHIRPS_DAILY

Figure 7.1b shows that between June-September during the aman season, the number of days when temperatures exceeded 30°C was slightly higher than the previous 10-year average. During the latter part of the aman season, the number of heat stress days dipped in October below the 10-year average, and then the number of heat stress days in November increased above the 10-year average.

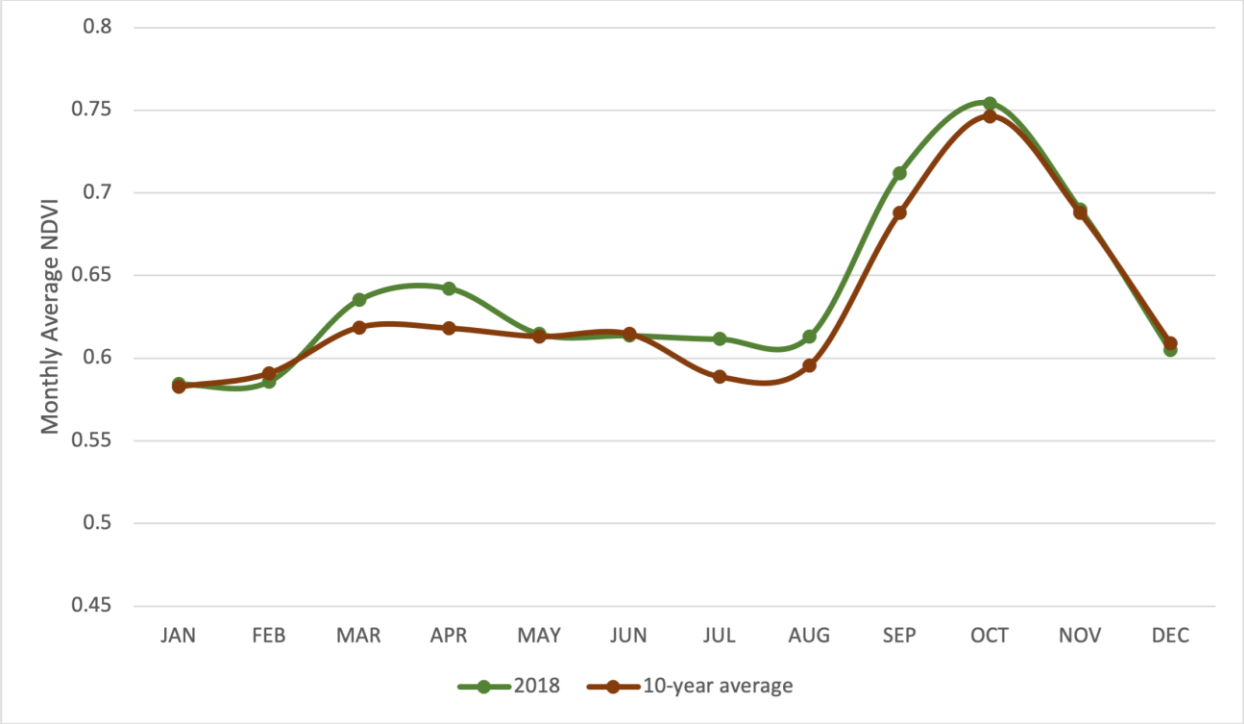
Figure 7.1b: Temperature (total number of heat stress days above 30°C) for the Bangladesh Zone of Influence in 2018 relative to the 10-year average



Temperature data source:
https://developers.google.com/earth-engine/datasets/catalog/MODIS_006_MOD11A1

Figure 7.1c presents the monthly NDVI values. From July-October, the values were higher than the 10-year average NDVI, indicating that the amount of green vegetation on the ground was considerably higher than normal during the 2018 aman rice season. The NDVI closely tracked the 10-year averages during November-December.

Figure 7.1c: Normalized Difference Vegetation Index (NDVI) values for the Bangladesh Zone of Influence in 2018 relative to the 10-year average



Normalized Difference Vegetation Index data source:
https://developers.google.com/earth-engine/datasets/catalog/MODIS_006_MOD13A2

The following conclusions are drawn from the data presented in **Figures 7.1a-c**. The average SPI value of -0.7 during July-November suggests that aman rice crop had near normal rainfall for normal production. Aman is a predominantly rainfed crop. However, farmers provide supplemental irrigation to aman if there is insufficient rainfall in the monsoon season. Indeed, the 2018/2019 Feed the Future ZOI endline survey data indicate that 52 percent of aman rice farmers used some form of supplemental irrigation in 2018. During the July-November main growing season, the total number of heat stress days that air temperatures exceeded 30°C was higher than the 10-year average (128 versus 123 days, respectively). It is possible that rice grain quality and production could have been adversely affected if those heat stress days occurred at the crop's flowering stage, causing heat injury.[98]

October is the peak flowering stage for aman rice. In October 2018, the number of heat stress days was 13.5 percent lower than the 10-year average heat stress days (23 days versus 27 days, respectively), which could result in favorable production outcomes. High NDVI values indicate enhanced photosynthesis and yields towards the peak growth stage of aman rice crop in Bangladesh.[99] The NDVI values between July-October were 2.8 percent higher than the 10-year average NDVI, indicating that the amount of green vegetation on the ground was slightly higher than normal. Taken together, these

[98] See, e.g., Wang et al. 2019. Research Progress on Heat Stress of Rice at Flowering Stage. *Rice Science*, 26(1): 1-10. URL: https://www.sciencedirect.com/science/article/pii/S1672630818300829
[99] Faisal et al. (2020)

findings suggest that rice yields for the aman season prior to the survey were likely to be higher than average.

According to the Feed the Future Phase 1 2011/2012 baseline and 2018/2019 endline surveys, transplanted aman rice yields were 2.42 metric tons per hectare in 2011/2012, which increased by 11.4 percent to 2.69 metric tons per hectare in 2018/2019.[100]

7.2 Fishpond aquaculture

7.2.1 Fishpond aquaculture in Bangladesh

Feed the Future Bangladesh focuses on the fishpond aquaculture value chain. In recent years, there have been remarkable developments in fishpond aquaculture in Bangladesh. An IFPRI study on the aquaculture value chain in Bangladesh found (1) there has been tripling of volumes and actors within the past 10 years in Bangladesh; and over the past three decades, Bangladesh's farmed fish market grew by 25 times in all aspects of the aquaculture industry; (2) the rapid transformation of the fish chain is a domestic market revolution as more than 90.0 percent of fish is consumed locally; and (3) investments by thousands of actors in the value chain have boosted adoption of new viable species beyond traditional carps.[101]

The fisheries sub-sector has had a profound impact on agricultural growth in recent decades. The *2019 Second Country Investment Plan (CIP-2) Monitoring Report* attributed accelerated agricultural GDP growth to sustained growth in the fisheries and livestock sub-sectors. Notably, fisheries was identified as the only agricultural sub-sector to attain greater than 6.0 percent growth consistently from 2010/2011 to 2018/2019, except for 2011/2012.[102]

These findings reinforce the aquaculture's potential for enhancing market-led agricultural growth and nutrition in the country. Yet despite this potential, there are various barriers to fisheries development. In analyzing policy for the first Country Investment Plan for Agriculture, Food Security, and Nutrition (CIP-1), Ahmed et al. (2011) identified various factors inhibiting fisheries development, including genetic deterioration and inbreeding depression in hatchery-produced seeds of various farmed fish species (e.g., carp, catfish, tilapia, and perch); insufficient investments in the fish seed/fingerling industry; lack of adequate quality extension services; isolation of fishery services from the rest of agricultural extension services; poor management of public water bodies; low productivity of fisheries and brackish water shrimp; and limited access to credit for all kinds of aquaculture activities. Nearly a decade later, many of these constraints continue to exist.

The first pillar of the CIP-2, which has the greatest budget allocation of all five pillars, prioritizes "diversified and sustainable agriculture, fisheries, and livestock for healthy diets,"[103] demonstrating the government's commitment to livestock and fisheries development. Given the Government of

[100] Feed the Future Bangladesh ZOI Surveys, 2011/2012 and 2018/2019
[101] Hernandez et al. (2018)
[102] FPMU (2019)
[103] FPMU (2019)

Bangladesh's commitment to developing the fisheries sector, as well as the immense growth over a decade, USAID has identified fishpond aquaculture as a targeted value chain.

To date, USAID has various activities that aim to support fishpond aquaculture. For instance, the Feed the Future Bangladesh Aquaculture and Nutrition Activity (BANA) (2018-2023), implemented by WorldFish, aims to increase productivity of aquaculture systems; strengthen aquaculture market systems, with special attention paid to expanding opportunities for women and youth; and increase awareness and adoption of nutrition-related behavior, specifically focusing on women and youth. While the USAID-funded Aquaculture for Improved Nutrition (AIN) activity implemented a direct delivery approach until 2017, BANA builds on this progress and lessons learned and applies a market systems approach to strengthening the aquaculture value chain.[104] Policies and investments that support a broad enabling environment for a wide variety of businesses (e.g., rural infrastructure development and minimization of regulatory constraints to enterprise start up and growth) will be very important for strengthening the aquaculture value chain.

7.2.2 Farmers' background

Table 7.2.1 presents the age and education characteristics of fishpond farmers in the ZOI. The highest proportion of fishpond farmers are 60+ years of age (21.2 percent), followed by farmers 45-49 years of age (15.5 percent). About 39.6 percent of all fishpond farmers completed primary education, with primary educational attainment among female fishpond farmers (55.6 percent) around 1.5-times higher than male fishpond farmers (37.6 percent). 27.4 percent of fishpond farmers have no education, which is slightly higher among men than women (28.5 percent versus 18.9 percent).

[104] WorldFish (n.d.)

Table 7.2.1: Age and Education of Fishpond Farmers in the ZOI, in Total and by Farmers' Sex

Background characteristic	Total (%)	Sex			Number of fishpond farmers (*n*)
		Male (%)	Female (%)	Sig.[a]	
Total	100.0	100.0	100.0		548
Age				***	
15-19	0.7	0.8	0.0		4
20-24	2.0	1.6	4.8		11
25-29	7.7	7.2	11.1		42
30-34	10.6	9.5	19.3		58
35-39	14.5	13.1	25.2		80
40-44	11.2	10.8	14.3		61
45-49	15.5	15.9	12.7		85
50-54	8.0	8.6	3.2		44
55-59	8.5	9.2	3.2		47
60+	21.2	23.2	6.2		116
Education				n/s	
No education	27.4	28.5	18.9		150
Less than primary	14.3	14.5	12.7		79
Completed primary	39.6	37.6	55.6		217
Completed secondary	8.4	8.3	9.5		46
Higher	10.2	11.1	3.3		56
Number of fishpond farmers (*n*)	**548**	**485**	**63**		**548**

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI baseline survey 2018/2019

In general, fishpond farmers raise fish for consumption by their household, to sell for income, or for both household consumption and sale. **Table 7.2.2** presents information about the reasons for raising fish in fishponds.

Most fishpond farmers raise fish for consumption exclusively (55.6 percent), which is relatively consistent across farmers' sex and age. About 43.2 percent of farmers raise fish in fishponds for home consumption and the market. Very few farmers (1.3 percent) only raise fish for the market; this is more common among male farmers and farmers who are 30+ years of age. Differences in raising fish for the market only by farmers' sex and age are statistically significant at the 1 percent level.

Table 7.2.2: Reasons for Raising Fish in Fishponds in the ZOI, in Total and by Farmers' Sex and Age

Reason for raising fish	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Reason				n/s			n/s
Consumption only	55.6	64.8	54.4	n/s	50.5	56.2	n/s
Market only	1.3	0.0	1.4	**	0.0	1.4	**
Consumption and market	43.2	35.2	44.2	n/s	49.5	42.4	n/s
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.2.3 Application of management practices and technologies by farmers

This section examines the management practices and technologies that farmers used to raise fish in fishponds. In all tables, Feed the Future-promoted improved management practices and technologies are indicated with a double dagger (‡).

7.2.3.1 Fish and pond characteristics

Globally, the top fish species that are farmed are carp, tilapia, salmon, and catfish.[105] The number of fish stocked by fishpond farmers can vary widely, depending on farmers' resources, including the ability to acquire fish and land on which to raise them. **Table 7.2.3** presents the average number of fish stocked, the type of fish, the main source of fish, and the type of pond that fishpond farmers in the ZOI used during the 12 months preceding the survey.

The average total weight of fish fry is 3,369 grams in the ZOI. On average, fishpond farmers in the ZOI have 11,852 fingerlings, yet male farmers have 4.79-times more fingerlings than their female counterparts

[105] FAO (2014)

(12,976 and 2,721, respectively). Differences in the number of fingerlings by farmers' sex is statistically significant at the 1 percent level.

The majority (91.5 percent) of fishpond farmers produce carp, followed by tilapia (54.9 percent), other fish (25.3 percent), and catfish (15.5 percent). The type of fish that fishpond farmers produce in the ZOI does not vary by farmers' sex or age.

Most farmers purchase their fish from vendors (65.5 percent), irrespective of sex and age. Other leading sources of fish include purchasing from the market (9.6 percent), local hatcheries (8.1 percent), non-local hatcheries (7.8 percent), and from friends or relatives (5.2 percent).

Virtually all (96.7 percent) fishpond farmers in the ZOI use a man-made earthen pond. Differences in the type of pond used by fishpond farmers are not statistically significant by sex or age of the farmer.

Table 7.2.3: Average Number of Fish, Type of Fish, Main Source of Fish, and Type of Ponds Used by Fishpond Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Characteristic‡	**Total**	**Female**	**Male**	**Sig.[a]**	**15-29**	**30+**	**Sig.[a]**
Average weight of fish fry (gram)	3,369.7	1,494.2	3,613.7	n/s	2,380.9	3,484.5	n/s
Average number of fingerlings	11,852	2,721	13,039	**	7,369	12,372	n/s
Type of fish[b] (%)				n/s			n/s
Carp	91.5	92.2	91.4	n/s	93.1	91.3	n/s
Tilapia	54.9	52.3	55.2	n/s	54.4	54.9	n/s
Catfish	15.5	13.9	15.7	n/s	12.0	15.9	n/s
Other fish	25.3	24.1	25.5	n/s	30.3	24.8	n/s
Main source of fish[b] (%)				n/s			**
Raised own or received (not purchased)	2.8	0.0	3.1		5.2	2.5	
Purchased from friend or relative	5.2	4.8	5.2		8.8	4.8	
Purchased from market	9.6	6.3	10.0		5.3	10.1	
Purchased from vendor	65.5	71.1	64.8		68.2	65.2	
Purchased from local hatchery	8.1	6.5	8.3		5.3	8.4	
Certified	76.4	100.0	72.6		7.0	69.4	
Non-certified	23.6	0.0	27.4		3.3	20.3	
Purchased from non-local hatchery	7.8	8.2	7.8		7.1	7.9	
Certified	90.6	100.0	89.6		9.2	81.3	
Non-certified	9.4	0.0	10.4		3.2	6.3	
Aid distribution	0.0	0.0	0.0		0.0	0.0	
Other	1.1	3.2	0.8		0.0	1.2	
Type of pond[b] (%)				n/s			n/s
Man-made earthen pond	96.7	96.8	96.7	n/s	92.8	97.1	n/s
Natural pond or lake	1.8	3.1	1.7	n/s	0.0	2.0	*
Raceway	2.4	1.6	2.5	n/s	7.2	1.9	n/s
Stream	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Other	0.6	0.0	0.6	n/s	0.0	0.6	n/s
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	

n/a=not applicable

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds. Feed the Future Bangladesh promoted purchase of carp, tilapia, and catfish fries and fingerlings from registered or certified hatcheries.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.2.3.2 Use of inputs

This section presents information on fishpond farmers' inputs, including supplemental feed, manure use, hormone application, and techniques to improve fish production.

Although fish eat foods that occur naturally in ponds such as algae and plankton, some farmers also give their fish supplemental feed so that the fish grow faster. Supplemental feed can be made from items, such as rice bran, maize flour, soy meal, leaves from crops, and fish meal. **Table 7.2.4** presents information about whether fishpond farmers in the ZOI used supplemental feed and the source of supplemental feed among those who did.

Among fishpond farmers, 39.0 percent use supplemental feed. Although the differences in the use of supplemental feed by farmers' age are not statistically significant, there is a higher proportion of male fishpond farmers (42.6 percent) who use supplemental feed than female farmers (11.4 percent), which is significant at the 0.1 percent level.

Among the fishpond farmers who use supplemental feed, 88.7 percent of farmers purchase the supplemental feed. As the numbers of fishpond farmers in the sample who are female or 15-29 years of age and who purchased supplemental feed are less than 30, estimates on their sources of supplemental feed are not statistically reliable and, in turn, are not presented.

Table 7.2.4: Supplemental Feed Use and Sources in the ZOI, in Total and by Fishpond Farmers' Sex and Age

		Sex			Age (years)		
Supplemental feed use and source‡	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Used supplemental feed‡	39.0	11.4	42.6	***	43.8	38.4	n/s
Number of fishpond farmers (*n*)	548	63	485		57	491	
Source of supplemental feed				n/a			n/a
Mostly made	6.2	^	6.4		^	6.5	
Mostly purchased	88.7	^	88.8		^	88.3	
Half made, half purchased	5.2	^	4.8		^	5.3	
Number of fishpond farmers who used supplemental feed (*n*)	**213**	**7**	**206**		**25**	**188**	

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

As noted in the FAO training materials, manure can be added to fishponds as an organic fertilizer to increase the natural food supply for fish and to improve fish production. Manure is a food source for fish and a food source for zooplankton. It also increases the amount of bacteria in the water, which speeds up the decomposition of organic matter, and adds carbon dioxide to the water, which enables efficient use of nutrients in the water. Manure does have disadvantages, however. For example, it has low nitrogen, phosphorus, and potassium content, which are primary fertilizer nutrients; negatively affects the dissolved oxygen content in ponds; and can result in fish loss if too much is applied at one time.[106] **Table 7.2.5** presents information about whether fishpond farmers in the ZOI added manure to their fishponds and the source of the manure among those who did.

Slightly less than 20.0 percent (17.9 percent) of fishpond farmers use manure, with minimal variations by sex or age of the farmer. Among the fishpond farmers who use manure, 70.1 percent got the manure from their own animals, followed by family, friends, or a neighbor's farm (17.4 percent).

Table 7.2.5: Manure Use and Sources in the ZOI, in Total and by Fishpond Farmers' Sex and Age

		Sex			Age (years)		
Manure use and source‡	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Used manure‡	17.9	16.0	18.2	n/s	19.6	17.7	n/s
Number of fishpond farmers (*n*)	548	63	485		57	491	
Main source of manure				n/a			n/a
Own animals	70.1	^	71.3		^	72.0	
Family, friends, or neighbor farm	17.4	^	15.9		^	15.0	
Purchase	12.5	^	12.8		^	12.9	
Number of fishpond farmers who used manure (*n*)	**97**	**10**	**87**		**11**	**86**	

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

[106] For more information, see FAO training materials on fertilizing fish ponds at: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e06.htm

Hormones are a controlled substance and should not be used because of the potential for misuse. Nevertheless, some fishpond farmers do use hormones in an effort to modify their production systems. **Table 7.2.6** presents information about whether fishpond farmers in the ZOI used hormones and, if they use hormones, when they apply them.

Very few fishpond farmers in the ZOI (1.6 percent) use hormones. Although farmers' *age* does not affect hormone practices, farmers' *sex* does: 1.9 percent of male fishpond farmers use hormones compared with 0.0 percent of female fishpond farmers. This difference is statistically significant at the 1 percent level. Consistent with the low use of hormones reported overall, very few farmers received training on hormone use (5.3 percent).

Table 7.2.6: Hormone Practices Used by Fishpond Farmers in the ZOI, in Total and by Farmers' Sex and Age

Hormone use, training, and timing of use‡	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Used hormones	1.6	0.0	1.9	**	1.7	1.6	n/s
Number of fishpond farmers (*n*)	548	63	485		57	491	
Received training in hormone use	5.3	1.6	5.8	n/s	3.6	5.5	n/s
Timing of hormone application[b]				n/a			n/a
Initial growth phase (first 4 weeks)	^	^	^	n/a	^	^	n/a
Development phase	^	^	^	n/a	^	^	n/a
Other time	^	^	^	n/a	^	^	n/a
Number of fishpond farmers who used hormones (*n*)	**9**	**0**	**9**		**1**	**8**	

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

As noted in FAO training materials, fish diseases can result in large losses for fishpond farmers. Fish diseases can, for example, reduce growth and production, increase vulnerability to predators, increase susceptibility to low water quality, or result in death. The three main causes of fish diseases include improper feeding, stress introduced by extreme or toxic conditions, and attacks by disease organisms.[107] Preventing disease in fish is more efficient and effective than controlling diseases after they occur.

Table 7.2.7 presents information about whether fishpond farmers in the ZOI observed disease in their fish, and if they did, what they used to control the disease. It is important to note that substances including formalin, malachite green and methyl blue should not be used on fish intended for human consumption; formalin can only be safely used on fish eggs.

One-quarter (25.3 percent) of fishpond farmers observed disease among fish, which is relatively consistent across farmers' sex and age. Among fishpond farmers who observed disease among fish, the most prevalent disease control methods used include lime (45.0 percent), potash (28.6 percent), or none (35.8 percent).

Table 7.2.7: Disease Control Methods Used by Fishpond Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Disease control‡	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Observed disease among fish	25.3	20.8	25.9	n/s	21.3	25.8	n/s
Number of fishpond farmers (*n*)	548	63	485		57	491	
Method of disease control used[b]							
Salt‡	2.9	^	3.2	n/a	^	3.2	n/a
Formalin‡	0.7	^	0.8	n/a	^	0.8	n/a
Malachite green	2.2	^	2.4	n/a	^	1.6	n/a
Methyl blue	3.7	^	4.1	n/a	^	3.3	n/a
Antibiotics/antibiotic feed	7.3	^	7.3	n/a	^	7.3	n/a
Lime	45.0	^	44.1	n/a	^	43.0	n/a
Potash	28.6	^	29.1	n/a	^	26.5	n/a
Other	15.5	^	16.3	n/a	^	15.4	n/a
None	35.8	^	35.6	n/a	^	38.4	n/a
Number of fishpond farmers who observed disease among their fish (*n*)	**138**	**13**	**125**		**12**	**126**	

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent. Formalin, malachite green, and methyl blue should not be used on fish intended for human consumption; formalin can only be safely used on fish eggs.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

[107] For more information, see FAO training materials on disease prevention and treatment at: http://www.fao.org/fishery/static/FAO_Training/FAO_Training/General/x6709e/x6709e15.htm

Parasites that affect fish are organisms that live in or on the fish—their host—and obtain nutrients from the fish at the fish's expense. Parasites that commonly live on fish include protozoa, flukes, leeches, copepods, fish lice, and water fungi, and although sometimes parasites can be controlled by making changes to the fish's environment, other times chemical treatment may be warranted.[108] **Table 7.2.8** presents information about whether fishpond farmers in the ZOI observed parasite cases among their fish, and if they did, what they used to control the parasites. It is important to note that substances including formalin, malachite green and methyl blue should not be used on fish intended for human consumption; formalin can only be safely used on fish eggs.

Among fishpond farmers in the ZOI, 15.0 percent observed parasite cases among fish. Male fishpond farmers (16.0 percent) who observed parasite cases among fish are twice as prevalent as female fishpond farmers (7.9 percent)—a difference that is statistically significant at the 5 percent level. Among fishpond farmers who observed parasite cases, over half (52.5 percent) do not use any parasite control. Slightly more than one-quarter (27.8 percent) use lime to control parasites, followed by potash (22.2 percent).

Table 7.2.8: Parasite Control Methods Used by Fishpond Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Parasite control‡	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Observed parasite cases among fish	15.0	7.9	16.0	*	10.7	15.6	n/s
Number of fishpond farmers (*n*)	548	63	485		57	491	
Method of parasite control used				n/a			n/a
Salt‡	3.5	^	3.7	n/a	^	3.8	n/a
Formalin‡	0.0	^	0.0	n/a	^	0.0	n/a
Malachite green	0.0	^	0.0	n/a	^	0.0	n/a
Methyl blue	0.0	^	0.0	n/a	^	0.0	n/a
Antibiotics/antibiotic feed	4.9	^	5.3	n/a	^	4.0	n/a
Lime	27.8	^	28.3	n/a	^	24.7	n/a
Potash	22.2	^	22.3	n/a	^	19.9	n/a
Other	8.7	^	7.9	n/a	^	9.3	n/a
None	52.5	^	52.1	n/a	^	54.0	n/a
Number of fishpond farmers who observed parasite cases among their fish (*n*)	**82**	**5**	**77**		**6**	**76**	

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent. Substances including formalin, malachite green and methyl blue should not be used on fish intended for human consumption; formalin can only be safely used on fish eggs.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

[108] For more information, see FAO training materials on disease prevention and treatment at: http://www.fao.org/fishery/static/FAO_Training/FAO_Training/General/x6709e/x6709e15.htm

As noted in the FAO training materials, maintaining good water quality is critical to obtaining high fish production. Maintaining good water quality can be achieved by controlling the composition of the pond water to create the best conditions for raising fish. Three water characteristics that are particularly important to water quality are the pH, turbidity, and dissolved oxygen content. The pH of pond water is a measure of its acidity or alkalinity. In general, pond water that is neutral—not too acidic or alkaline—is best for raising fish. Pond water pH can be measured using a number of methods, including pH indicator paper, a water-testing kit, or a pH meter. Pond water turbidity is the cloudiness or haziness of its water caused by suspended solids that are usually so small that they are invisible to the naked eye. Pond water with high turbidity does not allow sunlight to penetrate deep into the pond and limits the amount of oxygen that is produced. FAO indicates that although mineral turbidity must be assessed using laboratory tests, plankton turbidity can be assessed by fishpond farmers using their own arms or a Secchi disc. Fish need dissolved oxygen in the pond water to survive; it is also necessary to decompose organic material in fishponds.[109] The dissolved oxygen content in fishponds can be measured using chemical testing kits or an oxygen meter. Fishpond farmers can also look for "piping" behavior among their fish—that is, fish gasping for air at the water surface, and although "piping" behavior is not a measurement of the oxygen content, it signals to farmers that the dissolved oxygen content in their pond is low.[110]

There are a variety of methods that fishpond farmers can use to maintain good water quality in addition to adjusting the pH, turbidity, and dissolved oxygen content of their ponds. A few such methods include screening the water coming into the pond to ensure that wild fish, dirt, and debris do not enter; removing some of the suspended organic materials such as plant debris; and draining the pond to clean it. **Table 7.2.9** presents information about methods that fishpond farmers in the ZOI used to monitor and maintain good water quality.

Most fishpond farmers (86.0 percent) do not monitor water quality, which is more prevalent among female than male fishpond farmers (93.6 percent and 85.0 percent, respectively). This difference is statistically significant at the 5 percent level. 9.5 percent of farmers use their hand to assess turbidity, which is more common among males (10.3 percent) than females (3.3 percent)—a difference statistically significant at the 1 percent level. Although very few fishpond farmers (1.1 percent) in the ZOI test water pH, farmers' age affects the uptake of this method: 1.3 percent of farmers 30+ years of age employ this method compared with 0.0 percent of farmers 15-29 years of age. This difference is statistically significant at the 1 percent level.

[109] For more information, see FAO training materials on improving pond water quality at: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e02.htm
[110] Francis-Floyd (2011)

Table 7.2.9: Methods Used by Fishpond Farmers in the ZOI to Monitor and Maintain Good Water Quality, in Total and by Farmers' Sex and Age

Method‡	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Method used to monitor water quality[b]							
Used hand to assess turbidity	9.5	3.3	10.3	**	5.2	10.0	n/s
Used Secchi disk to assess turbidity	1.3	3.2	1.0	n/s	3.5	1.0	n/s
Tested water pH	1.1	1.6	1.1	n/s	0.0	1.3	**
Observed fish for "piping" behavior	5.6	1.6	6.1	n/s	3.6	5.9	n/s
Other	0.2	0.0	0.2	n/s	0.0	0.2	n/s
Did not monitor	86.0	93.6	85.0	*	89.3	85.6	n/s
Method used to maintain good water quality[b]							
Screened water coming into pond	1.7	0.0	1.9	**	1.8	1.7	n/s
Cut grass around pond	3.3	1.6	3.5	n/s	7.0	2.9	n/s
Drained pond to clean it	1.1	0.0	1.3	*	0.0	1.2	*
Added ash to stabilize water pH	0.2	0.0	0.2	n/s	1.7	0.0	n/s
Added dissolved oxygen	0.4	0.0	0.4	n/s	0.0	0.4	n/s
Added lime	16.7	8.2	17.8	n/s	26.3	15.6	*
Added fertilizer	8.1	6.4	8.4	n/s	14.1	7.4	n/s
Other	1.7	0.0	1.9	*	1.8	1.7	n/s
Did nothing	79.4	87.1	78.4	n/s	71.9	80.3	n/s
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	
Average number of times the farmers drained their ponds and allowed the bottom of the pond to dry during the 12 months preceding the survey‡	1.5	^	1.6	**	^	1.5	n/s
Number of fishpond farmers who drained their ponds and allowed the bottom of the pond to dry *(n)*	**161**	**17**	**144**		**16**	**145**	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

There are several techniques that can be used to improve fish production, including sex or age separation, feed variation, and stocking methods. **Table 7.2.10** presents information about techniques that fishpond farmers in the ZOI used to improve the production of their fish.

Most fishpond farmers (91.8 percent) do not use any technique to improve fish production. Although there are no statistically significant differences by farmers' age, farmers' sex has a more decisive effect on the techniques used by fishpond farmers to improve fish production in the ZOI. For instance, more female fishpond farmers (98.4 percent) than male (91.0 percent) do not use any technique to improve fish production—a difference statistically significant at the 1 percent level. Overall, 5.4 percent of fishpond farmers use feed variation to improve productivity, yet this is strongly associated with male

farmers and is statistically significant at the 0.1 percent level. Stocking method was also more frequently employed by male than female fishpond farmers, albeit very few fishpond farmers overall (0.7 percent). The difference by farmers' sex is statistically significant at the 5 percent level.

Table 7.2.10: Techniques Used by Fishpond Farmers in the ZOI to Improve Fish Production, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
	Total	Female	Male		15-29	30+	
Technique[a‡]	(%)	(%)	(%)	Sig.[b]	(%)	(%)	Sig.[b]
Sex separation	0.9	0.0	1.0	*	5.3	0.4	n/s
Age separation	1.5	1.6	1.5	n/s	1.8	1.5	n/s
Feed variation	5.4	0.0	6.1	***	7.1	5.2	n/s
Stocking method	0.7	0.0	0.8	*	3.5	0.4	n/s
Other	0.6	0.0	0.6	n/s	0.0	0.6	n/s
None	91.8	98.4	91.0	**	87.5	92.3	n/s
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	

[a] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

[b] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.2.3.3 Harvesting practices

Fish can be harvested all at once or in multiple partial harvests, and they can be harvested without draining the pond, by partially draining the pond, or by completely draining the pond. If draining the pond completely, a catch basin can be used inside the pond to catch the fish; outside the pond at the end of an outlet structure, woven baskets, netting, a harvest box, or a permanent harvesting basin can be used.[111] Seine nets, cast nets, or pull-up cages can be used to harvest fish if the pond is not drained or is partially drained.[112]

Table 7.2.11 presents information about the timing and method of harvesting fish among fishpond farmers in the ZOI. Nearly all (91.0 percent) farmers complete multiple partial harvests, with minimal variations by farmers' sex or age. Among fishpond farmers in the ZOI, 65.5 percent use cast net to harvest fish, followed by seine net (23.3 percent). Other methods include pull-up cages (7.9 percent) and other methods (3.3 percent). Among the fishpond farmers who use cages as a method of harvest, the average number of cages used is 15.1, with an average volume of 0.8 meters.

Table 7.2.11: Timing and Methods Used to Harvest Fish among Fishpond Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Harvesting characteristic	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Timing of fish harvesting‡				n/s			*
All at once	9.0	11.1	8.7		3.6	9.6	
Multiple partial harvests‡	91.0	88.9	91.3		96.4	90.4	
Method of fish harvesting				n/s			n/s
Cast net	65.5	74.6	64.3		64.5	65.6	
Seine net	23.3	17.5	24.1		30.1	22.6	
Pull-up cages	7.9	4.9	8.3		5.4	8.2	
Other	3.3	3.1	3.3		0.0	3.7	
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	
Average number of cages	15.1	^	15.7	n/a	^	15.4	n/a
Average volume of cages (meters)	0.8	^	0.8	n/a	^	0.8	n/a
Number of fishpond farmers who use cages as a method of harvest (*n*)	**42**	**3**	**39**		**3**	**39**	

n/a=not applicable

^ Results not statistically reliable, n<30

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

[111] For more information, see FAO training materials on fish harvesting from ponds at: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e11.htm

[112] For more information, see FAO training materials on handling live fish at: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e08.htm

7.2.3.4 Post-harvest processing

After fish are harvested, they must be prepared for home consumption or sale. There are a number of methods that can be used to prepare fish, including drying, gutting, leaving whole, pickling, salting, and smoking. **Table 7.2.12** presents information about the usual methods that fishpond farmers in the ZOI used to prepare their fish for home consumption and for sale or trade.

Among fishpond farmers in the Bangladesh ZOI who consume fish at home, the majority (65.4 percent) gut the fish, followed by slightly over one-quarter (28.0 percent) who leave the fish whole. Conversely, among the fishpond farmers who sell their fish, 98.4 percent leave the fish whole.

Table 7.2.12: Usual Fish Preparation Methods, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Preparation method	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Home consumption				n/s			n/s
Dry	0.7	0.0	0.8		0.0	0.8	
Gut only	65.4	72.9	64.4		57.9	66.3	
Leave whole round	28.0	25.6	28.3		26.6	28.2	
Pickle	0.6	0.0	0.6		0.0	0.6	
Salt	2.6	6.4	2.3		3.6	2.7	
Smoke	3.0	3.3	2.9		5.3	2.7	
Other	1.1	1.6	1.0		0.0	1.2	
Number of fishpond farmers whose household consumed their fish (*n*)	**541**	**63**	**478**		**57**	**484**	
Sale or trade				n/a			n/a
Dry	0.0	^	0.0		^	0.0	
Gut only	2.9	^	3.2		^	3.3	
Leave whole round	98.4	^	98.2		^	98.1	
Pickle	0.0	^	0.0		^	0.0	
Salt	0.0	^	0.0		^	0.0	
Smoke	0.4	^	0.4		^	0.5	
Other	0.0	^	0.0		^	0.0	
Number of fishpond farmers who sold their fish (*n*)	**241**	**22**	**219**		**28**	**213**	

n/a=not applicable

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Fish waste, including guts, scales, and skins, can be valuable if it is used as compost or animal feed. **Table 7.2.13** presents information about the waste reuse methods that fishpond farmers in the ZOI used.

Of fishpond farmers, 95.2 percent do not reuse fish guts and 97.8 percent do not reuse scales and skins as part of their waste reuse method. More farmers 15-29 years of age (5.3 percent) use fish guts as animal feed than those 30+ years of age (3.9 percent). This same trend holds true for the use of fish guts as animal feed among male fishpond farmers versus female (4.2 percent and 3.3 percent, respectively). The use of fish guts as animal feed is statistically significant at the 5 percent level for farmers' age.

Table 7.2.13: Waste Reuse Methods, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Waste reuse practice	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Fish guts[b]							
Nothing	95.2	96.7	95.0	n/s	94.7	95.3	n/s
Compost	0.9	0.0	1.0	*	1.8	0.8	n/s
Use as animal feed	4.1	3.3	4.2	n/s	5.3	3.9	*
Other	0.6	0.0	0.6	n/s	0.0	0.6	n/s
Scales and skins				**			n/s
Nothing	97.8	100.0	97.6	**	98.3	97.8	n/s
Compost	0.5	0.0	0.6	n/s	0.0	0.6	n/s
Use as animal feed	1.6	0.0	1.8	*	1.7	1.6	n/s
Sell	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Other	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	

n/a=not applicable

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.2.3.5 Training, record-keeping, and access to services and information

Fishpond farming requires that farmers know how to choose suitable fish, how to build a good pond for raising fish, how to ensure good water quality, how to ensure the fish have sufficient food, and how to harvest and market the fish. Advances in aquaculture are continuously being made, which results in techniques that fishpond farmers can learn to employ to increase production. **Table 7.2.14** presents information about whether fishpond farmers in the ZOI have been trained in aquaculture, and if they received formal training, when they were last trained.

Most fishpond farmers (89.3 percent) do not have any aquaculture training. Among fishpond farmers who have received training, informal training is more prevalent than formal training (6.8 percent and 3.5 percent, respectively).

Table 7.2.14: Training in Aquaculture and Time Since Last Formal Training, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Training characteristic	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Training in aquaculture				n/a			n/a
Formal only	3.5	0.0	4.0		5.4	3.3	
Informal only	6.8	4.9	7.0		0.0	7.6	
Both	0.4	0.0	0.4		0.0	0.4	
None	89.3	95.1	88.6		94.6	88.7	
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	
Time since last formal training				n/a			n/a
Within past 1 year	^	^	^		^	^	
Within past 2 years	^	^	^		^	^	
Within past 3 years	^	^	^		^	^	
3 or more years ago	^	^	^		^	^	
Number of fishpond farmers who received formal training (*n*)	**21**	**0**	**21**		**3**	**18**	

n/a=not applicable

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Not only is training important to fishpond farmers, but information obtained through other sources and the ability to access to extension services for fish are also important. Furthermore, keeping regular written records about fishpond management practices and issues encountered is a good practice that can help fishpond farmers learn from their experiences over time. **Table 7.2.15** presents information about whether fishpond farmers in the ZOI keep regular written records about their fish, whether they can access extension services for their fish, and what their primary source of information is for raising their fish.

Only 6.4 percent of fishpond farmers in the ZOI keep regular written records. Farmers' age has an effect on this practice as the proportion of keeping regular written records is three-times higher among farmers 15-29 years of age (15.8 percent) than farmers 30+ years of age (5.3 percent). This difference is statistically significant at the 5 percent level. The main source of information for fishpond farmers is friends, family, or neighbors (86.7 percent), followed by agriculture extension workers (8.5 percent).

Table 7.2.15: Record Keeping, Access to Extension Services, and Main Information Sources among Fishpond Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Practice or source	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Keep regular written records	6.4	4.9	6.6	n/s	15.8	5.3	*
Can access extension services for fish	61.7	55.2	62.5	n/s	61.5	61.7	n/s
Main information source				n/s			n/s
Agriculture extension worker	8.5	6.5	8.7		8.8	8.5	
Family, friend, or neighbor	86.7	90.3	86.2		82.3	87.2	
Internet	0.0	0.0	0.0		0.0	0.0	
Mobile phone messaging	0.4	0.0	0.4		0.0	0.4	
Radio program	0.0	0.0	0.0		0.0	0.0	
School	0.7	1.5	0.6		1.7	0.6	
Television	0.9	0.0	1.0		1.8	0.8	
Other	2.8	1.6	3.0		5.4	2.5	
Number of fishpond farmers (*n*)	548	63	485		57	491	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.2.4 Use of improved management practices and technologies

This section examines farmers' use of improved technologies and management practices promoted by Feed the Future in the Bangladesh ZOI. USAID seeks to improve the following management practices and technologies, which are described further in this section: improved fingerlings, feed and feeding practices, fish health and disease control, pond culture and preparation, and sampling and harvesting.

Table 7.2.16 shows the percentage of fishpond farmers in the ZOI who applied one or more improved management practices or technologies promoted by Feed the Future Bangladesh during the 12 months preceding the ZOI survey. The table also includes the percentage of fishpond farmers in the ZOI who used promoted improved management practices and technologies by aquaculture sub-category.

Nearly all fishpond farmers applied one or more promoted improved management practices and technologies in the ZOI (98.6 percent), irrespective of farmers' sex or age. The majority of fishpond farmers in the ZOI sample and harvest (90.6 percent), which is relatively consistent across farmers' age and sex. Nearly half of fishpond farmers (47.1 percent) use improved feed and feeding practices, with male farmers demonstrating twice the uptake compared with women (49.5 percent versus 24.1 percent). This difference is statistically significant at the 0.1 percent level. About 38.6 percent of fishpond farmers in the ZOI apply pond preparation techniques. One-quarter (25.9 percent) of farmers use

improved pond culture, which is more commonly employed among male (27.3 percent) than female fishpond farmers (13.7 percent). This difference is statistically significant at the 0.1 percent level. Overall, very few (1.6 percent) fishpond farmers apply fish health and disease control, yet this practice is more prevalent among male than female farmers (1.7 percent versus 0.0 percent). This difference is also statistically significant at the 0.1 percent level.

Table 7.2.16: Percentages of Fishpond Farmers in the ZOI Who Applied One or More Promoted Improved Management Practices and Technologies by Sub-category, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Sub-category	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Across all sub-categories	98.6	98.7	98.5	n/s	97.4	98.7	n/s
Improved fingerlings[b]	11.9	12.8	11.8	n/s	19.2	11.1	n/s
Improved feed and feeding practices[c]	47.1	24.1	49.5	***	54.2	46.3	n/s
Fish health and disease control[d]	1.6	0.0	1.7	***	1.2	1.6	n/s
Improved cage culture[e]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Improved pond culture[f]	25.9	13.7	27.3	***	29.5	25.6	n/s
Pond preparation[g]	38.6	37.3	38.7	n/s	36.7	38.7	n/s
Sampling and harvesting[h]	90.6	88.4	90.8	n/s	95.2	90.1	n/s
Management of carrying capacity[i]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other[j]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	

n/a=not applicable

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Carp, Tilapia and catfish fries and fingerlings were purchased from registered or certified hatchery

[c] Farmers gave their fish supplemental feed or added animal manure to the fishpond in last one year

[d] Farmers applied salt for disease or for parasite; observed disease and applied formalin; or observed parasite and applied formalin

[e] Not promoted by the USAID/Bangladesh Mission in the ZOI

[f] Farmers monitored or maintained water quality of the pond

[g] Pond has been drained at least once or manure has been added

[h] Farmers conducted partial harvesting

[i] Not promoted by the USAID/Bangladesh Mission in the ZOI

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.2.17 shows the percent distribution of fishpond farmers who used promoted improved management practices and technologies by the number used.

The use of some form of promoted improved practice or technology is nearly universal across fishpond farmers in the ZOI (98.6 percent). Farmer's sex has a statistically significant effect on the number of promoted improved management practices and technologies used at the 5 percent level. Although there is a higher proportion of female fishpond farmers who use one promoted improved practice or technology than male fishpond farmers (57.5 percent versus 37.8 percent), this trend reverses for the use of two or more promoted improved management practices and technologies. Farmers' age does not have a statistically significant effect on the application of improved management practices and technologies among fishpond farmers in the ZOI.

Table 7.2.17: Percent Distribution of Fishpond Farmers in the ZOI by the Number of Promoted Improved Management Practices and Technologies Used, in Total and by Farmers' Sex and Age

Promoted improved practice or technology	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Number used				*			n/s
0	1.4	1.3	1.4		2.6	1.3	
1	39.7	57.5	37.8		31.1	40.6	
2	21.7	18.1	22.0		21.0	21.7	
3	19.9	11.7	20.8		24.0	19.5	
4	13.6	9.6	14.0		15.1	13.4	
5	3.7	1.8	3.9		6.1	3.4	
Number of fishpond farmers (*n*)	**548**	**63**	**485**		**57**	**491**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.2.5 Yield of fishponds

Yield is a measure of total production per unit of production. For fish raised in fishponds, yield is the weight of fish, in kilograms, harvested in the 30 days preceding the survey divided by the total surface area, in hectares, of the ponds in which fish were raised.

Table 7.2.18 presents the total production in kilograms, total production units in hectares, and the total and average yields of fishponds in kilograms per hectare (kg/ha) for the 30 days preceding the ZOI Survey. The results are disaggregated by farmers' sex and age.

Among fishpond farmers in the ZOI, the total production during the 30 days preceding the survey was 136,479,059.0 kilograms, with 1,385,499.6 hectares of production, amounting to 98.5 kg/ha. Farmers' sex does not have an effect on fishpond yield in the ZOI, yet farmers' age does and is statistically significant at the 5 percent level. Specifically, fishpond farmers 30+ years of age produced 131,538,355.6 kg during the 30 days preceding the survey, which is 26-times higher than the total production for farmers 15-29 years of age (4,931,722.0 kg). As expected with higher total production, farmers in the older age

category also report higher total yields than farmers in the younger age category (104.5 kg/ha and 38.4 kg/ha, respectively).

Table 7.2.18: Yield from Fishponds in the ZOI during the 30 Days Preceding the Survey, in Total and by Farmers' Sex and Age

Background characteristic	Area-weighted			Average per farmer					Number of fishpond farmers (*n*)
	Production: Weight of fish harvested (kg)	Units of production: Surface area of fishponds (ha)	Yield (kg/ha)	Number of fish	Production: Weight of fish harvested (kg)	Units of production: Surface area of ponds used (ha)	Yield (kg/ha)	Sig.[a]	
Total	136,479,059.0	1,385,499.6	98.3	——	—	—	213.3		339
Sex								n/s	
Female	2,629,075.8	48,330.4	57.4	—	—	—	191.8		39
Male	133,860,983.2	1,33,7169.2	99.3	—	—	—	215.5		300
Age								*	
15-29 years	4,931,722.0	126,117.7	38.3	—	—	—	148.8		35
30+ years	131,538,355.6	1,259,381.9	104.4	—	—	—	220.3		304

— = Data are not available

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.2.19 presents the average number of fish harvested, weight of fish harvested in kilograms, and average yield in kilograms per hectare for the 30 days preceding the ZOI Survey. The average surface area of fishponds in the ZOI is also presented.

Over the month preceding the survey, fishpond farmers in the ZOI harvested, on average, 139.4 fish, with an average total weight harvested of 34.6 kg. The average yield was 213.3 kg/ha on 0.2 ha. As shown in **Table 7.2.18**, farmers' sex does not have a statistically significant effect on average fishpond yield, but there are meaningful differences by farmers' age, which is statistically significant at the 5 percent level. Again, farmers 30+ years of age, harvested 4-times more fish than farmers 15-29 years of age (151.3 fish and 35.3 fish, respectively), and had nearly 1.5-times higher average yield in the 30 days preceding the survey (220.3 kg/ha and 148.8 kg/ha, respectively).

Table 7.2.19: Average Fishpond Yield Information during the 30 Days Preceding the Survey, in Total and by Farmers' Sex and Age

	Average number of fish harvested	Average weight harvested (kg)	Average yield		Average area of fishponds (ha)	Number of fishpond farmers (*n*)
			(kg/ha)	Sig.[a]		
Total	139.4	34.6	213.3		0.2	339
Sex				n/s		
Female	34.7	7.1	191.8		0.1	39
Male	150.2	37.4	215.5		0.2	300
Age				*		
15-29 years	35.3	12.0	148.8		0.2	35
30+ years	151.3	37.2	220.3		0.2	304

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant. The fishpond yield was considered for the observations that were withing the three standard deviation of its mean.

Note: Estimates are based on de jure household members who are farmers responsible for raising fish in ponds.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.3 Dairy farming

7.3.1 Production of dairy cows in Bangladesh

Dairy farming is a value chain that the Feed the Future program in Bangladesh targets. However, despite having one of the highest cattle densities worldwide, Bangladesh's dairy cow productivity lags behind other countries.[113]

As part of the 2010 IFPRI-organized Food Security Investment Forum, which provided the foundation for the first Country Investment Plan (CIP-1), Ahmed et al. (2011) identified various challenges affecting livestock development: adulterated and inferior quality of commercial feeds and feed ingredients; inadequate feed labeling and control; limited access to technical support from livestock officers; shortage of feed and fodder; inadequate supply of veterinary services; problems of quality control in livestock products, drugs, vaccines, feeds, and breeding materials; inadequate coverage of animal health services; inadequate supply of sustainable breed development; genetic degradation of carp; and climate change effects. Nearly a decade after these key constraints were identified, many of these barriers inhibiting the livestock sub-sector development remain. Choudhury and Headey (2018) also identified Bangladesh's exceptionally severe land constraints as a key barrier to improving livestock (and milk) production.

Despite these challenges, the sector continues to expand. According to the *2019 Monitoring Report for CIP-2*, the livestock sector grew by around 3.4 percent—exceeding the average agricultural growth. This has been achieved, in large part, due to increased livestock production, particularly poultry and meat production.[114]

Many donor-funded livestock activities have been geographically concentrated in northern Bangladesh, which has, in turn, affected the development of livestock activities in southern and southwest Bangladesh where the Feed the Future ZOI is situated (Aimiuwu n.d.). Given the challenges and the opportunities presented by the dairy value chain for improving farmers' income and potentially household nutrition, USAID has identified dairy farming as a targeted value chain in the ZOI.

[113] Aimiuwu (n.d.)
[114] FPMU (2019)

7.3.2 Farmers' background

Dairy farm households in the Bangladesh ZOI are identified as those households that own at least one dairy cow (milking or non-milking). A dairy farmer is identified as an individual who mainly provides food, water, and care for the animals. **Table 7.3.1** presents the age and education characteristics of dairy farmers in the ZOI.

There are more female than male dairy farmers in the ZOI. It is important to note that the dairy farmer does not necessarily own the livestock, but is rather the one who looks after the animals. The majority of female dairy farmers are between 25-49 years of age, whereas most male dairy farmers are 45+ years of age. Most dairy farmers either have no education (34.8 percent) or have only completed primary education (40.7 percent). A greater proportion of female dairy farmers have completed primary education compared with male dairy farmers (45.5 percent and 34.3 percent, respectively), although the difference is not statistically significant.

Table 7.3.1: Age and Education of Dairy Farmers in the ZOI, in Total and by Farmers' Sex

Background characteristic	Total (%)	Sex			Number of dairy farmers (*n*)
		Male (%)	Female (%)	Sig.[a]	
Age				***	
15-19	1.2	0.8	1.5		10
20-24	5.7	2.8	7.9		48
25-29	8.7	5.5	11.0		73
30-34	13.9	8.1	18.3		117
35-39	13.4	8.8	16.9		113
40-44	11.3	8.8	13.2		95
45-49	11.5	12.4	10.8		97
50-54	9.7	11.0	8.8		82
55-59	10.2	14.3	7.1		86
60+	14.4	27.5	4.5		123
Education				n/s	
No education	34.8	35.4	34.3		294
Less than primary	16.1	18.7	14.1		136
Completed primary	40.7	34.3	45.5		343
Completed secondary	4.5	5.2	4.0		38
Higher	3.9	6.4	2.1		33
Number of dairy farmers (*n*)	**844**	**364**	**480**		**844**

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.3.2 shows the mean number of dairy cattle owned by farmers in the ZOI. The numbers are shown by type of dairy cattle. Most households own only one or two animals and only one type of animal. As a result, the mean number of dairy cattle owned by dairy farmers, by type of animal, is very low. On average, dairy farm households with male dairy farmers own more livestock than dairy farm households with female farmers, and the differences are statistically significant at the 0.1 percent level for non-milking dairy cows and at the 1 percent level for bulls.

Table 7.3.2: Dairy Herd Structure: Mean Number of Dairy Cattle Owned by Dairy Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Type of dairy cattle	Total	Female	Male	Sig.[a]	15-29	30+	Sig.[a]
Milking dairy cows	0.7	0.7	0.8	n/s	0.6	0.7	*
Non-milking dairy cows	0.9	0.8	1.1	***	0.9	0.9	n/s
Bulls 1 year old or older	0.5	0.4	0.6	**	0.5	0.5	n/s
Calves less than 1 year old	0.6	0.5	0.6	n/s	0.5	0.6	*
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.3.3 Application of management practices and technologies

This section examines the management practices and technologies that farmers used to raise dairy cows. In all tables, Feed the Future-promoted improved management practices and technologies are indicated with a double dagger (‡).

Acquisition and breeding practices

Dairy cows and bulls can be purchased, bred, or obtained as in-kind credit. Dairy farmers can improve the productivity of their cows through selective breeding and control of reproduction. In developing countries, cattle are primarily bred through natural mating; artificial insemination is generally only used by larger-scale dairy farms.[115] Artificial insemination is beneficial in dairy farming when the services are available, accessible, and affordable because it ensures that the genes from good bulls are passed to more offspring. For the improved genetic potential to be realized, inputs need to be intensified and good dairy production practices must be in place. Using natural breeding, one bull can serve about 30 dairy cows each year, but using artificial insemination, one bull can serve more than 200 dairy cows each year.[116] **Table 7.3.3** presents information on breeding practices used by dairy farmers in the ZOI.

Most farmers acquire their dairy cows through purchase (60.2 percent), followed by breeding (41.9 percent). Around two-thirds (64.6 percent) of the dairy cow farm households in the ZOI reported using artificial insemination. Dairy cow farmers who are 15-29 years of age are more likely to use artificial insemination to breed dairy cows (80.2 percent) compared with dairy cow farmers who are 30+ years of age (62.3 percent), and the difference is statistically significant at the 1 percent level. 37.1 percent of

[115] FAO (2019)
[116] For more information, see FAO training materials on artificial insemination in dairy buffalo and cattle at: http://www.fao.org/ag/againfo/resources/documents/Dairyman/Dairy/V4U6_1.htm

dairy farmers reported using natural breeding. Two-thirds (66.4 percent) of dairy cow farmers own local, traditional breeds.

Table 7.3.3: Types of Dairy Cows Owned and Methods of Dairy Cow Acquisition in the ZOI, in Total and by Farmers' Sex and Age

Type or method	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Type of dairy cows				*			n/s
Mostly local, traditional breeds	66.4	61.2	73.3		60.1	67.5	
Mostly exotic, modern breeds	28.6	33.6	22.0		33.8	27.7	
Half local, half exotic	4.7	4.6	4.7		5.4	4.5	
Don't know	0.3	0.6	0.0		0.7	0.3	
Method of dairy cow acquisition[b]							
Purchased	60.2	62.4	57.4	n/s	57.3	60.8	n/s
Bred	41.9	39.8	44.6	n/s	34.5	43.3	*
Artificial insemination[‡]	64.6	67.9	60.7	n/s	80.2	62.3	**
Natural breeding	37.1	32.7	42.4	n/s	22.0	39.3	*
Obtained as in-kind credit	0.7	0.8	0.5	n/s	0.7	0.7	n/s
Received as a gift	13.5	12.9	14.2	n/s	18.3	12.6	n/s
Received through program	1.4	0.8	2.1	n/s	2.3	1.2	n/s
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

[‡] Promoted improved technology or management practice
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

When breeding dairy cows naturally, in some cases, dairy farmers may not select the bull to mate—whether it is because there is only one bull available or because multiple bulls are available but the farmers do not control their reproduction. In other cases, however, dairy farmers may purposefully select the bull from their own herd, or they may exchange or purchase a bull from another herd. If options are available, dairy farmers may choose a bull to mate because he has good body size or composition, is the son of a high-producing cow, or is known to have high fertility. **Table 7.3.4** presents information related to natural breeding practices used by dairy farmers in the ZOI.

Most dairy farmers acquire bull services by purchasing them from another herd (58.7 percent) or exchanging with another herd (33.0 percent). The sex of the dairy farmer has an effect on both methods of acquiring bull services. Both differences are statistically significant at the 0.1 percent level.

In 56.7 percent of the cases, farmers select the bull for breeding because it has good body size and composition, followed by 20.9 percent who select bulls because it is the son of a high-producing cow.

Table 7.3.4: Natural Breeding Practices—Methods of Acquiring Bull Services and Reasons for Bull Selection in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Method or reason‡	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Method of acquiring bull services[b]							
Selected from own herd	10.8	11.7	9.9	n/s	5.6	11.4	n/s
Exchanged with other herd	33.0	22.8	42.4	***	24.1	34.1	n/s
Purchased from other herd	58.7	69.3	48.8	***	67.7	57.5	n/s
Reason for bull selection[b]							
No selection, only one bull	19.4	21.5	17.5		24.5	18.8	
No selection, multiple bulls in herd	9.8	10.9	8.8		5.6	10.3	
Has good body size, composition‡	56.7	56.7	56.8		45.8	58.1	
Is son of high-producing cow‡	20.9	25.8	16.3		29.9	19.7	
Is known to have good fertility‡	13.0	12.3	13.6		19.1	12.2	
Number of dairy farmers who breed their dairy cows (*n*)	**329**	**157**	**172**		**37**	**292**	

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Farmers who use artificial insemination to breed their dairy cows must obtain artificial insemination services from a provider. **Table 7.3.5** presents information related to artificial insemination practices used by dairy farmers in the ZOI.

Most dairy farmers receive artificial insemination services from private veterinary pharmacies (53.0 percent), followed by private services providers (31.8 percent). The trend is consistent when farmers are disaggregated by sex and age categories.

Table 7.3.5: Primary Providers of Dairy Cow Artificial Insemination Services in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Artificial insemination provider	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Primary provider[‡]				n/s			n/s
Cooperative	0.0	0.0	0.0		0.0	0.0	
Private services provider[‡]	31.8	33.6	28.7		36.0	30.9	
Community animal health worker[‡]	5.2	5.2	5.2		2.2	5.8	
Private veterinary pharmacy	53.0	51.7	55.0		51.2	53.3	
Public veterinary services provider	10.1	9.4	11.1		10.5	10.0	
Other	0.0	0.0	0.0		0.0	0.0	
Number of dairy farmers who use artificial insemination to breed their dairy cows (*n*)	**494**	**306**	**188**		**86**	**408**	

[‡] Promoted improved technology or management practice
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.1.7 Use of inputs

The inputs discussed in this section include dairy cow housing, water supply, feed, and health services, including vaccinations and mastitis prevention. Housing for dairy cows can range from no housing to improved housing that has a roof, sides, and a concrete floor. Dairy cows consume large amounts of water. Dairy cows may be brought to a water source (e.g., a pond, pool, creek, or stream), or water might be brought to the dairy cows (e.g., in buckets or by pipe). **Table 7.3.6** presents the type of housing and water supply methods that farmers in the ZOI use for their dairy cows. Many farmers house their dairy cows in sheds with a roof, sides, and dirt floor (45.5 percent), followed by sheds with a roof, sides, and concrete floor (34.1 percent). Around 17.3 percent of the farmers house their dairy cows in sheds with roof only and no sides. This trend sustains even when farmers are disaggregated into sex and age categories. Cow sheds with a roof, sides and concrete floors are slightly more prevalent in households with female dairy farmers and dairy farmers in the age group 15-29 years.

Nearly all (92.5 percent) dairy farmers provide water to their dairy cows using water buckets. When disaggregated by farmer's sex, male dairy farmers are slightly more likely to take their cows to ponds or pools for drinking, or provide water to them from piped water sources, than their female counterparts. Similarly, when disaggregated by farmer's age, farmers 30+ years of age are slightly more likely to take their cows to the pond or pool for drinking water, or provide water to them from piped water sources, compared with farmers in the age group 15-29 years.

Table 7.3.6: Type of Housing and Water Supply Method Used for Dairy Cows in the ZOI, in Total and by Farmers' Sex and Age

Characteristic	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Type of housing				n/s			n/s
Family housing	1.6	1.8	1.3		1.5	1.6	
No housing	0.7	0.6	0.8		0.7	0.7	
Open corral only	0.8	0.6	1.1		0.8	0.8	
Roof only, no sides	17.3	13.2	22.9		12.0	18.3	
Roof and sides, dirt floor	45.5	47.7	42.4		44.9	45.6	
Roof and sides, concrete floor	34.1	36.0	31.5		40.1	33.0	
Water supply‡				*			n/s
Cows drink from pond or pool	3.1	1.2	5.7		1.5	3.4	
Cows drink from creek or stream	1.5	1.0	2.2		2.3	1.4	
Water brought to cows in buckets	92.5	95.9	88.0		93.9	92.2	
Water piped to cows	2.9	1.9	4.2		2.3	3.0	
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

‡ Promoted improved technology or management practice
Note: The Feed the Future program in Bangladesh promotes clean water availability, but does not specify the type of water supply.
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Allowing dairy cows to graze is allowing them to directly consume the growing forage: grasses and legumes in a pasture or rangeland.[117] Grazing is a main feeding method used in developing countries, but overgrazing is a concern among farmers because it can result in the degradation of the land that is grazed.[118] The nutrients that dairy cows consume contribute to their ability to produce milk, and different types of forages have different nutrient content. Forages include crop residues and cultivated fodders. **Table 7.3.7** presents information about grazing and forages fed to dairy cows in the ZOI, including the types and sources of forage that dairy farmers feed their dairy cows.

Less than half of dairy farmers (46.8 percent) have dairy cows that graze on forages. When disaggregated by sex of the farmer, 39.1 percent of cows belonging to female dairy farmers graze, whereas 57.0

[117] Oregon State University Forage Information System (2019)
[118] FAO (2019)

percent of dairy cows belonging to male dairy farmers graze. This difference is statistically significant at the 0.1 percent level.

Among the farmers with dairy cows, 86.9 percent feed them conserved rice straw, 76.5 percent feed them fresh cut grass, 38.9 percent feed them cereals, and 20.7 percent feed them tree fodder. A larger proportion of female farmers feed cereals (42.8 percent) to their dairy cows compared with male farmers (33.7 percent). This difference is statistically significant at the 5 percent level. Farmers 30+ years of age feed tree fodder to their cows more than farmers 15-29 years of age (22.1 percent versus 13.0 percent). This difference is statistically significant at the 1 percent level.

The farmers obtain forage from a variety of different sources, with primary sources being pulled from cropland (51.9 percent), gathered from roadside (51.6 percent), grew themselves (40.1 percent), and bought from the market (33.4 percent). A higher proportion of female dairy farmers obtain forage to feed their cows from the market (40.2 percent) than their male counterparts (24.4 percent), and this difference is statistically significant at the 0.1 percent level.

Table 7.3.7: Dairy Cow Grazing and Characteristics of Forages Used in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Practice or characteristic	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Dairy cows graze	46.8	39.1	57.0	***	45.5	47.0	n/s
Forages fed to dairy cows[b]							
Conserved rice straw‡	86.9	86.4	87.5	n/s	86.2	87.0	n/s
Conserved rice stover‡	6.8	8.0	5.3	n/s	9.3	6.4	n/s
Legume haulms or stovers‡	14.0	12.2	16.2	n/s	11.3	14.4	n/s
Forage legumes‡	5.2	4.4	6.1	n/s	2.3	5.7	*
Napier grass‡	6.5	6.7	6.2	n/s	9.9	5.8	n/s
Guinea grass‡	0.9	0.2	1.9	*	0.8	1.0	n/s
Fresh-cut grass‡	76.5	76.6	76.4	n/s	76.3	76.5	n/s
Tree fodder‡	20.7	20.9	20.4	n/s	13.0	22.1	**
Cereals	38.9	42.8	33.7	*	38.3	39.0	n/s
Other	2.3	3.6	0.6	n/s	5.4	1.7	n/s
Forage source[b]							
Gathered from roadside	51.6	48.5	55.8	n/s	47.7	52.3	n/s
Pulled from cropland	51.9	47.5	57.8	*	44.2	53.3	*
Grew it themselves	40.1	41.1	38.8	n/s	42.2	39.7	n/s
Bought from neighbor	9.6	11.7	6.9	*	12.4	9.1	n/s
Bought from market	33.4	40.2	24.4	***	39.9	32.2	n/s
Grew naturally	27.7	24.9	31.4	n/s	24.2	28.3	n/s
Other	0.4	0.4	0.3	n/s	0.0	0.4	n/s
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Crop by-products are supplemental feeds that are made from plant parts, such as stems and seed pods, that are left over after the main crop is harvested. **Table 7.3.8** presents information about crop by-product use among dairy farmers in the ZOI, including the frequency of feeding and the type and source of the crop by-products.

91.6 percent of dairy farmers feed crop by-products to their dairy cows, and 85.7 percent of them feed crop by-products to their cows on a daily basis. Farmers 15-29 years of age are more likely to feed crop by-products to their cows daily (95.1 percent) compared with farmers 30+ years of age (83.9 percent). This difference is statistically significant at the 0.1 percent level. On the other hand, farmers 30+ years of age are more likely to feed crop by-products to dairy cows whenever available (12.1 percent) compared with farmers 15-29 years of age (4.1 percent), with a difference that is statistically significant at the 1 percent level.

Table 7.3.8 also shows that 90.6 percent of farmers feed rice bran to their dairy cows, followed by wheat bran (36.5 percent) and oilseed cakes (27.1 percent). 83.0 percent of farmers acquire crop by-products through their own food preparation, with the proportion being higher for male farmers (90.7 percent) compared with female farmers (77.4 percent), and the difference being statistically significant at the 0.1 percent level. A greater proportion of female farmers acquire crop by-products from their local brewer (30.5 percent) compared to male farmers (20.8 percent), and the difference is statistically significant at the 1 percent level. A greater proportion of female farmers also acquire crop by-products from the market (41.1 percent) compared with male farmers (32.3 percent), and the difference is statistically significant at the 5 percent level.

Table 7.3.8: Characteristics of Crop By-product Use by Dairy Farmers in the ZOI, in Total and by Farmers' Sex and Age

Crop by-product use or characteristic‡	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Fed to dairy cows	91.6	93.2	89.4	*	93.2	91.3	n/s
Number of dairy farmers (*n*)	844	480	364		131	713	
Frequency of feeding							
Daily‡	85.7	87.9	82.6	n/s	95.1	83.9	***
Weekly‡	3.2	2.9	3.6	n/s	0.8	3.7	*
Monthly	0.3	0.0	0.6	n/s	0.0	0.3	n/s
Whenever available	10.9	9.2	13.2	n/s	4.1	12.1	**
Other	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Type[b]							
Maize bran	12.2	11.0	14.0	n/s	14.0	11.9	n/s
Wheat bran	36.5	36.7	36.3	n/s	32.8	37.2	n/s
Molasses	2.3	1.3	3.7	n/s	0.8	2.6	n/s
Fruit or vegetable processing waste	21.3	21.6	20.8	n/s	15.6	22.3	n/s
Oilseed cake	27.1	26.8	27.7	n/s	29.5	26.7	n/s
Brewer's grain	3.6	4.7	2.2	n/s	4.9	3.4	n/s
Cottonseed meal or cake	1.0	1.3	0.6	n/s	0.8	1.1	n/s
Rice bran	90.6	91.7	89.0	n/s	90.3	90.7	n/s
Other	10.4	14.2	5.3	*	14.0	9.8	n/s
Source[b]							
Own food preparation	83.0	77.4	90.7	***	81.1	83.3	n/s
Local brewer	26.5	30.5	20.8	**	28.0	26.2	n/s
Market	37.5	41.1	32.3	*	39.3	37.1	n/s
Dairy cooperative	0.5	0.4	0.6	n/s	0.8	0.5	n/s
Other cooperative	0.1	0.2	0.0	n/s	0.0	0.2	n/s
Milk producer (not co-op)	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Local agrovet supplier	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Other	0.3	0.2	0.3	n/s	0.0	0.3	n/s
Number of dairy farmers who feed crop by-products to their dairy cows (*n*)	**772**	**447**	**325**		**122**	**650**	

n/a=not applicable

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Mixed concentrates are nutrient-rich feeds that are fed to dairy cows to increase milk production. They are usually a mixture of grains and cereals, and can include other nutrient-dense ingredients, such as brans, pomaces, or oilseed cake, and are typically formulated into a meal or pelletized. **Table 7.3.9** presents information about the use of mixed concentrates by dairy farmers in the ZOI, including the frequency of feeding and the sources of the feeds.

Over half of dairy farmers in the ZOI (53.1 percent) feed mixed concentrates to their dairy cows, more so among female (60.1 percent) than male dairy farmers (43.8 percent). This difference is statistically significant at the 0.1 percent level. Among those who feed mixed concentrates to their dairy cows, a greater proportion of female farmers feed on a daily basis (71.8 percent) compared with male farmers (58.5 percent). Most farmers (81.7 percent) who feed mixed concentrates to their dairy cows acquire the product from the market.

Table 7.3.9: Characteristics of Mixed Concentrate Feed Use by Dairy Farmers in the ZOI, by Farmers' Sex and Age

Mixed concentrate feed use and characteristic‡	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Fed to dairy cows	53.1	60.1	43.8	***	55.7	52.6	n/s
Number of dairy farmers (*n*)	844	480	364		131	713	
Frequency of feeding				n/s			n/s
Daily	67.2	71.8	58.5		68.4	66.9	
Weekly	15.9	10.5	25.8		16.4	15.8	
Monthly	1.3	1.4	1.2		0.0	1.6	
Whenever available	15.0	16.3	12.6		15.2	15.0	
Other	0.6	0.0	1.8		0.0	0.8	
Source[b]							
Market	81.7	81.2	82.4	n/s	83.5	81.3	n/s
Dairy cooperative	1.8	2.4	0.6	n/s	2.7	1.6	n/s
Other cooperative	0.9	1.0	0.6	n/s	1.4	0.8	n/s
Local agrovet supplier	0.9	0.7	1.3	n/s	1.3	0.8	n/s
Milk producer (not co-op)	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Number of dairy farmers who fed mixed concentrates to their dairy cows (*n*)	**447**	**288**	**159**		**73**	**374**	

n/a=not applicable

‡ Promoted improved technology or management practice

Note: The Feed the Future program in Bangladesh promotes mixed concentrate feed use; however, the frequency of feeding and source are not specified.

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.3.10 presents the frequency with which dairy farmers in the ZOI feed vitamins and minerals to their dairy cows. Note that in the better formulations of compounded concentrate feed, vitamins and minerals are incorporated into the mix; it is therefore possible that the figures presented here miss some farmers who do not add vitamin and mineral supplements separately.

Over half (54.8 percent) of farmers feed vitamins and minerals to their dairy cows. Among those farmers who feed vitamins and minerals to their dairy cows, nearly three-quarters (73.7 percent) feed them on a daily basis and 10.9 percent on a weekly basis. Although there is no statistically significant difference in the frequency with which farmers feed their dairy cows vitamins or minerals by farmers' sex, farmers 15-29 years of age report this practice more than farmers 30+ years of age, with a difference that is statistically significant at the 5 percent level.

Table 7.3.10: Frequency with which Farmers Feed Their Dairy Cows Vitamins or Minerals in the ZOI, by Farmers' Sex and Age

Vitamin and mineral use and feeding frequency‡	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Fed to dairy cows	54.8	55.2	54.2	n/s	60.0	53.9	n/s
Number of dairy farmers (*n*)	844	480	364		131	713	
Frequency of feeding				n/s			*
Daily	73.7	74.9	72.1		80.6	72.3	
Weekly	10.9	9.1	13.3		11.6	10.7	
Monthly	5.9	6.8	4.5		3.9	6.3	
Whenever available	8.7	9.2	8.1		3.9	9.7	
Other	0.9	0.0	2.0		0.0	1.0	
Number of dairy cows who fed vitamins or minerals to their dairy cows (*n*)	**461**	**264**	**197**		**78**	**383**	

‡ Promoted improved technology or management practice

Note: The Feed the Future program in Bangladesh promotes giving dairy cows vitamins and minerals; however, the frequency of feeding is not specified.

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

When dairy cows contract diseases, dairy farmers are subject to potentially large economic losses. Disease can result in the death of dairy cows or in reduced productivity. Access to trained health service providers and medicines, therefore, is important in dairy farming. Dairy farmers in developing countries, however, have limited knowledge of disease prevention, management, and control. In addition, disease prevalence is high, and dairy cow health services can be unavailable or unaffordable.[119]

Table 7.3.11 presents information on where farmers obtain health services and medicines for their dairy cows in the ZOI. Dairy farmers were specifically asked about obtaining health services, such as vaccinations, treatment for sick animals, and assistance with the delivery of calves, from trained providers.

[119] FAO (2019)

About 38.1 percent of dairy farmers do not consult with any trained health service provider for their dairy cows. Over one-third (36.1 percent) of the farmers consult private veterinarians for health services for their dairy cows. Very few farmers (2.1 percent) treat their own dairy cows. One-third of dairy farmers (33.8 percent) do not give any medicines to their dairy cows. 45.9 percent of the farmers acquire medicines for their dairy cows from private veterinary pharmacies. 9.3 percent of the farmers acquire medicines for their dairy cows from traders. Farmers' age does not have a statistically significant effect on whether farmers obtain health services and medicines for their dairy cows in the ZOI. On the other hand, farmers' 30+ years of age are more likely to consult community animal health workers than farmers 15-29 years of age (2.3 percent versus 0.0 percent).

Farmers' age does affect whether farmers source medicines for their dairy cows: a higher proportion of farmers 15-29 years of age source from the private veterinary pharmacy than farmers 30+ years of age, with a difference statistically significant at the 0.1 percent level, whereas farmers 30+ years of age are more likely to report sourcing medicines from the government–or not giving any medicines compared with farmers 15-29 years of age. These differences are statistically significant at the 0.1 percent and the 5 percent levels, respectively.

Table 7.3.11: Trained Health Service Providers and Sources of Medicines Used by Dairy Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Provider or source‡	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Trained health service provider[b]							
Self	2.1	1.6	2.7	n/s	0.8	2.3	n/s
Community animal health worker‡	2.9	2.9	3.0	n/s	0.0	3.5	***
Government extension services	4.4	3.8	5.3	n/s	4.6	4.4	n/s
Public veterinarian‡	4.3	4.2	4.4	n/s	5.3	4.1	n/s
Private veterinarian‡	36.1	36.3	35.7	n/s	42.2	34.9	n/s
Private veterinary pharmacy	16.9	18.2	15.1	n/s	22.1	15.9	n/s
Other	0.4	0.6	0.0	n/s	0.8	0.3	n/s
Did not use health services	38.1	38.0	38.2	n/s	29.6	39.7	*
Source of medicines[b]							
Trader	9.3	7.7	11.3	n/s	6.1	9.8	n/s
Dairy cooperative	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Milk purchaser (not co-op)	0.1	0.2	0.0	n/s	0.0	0.1	n/s
Community animal health worker	5.6	4.1	7.6	n/s	3.8	6.0	n/s
Local agrovet supplier	7.2	7.3	7.1	n/s	10.0	6.7	n/s
Private veterinary pharmacy	45.9	45.3	46.6	n/s	55.8	44.0	*
Government	1.2	1.0	1.4	n/s	0.0	1.4	***
Did not give medicines	33.8	36.4	30.3	n/s	25.9	35.3	*
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

n/a=not applicable

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Vaccinating dairy cows will help keep them healthy. Rift Valley fever outbreaks, for example, can be prevented if animals are vaccinated before an outbreak begins, ideally through a continuous vaccination program.[120] Foot-and-mouth disease and contagious bovine pleuropneumonia are two other highly contagious diseases that can also be controlled by routine vaccination. **Table 7.3.12** presents information on dairy cow vaccination practices among farmers in the ZOI. This includes information on whether farmers vaccinate their dairy cows and the types of vaccines they give them.

Most (81.1 percent) farmers do not vaccinate their dairy cows. 11.5 percent of farmers vaccinate some of their dairy cows, and 7.4 percent of the farmers vaccinate all of their dairy cows. Of those who vaccinate their dairy cows, 57.7 percent vaccinate their dairy cows for foot and mouth disease, 33.6 percent for black quarter, 29.1 percent for hemorrhagic septicemia, and 27.6 percent for anthrax. Disaggregating farmers by sex and age does not reveal any statistically significant differences.

Table 7.3.12: Vaccination Practices among Dairy Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Vaccination characteristic‡	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Dairy cows vaccinated				n/s			n/s
None	81.1	82.5	79.4		80.2	81.3	
Some	11.5	10.8	12.3		12.1	11.4	
All	7.4	6.7	8.3		7.7	7.3	
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	
Type of vaccination given[b]							
Foot and mouth disease	57.7	52.1	64.0	n/s	45.8	60.0	n/s
Contagious bovine pleuropneumonia	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Rift Valley fever	9.4	8.3	10.7	n/s	3.8	10.5	n/s
Hemorrhagic septicemia (BS)	29.1	34.8	22.8	n/s	31.1	28.8	n/s
Black quarter (BQ)	33.6	32.4	34.8	n/s	31.2	34.0	n/s
Anthrax	27.6	28.5	26.5	n/s	26.7	27.7	n/s
Other	5.7	6.0	5.4	n/s	7.7	5.3	n/s
Number of dairy farmers who vaccinated their dairy cows (*n*)	**159**	**84**	**75**		**26**	**133**	

n/a=not applicable
‡ Promoted improved technology or management practice
Note: The Feed the Future program in Bangladesh promotes year-round vaccinations for livestock; however, the type of vaccination is not specified.
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Mastitis is inflammation of a dairy cow's udder that usually caused by bacterial infection. Mastitis reduces milk yields and increases production costs. Mastitis cannot be eliminated, but it can be reduced to low levels through good cow management practices, such as cleaning milking equipment thoroughly, keeping

[120] WHO (2018a)

dairy cow housing clean, washing and drying udders before milking, and dipping or spraying all teats with disinfectant teat dip after each milking.[121] Somatic cell count tests can be used to diagnose mastitis in a single dairy cow or in a herd, particularly when visible symptoms of mastitis are not present.[122]

Table 7.3.13 presents information on mastitis awareness and prevention among dairy farmers in the ZOI. Half (50.3 percent) of the dairy farmers have never heard of mastitis, whereas 40.3 percent of the farmers do not take any prevention methods against mastitis. Only 7.0 percent of the farmers wash and dry udders of dairy cows as a prevention method against mastitis. When disaggregated by age group, dairy farmers 30+ years of age are more likely (7.7 percent) than farmers 15-29 years of age (3.1 percent) to wash and dry udders of their dairy cows, and this difference is statistically significant at the 5 percent level.

Table 7.3.13: Mastitis Prevention Methods Used by Dairy Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Prevention method[a‡]	Total (%)	Female (%)	Male (%)	Sig.[b]	15-29 (%)	30+ (%)	Sig.[b]
Wash and dry udder‡	7.0	6.9	7.1	n/s	3.1	7.7	*
Teat dip‡	3.2	3.8	2.5	n/s	2.3	3.4	n/s
Somatic cell counts‡	0.2	0.4	0.0	n/s	0.0	0.3	n/s
Other prevention method	1.8	1.2	2.5	n/s	1.5	1.8	n/s
None, no prevention used	40.3	41.0	39.2	n/s	36.8	40.9	n/s
None, never heard of mastitis	50.3	49.6	51.2	n/s	56.3	49.2	n/s
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

‡ Promoted improved technology or management practice
[a] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.
[b] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.1.1.8 Production practices

In this section, dairy cow manure use, milk processing and sale, record keeping, and information sources are explored.

Lactating dairy cows have been estimated to produce between 56 and 82 kilograms of manure (including urine) per day based on milk yield, with dry cows and heifers both estimated to produce less.[123] That manure can be a valuable resource—whether it is used as fertilizer or fuel or sold. **Table 7.3.14** presents information on whether dairy farmers in the ZOI collect their cows' manure, and if they do collect it, how they store and use it.

[121] For more information, see FAO training materials on mastitis prevention at: http://www.fao.org/3/t0218e/t0218e04.htm
[122] Looper (n.d.)
[123] Western Dairy Digest (2005)

Virtually all (98.0 percent) dairy farmers collect manure, with a greater proportion of female farmers collecting manure (99.4 percent) compared with male farmers (96.3 percent). The difference is statistically significant at the 5 percent level.

When it comes to storing the manure, slightly less than half (48.3 percent) of dairy farmers gather the manure in a heap in an uncovered area. About one-quarter (23.4 percent) of farmers gather the manure in a heap in a covered area, and another quarter (26.9 percent) store the manure in a pit or lagoon. The primary purpose of using manure is for fuel (92.4 percent), followed by use as a fertilizer on a field (21.4 percent).

Table 7.3.14: Cow Manure Practices among Dairy Farmers in the ZOI, in Total and by Farmers' Sex and Age

Manure collection and use characteristic‡	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Collect cows' manure	98.0	99.4	96.3	*	98.5	98.0	n/s
Number of dairy farmers (*n*)	844	480	364		131	713	
Manure storage				n/s			n/s
In a heap, uncovered area	48.3	50.1	45.9		50.6	47.9	
In a heap, covered area‡	23.4	22.8	24.1		22.5	23.5	
In a pit or lagoon‡	26.9	25.7	28.5		24.6	27.3	
In a tank‡	0.4	0.6	0.0		0.8	0.3	
In a biogas-producing digester‡	0.2	0.2	0.3		0.8	0.1	
Other storage	0.8	0.6	1.1		0.8	0.8	
Manure use							
Use for fuel	92.4	94.0	90.2		95.4	91.9	
Put on field as fertilizer	21.4	20.2	23.2		19.6	21.8	
Give to friends or neighbors	11.4	9.8	13.6		9.2	11.8	
Sell to friends or neighbors	1.7	1.5	2.0		1.6	1.7	
Sell at market	1.0	1.5	0.3		0.8	1.0	
Other Use	0.6	0.4	0.8		0.0	0.7	
Nothing	3.9	2.9	5.3		3.1	4.1	
Number of dairy farmers who collect their dairy cows' manure (*n*)	**827**	**477**	**350**		**129**	**698**	

‡ Promoted improved technology or management practice

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Farmers may process the milk that their dairy cows produce into other products, such as yogurt or cheese. They may also sell some or all of the milk that their dairy cows produce. **Table 7.3.15** presents information on dairy farmers' practices related to processing and selling their cows' milk. Among 844 dairy farmers, 3.7 percent process their milk into other products, with a higher proportion of male dairy farmers (5.5 percent) than females (2.3 percent) doing so. This difference is statistically significant at the 5 percent level. About one-third (32.4 percent) of farmers sell their milk, which varies by farmers' age. Specifically, about one-third (34.0 percent) of dairy farmers 30+ years of age sell their milk, which is higher than the proportion of farmers 15-29 years of age (23.7 percent). This difference is statistically significant at the 5 percent level.

Among those farmers who sell their dairy cows' milk, it is most commonly sold to friends or neighbors (41.8 percent), one-third (32.1 percent) to an aggregator or off-taker, and one-quarter (25.7 percent) to the market. Most dairy farmers (85.5 percent) sold the morning milk only, followed by one-quarter (23.3 percent) who sold evening milk only.

Table 7.3.15: Milk Processing and Selling Practices of Dairy Farmers in the ZOI, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Practice or characteristic	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Process milk into other products	3.7	2.3	5.5	*	1.5	4.1	n/s
Sell milk	32.4	33.2	31.4	n/s	23.7	34.0	*
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	
Where milk is sold				n/s			n/s
To friends or neighbors	41.8	45.3	36.9	n/s	38.6	42.2	n/s
At market	25.7	21.9	31.2	n/s	15.9	27.0	n/s
To a school	0.0	0.0	0.0	n/a	0.0	0.0	n/a
To a milk-marketing cooperative	0.0	0.0	0.0	n/a	0.0	0.0	n/a
To an aggregator or off-taker	32.1	32.8	31.0	n/s	45.5	30.4	n/s
Others	0.4	0.0	0.9	n/s	0.0	0.4	n/s
Which milk is sold				n/s			n/s
Morning milk only	85.5	81.6	91.1		96.7	84.1	
Evening milk only	23.3	26.0	19.5		9.8	25.1	
Both morning and evening milk	8.9	7.6	10.7		6.5	9.2	
Number of dairy farmers who sell their dairy cows' milk (*n*)	**273**	**159**	**114**		**31**	**242**	

n/a=not applicable

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Milk marketing cooperatives may provide dairy farmers with a variety of services, including information about the amount and composition of the milk, extension and animal health services, and loans. Milk marketing cooperatives may also offer multiple methods of payment, including cash, store credit, mobile money, or direct deposit to a bank account. **Table 7.3.16** presents the services that dairy farmers report their milk marketing cooperatives offer.

According to the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019data, none of the surveyed dairy farmers in the ZOI use milk marketing cooperatives.

Table 7.3.16: Services Provided and Methods of Payment Used by Dairy Farmers' Milk Marketing Cooperatives in the ZOI

Service or method	Percent
Service provided[a]	
Amount of milk	80.0
Fat content of milk	20.0
Acidity of milk	0.0
Extension services	0.0
Animal health services	0.0
Loans	0.0
Payment method[a]	
Cash	100.0
Store credit	0.0
MPESA/mobile money	0.0
Direct deposit to bank account	0.0
Number of dairy farmers who use a milk marketing cooperative (*n*)	**5**

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

There are several reasons why farmers may sell their dairy cows. **Table 7.3.17** presents reasons why farmers sell their dairy cows in the ZOI. The predominant reason for dairy farmers to sell their dairy cows is because of a need for money (80.4 percent). About 10.8 percent of dairy farmers in the ZOI report that dairy cows are sold because the dam is poor performing. This is more commonly reported among male than female dairy farmers (13.8 percent versus 8.5 percent), and farmers 30+ years of age than farmers 15-29 years of age (11.6 percent versus 6.0 percent). These differences are statistically significant at the 5 percent level.

Table 7.3.17: Reasons Farmers Sell their Dairy Cows in the ZOI, in Total and by Farmers' Sex and Age

Reason[a]	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[b]	15-29 (%)	30+ (%)	Sig.[b]
Need cash	80.4	83.2	76.6	n/s	82.5	80.0	n/s
Dam is poor-performing	10.8	8.5	13.8	*	6.0	11.6	*
Low milk production	0.8	0.6	1.1	n/s	0.7	0.8	n/s
Will not re-breed	3.8	4.1	3.3	n/s	5.3	3.5	n/s
Too old	2.8	2.1	3.8	n/s	3.9	2.6	n/s
When heifers expected to produce more milk enter herd	0.1	0.2	0.0	n/s	0.0	0.1	n/s
Herd size not manageable	0.0	0.0	0.0	n/a	0.0	0.0	n/a
Not enough food for all animals	0.5	0.6	0.3	n/s	0.7	0.4	n/s
Other	0.8	0.6	1.1	n/s	0.7	0.8	n/s
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

n/a=not applicable

[a] Farmers were allowed to give more than one response, so the percentages may not add up to 100 percent.

[b] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.3.18 presents the mean number dairy cows and bulls that were sold per dairy farmer in the ZOI in the 12 months preceding the survey. On average, farmers sold 0.2 dairy cows and 0.3 bulls in the last 12 months. On average, male farmers sold 0.4 bulls and female farmers sold 0.2 bulls, with the difference being statistically significant at the 5 percent level.

The Feed the Future Bangladesh ZOI Baseline Survey 2018/2019did not collect data on dairy cattle that died; therefore, these data are not available.

Table 7.3.18: Mean Number of Dairy Cows and Bulls that Were Sold or Died per Dairy Farmer in the ZOI during the 12 Months Preceding the Survey, in Total and by Farmers' Sex and Age

Type of dairy cattle	Total	Sex			Age (years)		
		Female	Male	Sig.[a]	15-29	30+	Sig.[a]
Sold							
Dairy cows	0.2	0.2	0.2	n/s	0.2	0.2	n/s
Bulls	0.3	0.2	0.4	*	0.2	0.3	n/s
Died							
Dairy cows	—	—	—	—	—	—	—
Bulls	—	—	—	—	—	—	—
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

— = Data are not available

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Dairy farmers who keep written records can track milk yields and milk composition and use the information to make decisions about feeding, selecting calves with a higher capacity to produce, culling animals that are no long producing, and improving production.[124] In addition to keeping written records, it is also important for farmers to access information to help them raise their dairy cows well so that they are able to obtain high milk yields. **Table 7.3.19** presents the main information sources that dairy farmers in the ZOI use to obtain extension and other production performance information about how to raise their animals well and presents the percentage of dairy farmers who keep written records.

Only 10.1 percent of dairy farmers keep written records. Keeping written records is more prevalent among male dairy farmers (14.8 percent) than female dairy farmers (6.7 percent). This difference is statistically significant at the 0.1 percent level. About half of the ZOI dairy farmers (50.9 percent) get their information from friends or neighbors, followed by one-third (32.3 percent) who receive information from private veterinary pharmacies. In contrast, virtually no dairy farmers consult digital technologies, such as radio, television, mobile phone messaging, and internet, for information on dairy farming.

Table 7.3.19: Record-keeping Practices and Main Information Sources among Dairy farmers in the ZOI, in Total and by Farmers' Age and Sex

		Sex			Age (years)		
Practice or source	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Keeps written records	10.1	6.7	14.8	***	8.3	10.5	n/s
Main production performance information source				n/s			n/s
Friend/neighbor	50.9	49.4	52.9		44.9	52.0	
Community animal health worker	8.3	8.1	8.7		6.9	8.6	
Local agrovet supplier	2.2	2.0	2.4		2.3	2.2	
Private veterinary pharmacy	32.3	34.7	29.1		36.0	31.6	
Government veterinary officer	0.0	0.0	0.0		0.0	0.0	
Ag extension worker	5.2	4.4	6.3		9.2	4.5	
School	0.1	0.2	0.0		0.0	0.1	
Radio program	0.0	0.0	0.0		0.0	0.0	
Television	0.3	0.2	0.5		0.0	0.4	
Mobile phone messaging	0.0	0.0	0.0		0.0	0.0	
Internet	0.0	0.0	0.0		0.0	0.0	
Other	0.6	1.0	0.0		0.7	0.6	
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Dairy farmers may make key production decisions alone, together with their partner or spouse, or together with others. However, they may instead rely on their partner or spouse or others to make such decisions. **Table 7.3.20** presents the percent distribution of dairy farmers by who made key

[124] For more information, see FAO training materials on milk recording at: http://www.fao.org/3/t1265e/t1280e05.htm

production decisions—that is, which bulls to breed with dairy cows, which vaccinations to give dairy cows, and when to sell dairy cows.

In households where the dairy farmers are female, either the spouse alone or spouse and female farmer together make most of the key dairy cow production decisions. There is a higher proportion of households with female dairy farmers where the spouse made key dairy cow production decisions *exclusively* compared with *jointly* between female farmer and spouse. For instance, 55.1 percent of female dairy farmers reported that their spouse decided which bulls to breed and 57.4 percent report that their spouse decided which vaccinations to give to the dairy cows. In contrast, 29.2 percent of female dairy farmers reported that they jointly decided which bulls to breed and 32.2 percent of female farmers reported joint decisions with spouse regarding vaccinations. Only 6.5 percent of female dairy farmers decided which vaccinations to give to the dairy cows on their own. Further, 40.3 percent of female farmers reported that her spouse takes the sole decision regarding when to sell dairy cows, while 46.7 percent of female farmers reported that the farmer and her spouse took decisions jointly.

In households where the dairy farmers are male, key dairy cow production decisions are almost always taken by the male farmer alone. Table 7.3.20 shows that about 81.1 percent of the male dairy farmers reported that they took the sole decision on which bulls to breed. On the other hand, only 10.7 percent of female dairy farmers took the sole decision on which bulls to breed. In households where the dairy farmer is male, only 12.5 percent of the farmers reported taking decisions jointly with his spouse regarding which bulls to breed. Moreover, about 78.8 percent of the male farmers reported taking decisions alone regarding which vaccinations to give to the dairy cows. About 18.2 percent of the male farmers report taking decisions jointly with his spouse regarding vaccinations. Decision making is slightly more balanced regarding the sale of dairy cows: 61.5 percent of male dairy farmers report taking the sole decision regarding when to sell dairy cows, and 28.7 percent of male dairy farmers report taking decisions jointly with his spouse regarding sale of dairy cows.

Table 7.3.20: Percent Distribution of Who Made Key Dairy Cow Production Decisions in the ZOI, by Farmers' Sex

Decisionmakers	Which bulls to breed		Which vaccinations to give		When to sell dairy cows	
	Percent	Sig.[a]	Percent	Sig.[a]	Percent	Sig.[a]
Female farmers						
Self alone	10.7		6.5		6.5	
Spouse alone	55.1		57.4		40.3	
Self and spouse together	29.2		32.2		46.7	
Self and other (could also include spouse)	1.5		0.0		3.0	
Other	3.6		3.9		3.6	
Number of female dairy farmers (*n*)	**141**		**77**		**435**	
Male farmers						
Self alone	81.1		78.8		61.5	
Spouse alone	1.9		0.0		1.8	
Self and spouse together	12.5		18.2		28.7	
Self and other (could also include spouse)	4.5		1.5		7.7	
Other	0.0		1.5		0.3	
Number of male dairy farmers (*n*)	**159**		**66**		**335**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.

Note: 74 out of 844 dairy cow households were excluded from the analysis since decisionmakers could not be properly identified in those households.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.3.4 Use of improved management practices and technologies

This section examines dairy farmers' use of improved technologies and management practices promoted by Feed the Future in the Bangladesh ZOI to raise dairy cows and produce milk.

Table 7.3.21 shows the percentage of dairy farmers in the ZOI who applied one or more improved management practices or technologies (IMPT) promoted by the Bangladesh mission during the 12 months preceding the ZOI Survey. The table also includes the percentage of dairy farmers in the ZOI who used promoted improved management practices and technologies by livestock production and management sub-category. Among dairy farmers in the Bangladesh ZOI, the use of improved fodder crop (99.3 percent) and improved livestock handling practices and housing (96.9 percent) are nearly universal. 90.4 percent of farmers used improved feeding practices. When disaggregated by age of the dairy farmer, farmers who are 30+ years of age are less likely to employ improved feeding practices (89.4 percent) compared with farmers 15-29 years of age (96.2 percent). The difference is statistically significant at the 1 percent level. 87.7 percent of the farmers breed livestock using improved practices. The relatively less common improved management practices or technologies used by dairy farmers include using livestock health services and products (77.4 percent) and employing improved waste management practices (49.9 percent). The use of livestock health services and products is lower among dairy farmers who are 30+ years of age (76.3 percent) than those who are 15-29 years of age (83.3 percent), and the difference is statistically significant at the 5 percent level.

Table 7.3.21: Percentage of Dairy Farmers in the ZOI Who Used One or More Improved Management Practices and Technologies by Sub-category, in Total and by Farmers' Sex and Age

Sub-category	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Across all sub-categories	100.0	100.0	100.0	n/a	100.0	100.0	n/a
Improved livestock breeds[b]	87.7	87.6	87.7	n/s	86.3	87.9	n/s
Livestock health services and products[c]	77.4	76.2	78.9	n/s	83.3	76.3	*
Improved livestock handling practices and housing[d]	96.9	96.9	96.8	n/s	97.0	96.8	n/s
Improved feeding practices[e]	90.4	91.7	88.7	n/s	96.2	89.4	**
Improved grazing practices[f]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Improved waste management practices[g]	49.9	49.0	51.0	n/s	47.9	50.2	n/s
Improved use of fodder crops[h]	99.3	99.2	99.5	n/s	99.2	99.3	n/s
Cultivation of dual purpose crops[i]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other[j] (maintains written records)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Comprised of any of the following: artificial insemination; bull has good body, size, composition; bull is son of high-producing cow; bull is known to have good fertility
[c] Comprised of any of the following: obtained health services from trained provider; gave medicines.
[d] Comprised of housing with roof only, no sides or roof and sides, dirt floor or roof and sides, concrete floor.
[e] Comprised of feeding crop by-products daily or feeding crop by-products weekly or feeding mixed concentrates daily, or feeding mixed concentrates weekly or feeding vitamins or minerals daily or feeding vitamins or minerals weekly.
[f] Not promoted by Feed the Future Bangladesh
[g] Comprised of any of the following: put in heap in covered area; put in pit/lagoon; put in tank; put into a biogas-producing digester
[h] Comprised of any of the following: conserved rice straw; conserved rice stover; legume haulms or stovers; forage legumes; napier grass; guinea grass; cut fresh grass; tree fodder
[i] Not promoted by Feed the Future Bangladesh
[j] Not promoted by Feed the Future Bangladesh
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.3.22 shows the percent distribution of dairy farmers who used promoted improved management practices and technologies by the number used. The highest proportion (44.2 percent) of dairy farmers employed 5 of the promoted improved management practices and technologies, and around one-third (31.7 percent) employed all 6 of the promoted improved management practices and technologies in the ZOI.

Table 7.3.22: Percent Distribution of Dairy farmers in the ZOI by the Number of Promoted Improved Management Practices and Technologies Used, in Total and by Farmers' Sex and Age

Promoted improved practice or technology	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Number used				n/s			n/s
1	0.0	0.0	0.0		0.0	0.0	
2	0.5	0.4	0.6		0.0	0.6	
3	5.1	6.1	3.8		5.4	5.1	
4	18.6	17.1	20.5		15.2	19.2	
5	44.2	45.4	42.7		43.7	44.3	
6	31.7	31.1	32.5		35.7	30.9	
7	0.0	0.0	0.0		0.0	0.0	
8+	0.0	0.0	0.0		0.0	0.0	
Number of dairy farmers (*n*)	**844**	**480**	**364**		**131**	**713**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Yield is a measure of total production per unit of production. For dairy cows, yield is the liters of milk produced the day before the survey per milking dairy cow.

Table 7.3.23 presents the total milk production, total production units, and herd-weighted and farmer average yields for dairy cows. Yield results are also presented disaggregated—first by production and then by sex and age.

The total quantity of milk produced by dairy farmers in the ZOI is 40,184,141.9 liters per month. The sample-weighted total number of milking dairy cows in the region was 1,602,558. This means that the total yield is equal to 25.1 liters per milking dairy cow per month.

On average, each milking dairy cow produces 30.1 liters of milk per month. The milk yield of dairy cows among female farmers is 27.1 liters per milking cow per month compared to 24.6 liters per milking cow per month for male farmers. There is no statistically significant difference in milk yield of dairy cows by farmers' age.

As Bangladesh's production system is limited to smallholder mixed livestock-crop, data for other types of production systems are not presented.

Table 7.3.23: Dairy Cow Yield in the ZOI during the 30 Days Preceding the Survey, in Total and by Farmers' Sex and Age

Background characteristic	Herd size-weighted			Average per farmer				Number of dairy farmers with milking cows (*n*)
	Production (liters)	Units of production (number of milking cows)	Yield (liters/number of milking cows in herd)	Production (liters)	Units of production (number of milking cows)	Yield (liters/number of milking cows in herd)	Sig.[a]	
Total	40,184,141.9	1,602,558	25.1	30.1	1.2	26.0		500
Sex							n/s	
Female	22,610,042.0	843,372	26.8	29.5	1.1	27.1		285
Male	17,574,099.9	759,186	23.1	30.9	1.3	24.6		215
Age							n/s	
15-29 years	4,838,314.9	209,905	23.1	27.7	1.2	25.9		65
30+ years	35,345,827.0	1,392,653	25.4	30.5	1.2	26.1		435
Production System								
Agro-pastoral/ extensive grassland								
Sex								
Female	—	—	—	—	—	—		—
Male	—	—	—	—	—	—		—
Age								
15-29 years	—	—	—	—	—	—		—
30+ years	—	—	—	—	—	—		—
Smallholder mixed livestock-crop								
Sex							n/s	
Female	19,059,744.6	695,380.4	27.4	30.2	1.1	27.3		235
Male	15,548,446.2	677,833.0	22.9	29.8	1.3	23.9		197
Age							n/s	
15-29 years	4,190,508.9	183,996.0	22.8	27.3	1.2	25.4		57
30+ years	30,427,422.5	1,200,292.8	25.4	30.4	1.2	25.8		375
Urban/peri-urban								
Sex								
Female	—	—	—	—	—	—		—
Male	—	—	—	—	—	—		
Age								

Background characteristic	Herd size-weighted			Average per farmer				Number of dairy farmers with milking cows (*n*)
	Production (liters)	Units of production (number of milking cows)	Yield (liters/number of milking cows in herd)	Production (liters)	Units of production (number of milking cows)	Yield (liters/number of milking cows in herd)	Sig.[a]	
15-29 years	—	—	—	—	—	—		—
30+ years	—	—	—	—	—	—		—
Intensive industrial								
Sex								
Female	—	—	—	—	—	—		—
Male	—	—	—	—	—	—		—
Age								
15-29 years	—	—	—	—	—	—		—
30+ years	—	—	—	—	—	—		—

— = Data are not available

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for raising dairy cows. Data for dairy cow yield was collected for one day. To convert it monthly, the daily yield was multiplied by a factor of 30.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

7.4 Looking across rice, fishponds, and dairy cows

This section examines farmers' use of improved management practices and technologies promoted by Feed the Future in the Bangladesh ZOI across all targeted value chains—rice, fishponds, and dairy cows.

Table 7.4.1 shows the percentage of targeted VCC farmers in the ZOI who applied one or more improved management practice or technology promoted by the Bangladesh mission during the 12 months preceding the ZOI Survey. The table also includes the percentage of targeted VCC farmers in the ZOI who used promoted improved management practices and technologies by category.

Most (94.5 percent) targeted VCC farmers in the ZOI applied at least one improved management practice or technology. Among 1,935 targeted VCC farmers, the most common improved management practices and technologies include livestock management (50.4 percent), more so among female (60.3 percent) than male farmers (48.6 percent), a difference that is statistically significant at the 1 percent level; soil-related fertility and conservation (39.7 percent), with a higher proportion among male farmers than female farmers (43.2 percent and 20.9 percent, respectively), a difference that is statistically significant at the 0.1 percent level; and farmers 15-29 years of age compared with farmers 30+ years of age, a difference statistically significant at the 5 percent level; and aquaculture management (31.5 percent), with no statistically significant differences by farmers' age or sex.

Table 7.4.1: Percentage of Targeted Value Chain Commodity Farmers in the ZOI Who Applied One or More Promoted Improved Management Practices and Technologies by Category, in Total and by Farmers' Sex and Age

		Sex			Age (years)		
Category	Total (%)	Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Across all categories	93.6	96.7	92.4	***	92.0	93.9	n/s
Crop genetics[b]	6.5	3.1	7.8	***	5.0	6.8	n/s
Cultural practices[c]	2.7	0.6	3.5	***	1.7	2.9	n/s
Natural resource or ecosystem management[d]	—	—	—	—	—	—	—
Pest and disease management[e]	18.6	4.6	23.8	***	18.2	18.6	n/s
Soil-related fertility and conservation[f]	34.4	10.4	43.5	***	36.7	33.9	*
Irrigation[g]	0.7	0.2	0.9	n/s	0.7	0.7	n/s
Water management, non-irrigation-based[h]	—	—	—	—	—	—	—
Climate adaptation or climate risk management[i]	—	—	—	—	—	—	—
Post-harvest, handling and storage[j]	—	—	—	—	—	—	—
Marketing and distribution[k]	29.8	7.8	38.2	***	28.7	30.1	n/s
Value-added processing[l]	—	—	—	—	—	—	—
Aquaculture management[m]	23.2	9.7	28.3	***	13.9	25.2	n/s
Livestock management[n]	36.5	75.9	21.5	***	32.8	37.3	n/s
Other[o]	31.3	10.5	39.1	***	33.1	30.9	n/s
Number of targeted value chain commodity farmers (*n*)	**2,313**	**633**	**1,680**		**401**	**1,912**	

— = Data are not available

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Use of some specified varieties of HYV, Hybrid and fine rice promoted by Feed the Future Bangladesh.

[c] Seeds are planted in rows or some in rows and some randomly broadcast

[d] No promoted practices by Feed the Future Bangladesh in this category

[e] Use of herbicide

[f] Use of organic/compost fertilizer and micronutrients (Zinc, Gypsum)

[g] Use of Axial Flow Pumps

[h] No promoted practices by Feed the Future Bangladesh in this category

[i] No promoted practices by Feed the Future Bangladesh in this category.

[j] No promoted practices by Feed the Future Bangladesh in this category

[k] Sold from homestead and procurement hub (markets)

[l] No promoted practices by Feed the Future Bangladesh in this category

[m] Use of improved fingerlings, improved feed and feeding practices, fish health and disease control, improved pond culture, pond preparation, sampling and harvesting

[n] Use of improved livestock breeds, livestock health services and products, improved livestock handling practices and housing, improved feeding practices, improved waste management practices, improved use of fodder crops

[o] Use of combined harvester, transplanter, access to finance through agent banking/micro merchants among rice farmers

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice or raising fish or dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 7.4.2 shows the percent distribution of targeted VCC farmers in the ZOI who used promoted improved management practices and technologies by the number used.

Most targeted VCC farmers in the ZOI (93.2 percent) employ between one and five promoted improved management practices and technologies. The percent distribution of targeted VCC farmers who apply these improved management practices or technologies decreases as the number of technologies increases, from 45.3 percent who use one technology or practice to only 2.0 percent who use five. Farmers' sex has an effect on the number of promoted improved practices or technologies used, and differences by farmers' sex are statistically significant at the 0.1 percent level. Although the proportion of female farmers who apply one technology is nearly three-times higher than male farmers (82.1 percent and 31.4 percent, respectively), there is a higher proportion of male farmers who apply two or more technologies. Farmers' age is associated with the number of promoted improved practices or technologies used in the ZOI and this difference is statistically significant at the 5 percent level

Table 7.4.2: Percent Distribution of Targeted Value Chain Commodity Farmers by Number of Promoted Improved Management Practices and Technologies Used in the ZOI, in Total and by Farmers' Sex and Age

Promoted improved practice or technology	Total (%)	Sex			Age (years)		
		Female (%)	Male (%)	Sig.[a]	15-29 (%)	30+ (%)	Sig.[a]
Number used				***			*
0	6.4	3.3	7.6		8.0	6.1	
1	45.3	82.1	31.4		45.4	45.3	
2	20.5	7.0	25.6		23.0	19.9	
3	16.7	4.8	21.2		16.3	16.8	
4	8.7	2.4	11.1		6.1	9.2	
5	2.0	0.2	2.7		1.3	2.2	
6	0.3	0.3	0.4		0.0	0.4	
7	0.0	0.0	0.1		0.0	0.1	
8+	0.0	0.0	0.0		0.0	0.0	
Number of targeted value chain commodity farmers (*n*)	**2,313**	**633**	**1,680**		**401**	**1,912**	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members who are farmers responsible for cultivating rice or raising fish or dairy cows.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

8 FOOD INSECURITY AND DIETARY INTAKE

This chapter presents findings related to household food insecurity in the ZOI as well as women's and young children's dietary intake. The food insecurity and dietary indicators complement each other; when used together, they offer a more comprehensive understanding of causes and consequences of food insecurity in the ZOI.

8.1 Food insecurity

The experience of food insecurity is characterized by uncertainty and anxiety regarding food access and changes in the *quality* of the diet (i.e., less balanced and more monotonous diets). As food insecurity becomes severe, the *quantity* of food consumed by the household decreases as the portion sizes are reduced and meals are skipped, and when food insecurity is most severe, individuals are forced to go without eating. Research shows that the experience of food insecurity appears to be common across cultures.[125]

For the ZOI surveys, the prevalence of moderate and severe food insecurity indicator is based on the FIES, which measures the percentage of individuals in the population that experienced food insecurity at moderate or severe levels during the 12 months preceding the survey. FIES is a scale established by the United Nations' Food and Agriculture Organization that is used to estimate the probability that each household (or individual) belongs to a specific category of food insecurity severity.[126,127,128] The difficulty in accessing food due to *lack of money or other resources* is measured from answers to a set of eight questions that covers a range of severity of food insecurity in the 12 months preceding the survey.

The dietary intake indicators should be measured when food supplies are still adequate (i.e., approximately up to 4-5 months post-harvest). Data collection for the survey took place from November-February, representing the post-harvest season for aman rice in Bangladesh.

Bangladesh has progressed well in reducing food insecurity. The growth in overall food production has been staying ahead of population growth resulting in higher per capita availability of food over time. In the early 1970s, Bangladesh was a food-deficit country with a population of about 75 million. Today, the population is 165 million, and the country is now self-sufficient in rice production, which has tripled over the past three decades. Bangladesh has also made tremendous progress in fish production, registering an average annual growth rate of 6.2 percent in four years from 2015/2016 to 2018/2019. The livestock subsector experienced a growth rate of 3.4 percent over the same period.[129] However, there are still shortfalls in the production of certain non-rice crops such as pulses, vegetables, and fruits.

Along with food availability, peoples' access to food has also improved, including the poor, as poverty and food insecurity are interlinked. Bangladesh's average annual GDP growth rate of 6.1 percent from 2000 to 2016 contributed to the reduction in the rate of poverty from 48.9 percent to 24.3 percent

[125] Coates et al. (2006)
[126] FAO (2019)
[127] Cafiero, Viviani, & Nord (2018)
[128] Ballard et al. (2013)
[129] FPMU (2020)

during the same period.[130] With 1.2 percent annual population growth, per capita income increased steadily by 4.9 percent per year and increased income has improved access to food. According to the Household Income and Expenditure Survey (HIES), per capita food consumption has increased from 893 grams in 2000 to 914 grams in 2016.[131] Most significantly, real wages in Bangladesh have accelerated in recent years. As more workers have shifted to the formal sector and other non-farm jobs, labor in rural areas has become scarcer, bidding up rural real wages and thereby enhancing total labor earnings.[132] On average, the daily wage of a male agricultural laborer could buy 5.4 kg of rice in 2005. In 2019, it could buy 13.3 kg of rice.

Food utilization—the other dimension of food security—is closely related to nutrition, and there has been significant progress in nutritional outcomes as well. A cross-country study concluded that from 1997 to 2007, Bangladesh had recorded one of the fastest prolonged reductions in child underweight and stunting prevalence in recorded history.[133] The rate of stunting (low height-for-age) among children under five, which reflects the state of chronic undernutrition, has decreased from 55 percent in 1997 to 31 percent in 2017.[134]

Table 8.1.1 presents estimates of food insecurity in the ZOI population, as well as by household characteristics, including gendered household type, educational attainment, wealth quintile, poverty status, and severity of shock exposure.

Across the ZOI population, 7.9 percent of all households experienced moderate or severe hunger. When disaggregated by gendered household type, more households with female adults only experienced moderate or severe hunger (9.5 percent) compared with households with both male and female adults (7.7 percent).

When disaggregated by educational attainment of the household, there is a clear inverse relationship between education and food insecurity. The prevalence of moderate and severe food insecurity for households with no education is 13.8 percent, which is much higher than 4.6 percent in households with higher educational attainment.

When disaggregated by wealth status, there is also an overall inverse relationship between wealth and food insecurity. The prevalence of moderate or severe food insecurity is 15.7 percent in households in the lowest wealth quintile and 1.9 percent in households in the highest quintile. This divergent pattern is also reflected in the disaggregation by poverty status, where 17.3 percent of poor households experienced moderate or severe food insecurity in contrast to 6.8 percent of non-poor households.

When disaggregated by SEI, households with low SEI are less likely to experience moderate or severe food insecurity (4.6 percent) compared with those with moderate SEI (14.6 percent) or severe SEI (20.4

[130] BBS (2019)
[131] BBS (2019)
[132] Zhang et al. (2014)
[133] Headey (2013)
[134] Osmani et al. (2016); NIPORT (2020)

percent). This indicates that households that have faced more number shocks and/or faced more severe shocks are also likely to have experienced food insecurity.

Table 8.1.1: Prevalence of Food Insecurity in the ZOI Population by Severity, in Total and by Selected Household Characteristics

Household characteristic	Little to no (%)	Moderate (%)	Severe (%)	Moderate or severe (%)	Sig.[a]	Number of households 176 (*n*)[b]
All households	92.1	7.0	0.9	7.9		2,525
Gendered household type					n/s	
Male and female adults	92.3	6.9	0.8	7.7		2,222
Female adults only	90.5	8.1	1.4	9.5		296
Male adults only	^	^	^	^		^
Children only (no adults)	^	^	^	^		^
Household education					***	
No education	86.2	11.4	2.3	13.8		146
Less than primary	86.1	12.1	1.8	13.9		265
Completed primary	92.0	7.2	0.8	8.0		1,368
Completed secondary	94.3	5.1	0.6	5.7		354
Higher	95.4	4.1	0.6	4.6		392
Wealth quintile					***	
Highest (wealthiest)	98.1	1.8	0.1	1.9		493
Fourth	93.8	5.5	0.7	6.2		486
Middle	94.2	5.5	0.3	5.8		503
Second	90.3	8.4	1.3	9.7		511
Lowest (poorest)	84.3	13.9	1.9	15.7		532
Poverty status					***	
Poor	82.7	15.1	2.2	17.3		223
Non-poor	93.2	6.1	0.7	6.8		2,302
Shock exposure index					***	
Did not experience any shocks	96.5	3.2	0.3	3.5		1,263
Low	95.4	4.3	0.3	4.6		480
Moderate	85.4	12.7	1.8	14.6		494
High	79.6	17.8	2.6	20.4		288

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

Note: Indicator estimates and disaggregate categories based on individual household members (i.e., gendered household type, household education, and wealth quintile) are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 8.1.2 presents estimates of food insecurity in the ZOI population by agriculture-related household characteristics, including household ownership of agricultural land, ownership of livestock, and cultivation of targeted crop commodities.

Households that own agricultural land (less than 5 hectares) are 56.6 percent less likely to experience moderate or severe hunger compared with households with no agricultural land. This shows that agricultural land is a very important asset that can drastically reduce the likelihood of food insecurity.

Disaggregation by livestock and fishponds ownership shows that households that own at least one selected livestock (cows/bulls or goats/sheep or chickens or fishponds) are less likely to experience moderate or severe food insecurity compared with households that do not own any selected livestock or fishponds. Owning cows or bulls is associated with lower levels of moderate or severe food insecurity prevalence (5.6 percent) compared with owning goats or sheep (7.3 percent) or chickens (7.4 percent).

Households that produce rice are also much less likely to experience moderate or severe food insecurity (5.3 percent) compared with households that do not produce rice (11.6 percent). This is not surprising as rice is the most important staple crop for Bangladesh.

Table 8.1.2: Prevalence of Food Insecurity in the ZOI Population by Severity, in Total and by Selected Household Agricultural Characteristics

				Moderate or severe				
				Household has characteristic		Household does not have characteristic		
Household characteristic	Little to no (%)	Moderate (%)	Severe (%)	(%)	Unweighted population totals (*n*)[b]	(%)	Unweighted population totals (*n*)[b]	Sig.[a]
All households	92.1	7.0	0.9	7.9	199	92.1	2,326	
Household ownership of agricultural land								
None	90.1	8.7	1.2	9.9	1,640	4.3	885	
Less than 5 hectares	95.7	4.1	0.2	4.3	884	9.9	1,641	
5-9 hectares	^	^	^	^	1	^	2,524	
10 or more hectares	^	^	^	^	0	^	0	
Household ownership of livestock/fishponds[c]								
At least one type of livestock[d]	92.7	6.6	0.8	7.3	2,268	13.5	257	***
Cows or bulls	94.4	5.3	0.4	5.6	1,144	9.9	1,381	***
Goats or sheep	92.7	6.6	0.7	7.3	882	8.2	1,643	n/s
Chickens	92.6	6.6	0.7	7.4	2,004	10.1	521	***
Fishponds	92.8	6.5	0.7	7.2	548	8.1	1977	n/s
Household crop VCC production								
None	88.4	10.0	1.6	11.6	1,119	5.3	1,406	***
Rice	94.7	4.9	0.3	5.3	1,406	11.6	1,119	***

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] Sub-categories will not sum to 100 percent because a household may have owned multiple types of livestock or produced multiple VCCs.

[d] None means that the household does not own any of the livestock animals or fishponds included in the table—that is, cows or bulls, goats, sheep, chickens or fishponds—but may own other livestock animals including other cattle, horses, mules or donkeys.

Note: Estimates are based on de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

8.2 Women's minimum dietary diversity

This section presents information on the dietary diversity of women of reproductive age in the ZOI.

Women of reproductive age (15-49 years) are at risk of multiple micronutrient deficiencies, which can jeopardize their health and their ability to care for their children and participate in income-generating activities.[135] The Feed the Future women's dietary diversity indicator is a proxy for the micronutrient adequacy of women's diets. The dietary diversity indicator reports the mean number of food groups consumed in the previous day by women of reproductive age.

The women's minimum dietary diversity indicator uses the following 10 food groups: (1) grains, roots, and tubers; (2) legumes and beans; (3) nuts and seeds; (4) dairy products; (5) eggs; (6) flesh foods, including organ meat and miscellaneous small animal protein; (7) vitamin A-rich dark green leafy vegetables; (8) other vitamin A-rich vegetables and fruits; (9) other fruits; and (10) other vegetables. Achievement of women's minimum dietary diversity is defined as having consumed foods from at least 5 of the 10 food groups in the 24 hours preceding the survey. Thus, this indicator is a dichotomous variable, and the measure is reported as the percentage of women who achieve a minimum dietary diversity.

Table 8.2.1 shows the percentage of all women of reproductive age in the ZOI who have achieved minimum dietary diversity by individual-level and household-level characteristics. Household-level characteristics include gendered household type, wealth quintile, poverty status, and severity of shock exposure. Individual-level characteristics include women's age, educational attainment, and pregnancy status. Note that, as this table focuses on women of reproductive age, information on child-headed households is not applicable.

More than half of women 15-49 years of age achieve minimum dietary diversity in the ZOI, ranging from 61.9 percent to 69.6 percent by age group. However, there is no consistent relationship between age and minimum dietary diversity. Women with higher than secondary educational attainment demonstrate the highest achievement in minimum dietary diversity. However, other education categories, such as no education, less than primary, completed primary, and completed secondary do not show any pattern. Pregnant women show greater achievement of the minimum dietary diversity. Women belonging to households with both male and female adults (66.0 percent) have slightly higher achievements in minimum dietary diversity compared with female adult households (63.0 percent), yet this difference is not statistically significant. However, wealth quintile and poverty status both have a strong effect on minimum dietary diversity among women of reproductive age, which is statistically significant at the 0.1 percent level. Specifically, the percentage of women achieving minimum dietary diversity gradually increases by wealth quintile, from 49.8 percent among the poorest households to 79.5 percent among the wealthiest households. Reinforcing this finding, 68.0 percent of women of reproductive age in non-poor households achieved minimum dietary diversity compared with only 46.8 percent of poor

[135] Darnton-Hill et al. (2005)

households. Conversely, women's achievement in minimum dietary diversity is not statistically associated with shock exposure.

Table 8.2.1: Percent of Women of Reproductive Age in the ZOI Achieving Minimum Dietary Diversity, in Total and by Selected Woman and Household Characteristics

Characteristic	Percent	Sig.[a]	Number of women (*n*)[b]
All women of reproductive age	65.7		2,758
Age		n/s	
15-19	69.6		463
20-24	62.1		447
25-29	69.4		416
30-34	64.5		419
35-39	64.3		383
40-44	61.9		297
45-49	66.9		333
Education		**	
No education	62.5		517
Less than primary	58.1		355
Completed primary	67.3		1,456
Completed secondary	65.1		235
Higher	76.3		195
Pregnancy status[c]		n/s	
Pregnant	69.1		101
Not pregnant	65.6		2,656
Gendered household type		n/s	
Male and female adults	66.0		2,437
Female adults only	63.0		315
Male adults only	^		5
Children only (no adults)	n/a		n/a
Wealth quintile		***	
Highest (wealthiest)	79.5		510
Fourth	74.5		541
Middle	64.4		570
Second	66.4		576
Lowest (poorest)	49.8		560
Poverty status		***	
Poor	46.8		253
Non-poor	68.0		2,504
Shock exposure index		n/s	
Did not experience any shocks	64.8		1,384
Low	68.7		504
Moderate	64.1		544
High	67.7		325

n/a=not applicable

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] Validated cut-offs for adequate dietary diversity for pregnant women do not exist. These estimates reflect the established adequate dietary diversity cut-off for women of reproductive age generally.

Note:
Indicator estimates and the gendered household type disaggregate are based on de facto household members.
The wealth quintile and poverty status disaggregates are calculated using de jure household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 8.2.2 shows the percentage of all women of reproductive age in the ZOI who have achieved minimum dietary diversity by household-level agricultural characteristics. Household-level agricultural characteristics include ownership of agricultural land, and ownership of livestock, and cultivation of targeted crop commodities.

Women's achievement of minimum dietary diversity is higher for households that own some agricultural land than those without agricultural land (70.2 percent and 63.1 percent, respectively). Similarly, 68.3 percent of women belonging to rice-producing households show greater achievement of dietary diversity compared with only 62.0 percent of women belonging to non-rice producing households. The difference is statistically significant at 0.1 percent level. However, 66.8 percent of women who belong to households that own chickens show greater achievement of minimum dietary diversity compared with women belonging to households that own cows or bulls or goats or sheep and fish (66.8 percent, 63.2 percent, and 64.6 percent, respectively). However, this is not statistically significant.

Table 8.2.2: Percent of Women of Reproductive Age in the ZOI Achieving Minimum Dietary Diversity, in Total and by Selected Household Agricultural Characteristics

Household characteristic	Percent	Sig.[a]	Number of women (*n*)[b]
Household ownership of agricultural land		***	
None	63.1		1,775
Less than 5 hectares	70.2		982
5-9 hectares	^		1
10 or more hectares	^		0
Household ownership of livestock/fishponds[c]			
None[d]	64.4	n/s	257
Cows or bulls	66.8	n/s	1,144
Goats or sheep	63.2	n/s	882
Chickens	66.8	n/s	2,004
Fish	64.6	n/s	548
Household crop value chain commodity production[c]		***	
None	62.0		1,202
Rice	68.3		1,556

^ Results not statistically reliable, n<30
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.
[c] Sub-categories will not sum to 100 percent because a household may have owned multiple types of livestock or produced multiple targeted VCCs.
[d] None means that the household does not own any of the livestock animals included in the table—that is, cows or bulls, goats, sheep, or chickens—but may own other livestock animals including other cattle, horses, mules, donkeys, or fish.
Note: Indicator estimates are based on de facto household members.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

Table 8.2.3 shows the percentage of women 15-49 years of age who consumed each of the 10 food groups overall and by dietary diversity achievement status.

Women of reproductive age in the ZOI virtually all consume grains, roots and tubers (99.9 percent), other vegetables (96.9 percent), and other vitamin-A rich vegetables and fruits (90.2 percent). Among the 10 food groups, the least consumed food groups are nuts (0.9 percent), dairy products (10.7 percent), other fruits (19.3 percent), and eggs (20.3 percent). More than half of women do not consume legumes and vitamin A-rich dark green leafy vegetables.

More women of reproductive age who achieved minimum dietary diversity consumed different food groups than those who did not achieve minimum dietary diversity. Differences by food groups are statistically significant, except for the consumption of grains, roots and tubers.

Table 8.2.3: Percent of Women of Reproductive Age in the ZOI Who Consumed Foods in Each Food Group during the 24 Hours Preceding the Survey, in Total and by Achievement of Minimum Dietary Diversity Status

		Dietary diversity achievement status		
Food group	**Total**	**Achieved**	**Did not achieve**	**Sig.[a]**
Grains, roots, and tubers	99.9	100.0	99.7	n/s
Legumes and beans	36.2	48.2	13.2	***
Nuts and seeds	0.9	1.2	0.3	**
Dairy products	10.7	15.5	1.6	***
Meat and organ meats	79.7	86.6	66.5	***
Eggs	20.3	27.5	6.4	***
Vitamin A-rich dark green leafy vegetables	41.8	58.0	11.1	***
Other vitamin A-rich vegetables and fruits	90.2	97.4	76.4	***
Other fruits	19.3	26.8	5.1	***
Other vegetables	96.9	99.7	91.5	***
Number of women of reproductive age (*n*)	2,758	1,780	978	

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

8.3 Infant and young child feeding

This section presents young children's dietary intake measures, including the Feed the Future indicators of exclusive breastfeeding among children 0-5 months of age and the minimum acceptable diet among children 6-23 months of age.

8.3.1 Exclusive breastfeeding

Exclusive breastfeeding provides children with significant health and nutrition benefits, including protection from gastrointestinal infections and reduced risk of mortality due to infectious disease.[136] Exclusive breastfeeding means that the infant received breast milk (including expressed breast milk or breast milk from a wet nurse); the infant may also have received oral rehydration salts, vitamins, minerals, or medicines, but did not receive any other food or liquid. This indicator measures the percentage of children 0-5 months of age who were exclusively breastfed the day preceding the survey.

Table 8.3.1 shows the prevalence of exclusive breastfeeding among children 0-5 months of age in the ZOI. Estimates are shown for all children, as well as by child's sex, educational attainment of the child's primary caregiver, wealth quintile, household poverty status, and severity of shock exposure. Note that the data are collected from the self-identified primary caregiver and not strictly from the biological mother, although it is often the same person.

The proportion of children 0-5 months of age exclusively breastfed is 53.9 percent. There is a higher proportion of female children 0-5 months of age that is exclusively breastfed than male children (58.1 percent for female and 50.4 percent for male). Children belonging to a caregiver who has completed primary education have higher rates of exclusive breastfeeding than children belonging to caregivers who have completed less than primary education (54.0 percent versus 42.3 percent). Children in poorer households tend to be more exclusively breastfed than children living in relatively wealthier households. However, none of these differences are statistically significant. BDHS 2017/2018 did not collect data on poverty and shock exposure index; therefore, the prevalence of exclusive breastfeeding cannot be analyzed by these disaggregates.

[136] WHO (2018b)

Table 8.3.1: Prevalence of Exclusive Breastfeeding among Children 0-5 Months of Age in the ZOI, in Total and by Selected Child, Caregiver, and Household Characteristics

Characteristic	Percent	Sig.[a]	Number of children (*n*)[b]
All children 0-5 months of age	53.9		247
Child sex		n/s	
Male	50.4		139
Female	58.1		108
Caregiver education[c]		n/s	
No education	^		11
Less than primary	42.3		37
Completed primary	54.0		136
Completed secondary	^		17
Higher	48		46
Wealth quintile		n/s	
Highest (wealthiest)	46.6		37
Fourth	60.8		49
Middle	46.7		59
Second	57.4		49
Lowest (poorest)	56.4		53
Poverty status			
Poor	—		—
Non-poor	—		—
Shock exposure index			
Did not experience any shocks	—		—
Low	—		—
Moderate	—		—
High	—		—

— = Data are not available

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] The ZOI Survey identifies the primary caregiver of each age-eligible child. This person is likely, but not necessarily, the child's biological mother.

Notes:

Indicator estimates and the gendered household type disaggregate are based on de facto household members.
The wealth quintile and poverty status disaggregates are calculated using de jure household members.
Source: Bangladesh Demographic Health Survey (BDHS) 2017/2018

8.3.2 Minimum acceptable diet

Minimum acceptable diet (MAD) is one of the eight core indicators for assessing infant and young child feeding practices among children 6-23 months of age. The MAD indicator captures multiple dimensions of feeding, is calculated separately for breastfed and non-breastfed children, and includes information on two components—minimum dietary diversity (MDD) and minimum meal frequency.

The indicator is calculated by combining the MDD and minimum meal frequency information for breastfed and non-breastfed children 6-23 months of age. Children who meet both the MDD and the

minimum meal frequency criteria during the day preceding the survey are considered to meet the MAD criteria. Breastfed children 6-23 months of age must have consumed foods from at least 4 of 7 food groups[137] (MDD) and eaten solid, semi-solid, or soft foods at least 2 times if they were 6-8 months of age or at least 3 times if they were 9-23 months of age (minimum meal frequency). Non-breastfed children 6-23 months of age must have consumed foods from at least 4 of 6 food groups[138] (MDD), received at least 2 milk feedings, and eaten solid, semi-solid, or soft foods at least 4 times (minimum meal frequency). As recommended by WHO, the ZOI Survey disaggregates the indicator for the following age groups: 6-11 months, 12-17 months, and 18-23 months.[139]

Table 8.3.2 presents the MAD indicator for children 6-23 months in the ZOI. Estimates are shown for all children, as well as by child sex and age categories, primary caregiver's educational attainment, gendered household type, wealth quintile, poverty status, and severity of shock exposure.

More than one third (35.9 percent) of children 6-23 months of age receive an acceptable diet. There is a slightly higher proportion of female children that have a minimum acceptable diet compared to male children (females: 37.3 percent; males: 34.3 percent), although the difference is not statistically significant. Compared to younger children (6-17 month of age), older children (12-17 months and 18-23 months of age) are more likely to have a minimum acceptable diet, and the difference is statistically significant at the 0.1 percent. Caregiver education and household wealth status are positively associated with the achievement of minimum acceptable diet for children. Specifically, as caregiver education and household wealth increase, the achievement of acceptable diet increases. Wealth quintile is statistically significant at the 0.1 percent, whereas caregivers' education is significant at the 5 percent level. About half of children 6-23 months of age (51.4 percent) living in female adult only households achieve a minimum acceptable diet, which is higher than children living with male and female adults (34.5 percent). However, this difference is not statistically significant.

[137] The seven food groups for breastfed children are as follows: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) flesh foods (meat, fish, poultry, and liver or organ meats); (5) eggs; (6) vitamin-A rich fruits and vegetables; and (7) other fruits and vegetables.

[138] The six food groups for non-breastfed children are the same as for breastfed children, except that they exclude dairy products (milk, yogurt, cheese).

[139] WHO (2018c)

Table 8.3.2: Percent of Children 6-23 Months of Age in the ZOI Who Received a Minimum Acceptable Diet, in Total and by Selected Child, Caregiver, and Household Characteristics

Characteristic	Percent	Sig.[a]	Number of children (*n*)[b]
All children 6-23 months of age	35.9		562
Child sex		n/s	
Male	34.3		271
Female	37.3		291
Child age		***	
6-11 months	22.0		193
12-17 months	41.1		186
18-23 months	44.9		183
Child breastfeeding status		***	
Breastfed	36.8		542
Not breastfed	^		20
Caregiver education[c]		*	
No education	^		19
Less than primary	32.5		83
Completed primary	33.8		312
Completed secondary	48.6		33
Higher	46.3		115
Gendered household type		n/s	
Male and female adults	34.5		511
Female adults only	51.4		47
Male adults only	^		4
Children only (no adults)	^		0
Wealth quintile		***	
Highest (wealthiest)	61.5		76
Fourth	45.6		113
Middle	25.7		124
Second	33.7		128
Lowest (poorest)	27.6		121
Poverty status			
Poor	—		—
Non-poor	—		—
Shock exposure index			
Did not experience any shocks			
Low	—		—
Moderate	—		—
High	—		—

— = Data are not available.
^ Results not statistically reliable, n<30
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.
[c] The ZOI Survey identifies the primary caregiver of each age-eligible child. This person is likely, but not necessarily, the child's biological mother.
Notes:
Indicator estimates and the gendered household type disaggregate are based on de facto household members.
The wealth quintile and poverty status disaggregates are calculated using de jure household members.
Source: Bangladesh Demographic and Health Survey (BDHS) 2017/2018

Table 8.3.3 presents the percentage of children achieving the components of a MAD (i.e., minimum meal frequency and minimum dietary diversity) and consuming each of the food groups included in the minimum dietary diversity indicator. Estimates are shown for all children, as well as by age categories, and are presented separately for breastfed and non-breastfed children.

The proportion of achieving minimum meal frequency and minimum dietary diversity for children 6-23 months of age is 83.0 percent and 37.4 percent, respectively. Achievement of minimum meal frequency and minimum dietary diversity increases with children's age, but there is only a statistically significant difference for minimum dietary diversity at the 0.1 percent level. By 18-23 months of age almost all children consume grains, roots, and tubers in the preceding 24 hours. The difference between age groups in the consumption of grains, roots and tubers is statistically significant at the 0.1 percent level. Children tend to consume less legumes and nuts than other food groups. The intake of dairy products is higher among children 6-11 months of age (34.2 percent) compared to older children 12-23 months of age, but the consumption of other food groups (flesh foods, eggs, vitamin a rich fruits and vegetables and other fruits and vegetables) is higher among older children 12-23 months of age compared with children 6-11 months of age. The difference for flesh foods and vitamin a rich fruits and vegetables is statistically significant at the 0.1 percent level, and it is significant at the 5 percent level for eggs and other fruits and vegetables.

Similar to all children 6-23 months of age, minimum meal frequency and minimum dietary diversity for breastfed children increases with children's age. The difference for minimum meal frequency is statistically significant at the 5 percent level, whereas it is statistically significant at the 0.1 percent level for minimum dietary diversity. Intake of all other food groups except dairy products is higher among older children 12-23 months of age compared to the younger children 6-11 months of age. The differences for grains, roots and tubers, flesh foods, and vitamin A-rich fruits and vegetables are statistically significant at the 0.1 percent level, and significant at the 5 percent level for eggs and other fruits and vegetables.

Table 8.3.3: Percent of Children 6-23 Months of Age in the ZOI Achieving Minimum Feeding Frequency, Dietary Diversity, and Consuming Foods from Each of the Food Groups in the Minimum Acceptable Diet Indicator, in Total and by Breastfeeding Status and Age

Breastfeeding status and food group consumed	All children	Child age (months)			
		6-11	12-17	18-23	Sig.[a]
All children 6-23 months of age					
Achieving minimum meal frequency	83.0	77.4	86.0	85.9	n/s
Achieving minimum dietary diversity	37.4	23.4	41.9	47.4	***
Consuming:					
Grains, roots, and tubers	91.1	80.7	95.3	97.5	***
Legumes and nuts	18.7	10.8	28.2	17.5	n/s
Dairy products	30.8	34.2	27.4	30.7	n/s
Flesh foods[b]	55.6	36.3	60.4	70.6	***
Eggs	47.8	38.4	52.2	53.0	*
Vitamin A-rich fruits and vegetables	36.5	19.8	42.6	47.7	***
Other fruits and vegetables	26.3	18.3	30.3	30.4	*
Number of children (*n*)	**562**	**193**	**186**	**183**	

Breastfeeding status and food group consumed	All children	Child age (months)			
		6-11	12-17	18-23	Sig.[a]
Breastfed children					
Achieving minimum meal frequency	83.9	77.7	87.0	87.5	*
Achieving minimum dietary diversity	38.1	23.5	42.8	48.8	***
Consuming:					
Grains, roots, and tubers	90.8	80.6	95.1	97.4	***
Legumes and nuts	18.5	10.8	28.0	17.4	n/s
Dairy products	29.8	33.8	26.4	29.0	n/s
Flesh foods[b]	55.0	35.9	60.3	70.0	***
Eggs	47.9	38.4	52.7	53.1	*
Vitamin A-rich fruits and vegetables	36.9	19.9	42.2	49.5	***
Other fruits and vegetables	26.0	18.0	30.4	30.1	*
Number of breastfed children (*n*)	542	191	177	174	
Non-breastfed children					
Achieving minimum meal frequency	^	^	^	^	n/a
Achieving minimum milk feeding frequency	^	^	^	^	n/a
Achieving minimum dietary diversity	^	^	^	^	n/a
Consuming:					
Grains, roots, and tubers	^	^	^	^	n/a
Legumes and nuts	^	^	^	^	n/a
Dairy products	^	^	^	^	n/a
Flesh foods[a]	^	^	^	^	n/a
Eggs	^	^	^	^	n/a
Vitamin A-rich fruits and vegetables	^	^	^	^	n/a
Other fruits and vegetables	^	^	^	^	n/a
Number of non-breastfed children (*n*)	**20**	**2**	**9**	**9**	

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] This category may include organ meats and insects.

Note: Indicator estimates are based on de facto household members.

Source: Bangladesh Demographic and Health Survey (BDHS) 2017/2018

9 NUTRITIONAL STATUS OF WOMEN AND CHILDREN

This chapter presents findings for the Feed the Future ZOI indicators related to the nutrition of women and children: the percentage of women of reproductive age who are underweight, and the percentages of children under 5 years of age who are stunted or wasted, and who are of healthy weight.

9.1 Body mass index of women age 15-49 years

Body mass index (BMI) is a calculation used to understand nutritional status, particularly of adults. BMI is the weight of the individual in kilograms divided by his or her height in meters squared (weight [kg]/ height $[m]^2$). BMI is an inexpensive and easy-to-perform method of screening for weight category: underweight, normal or healthy weight, overweight, and obese. BMI is interpreted directly using categories with specific cut-off points, which is useful when assessing the nutritional status of adults. A high BMI can be an indicator of high body fat, but BMI is not a diagnostic for body fat or the health of an individual. To determine whether a high BMI is a health risk, a healthcare provider would need to perform further assessments.

Table 9.1 presents women's mean BMI and the percentage of women who fall into each BMI category: underweight (BMI<18.5), normal weight (18.5≤BMI<25.0), overweight (25.0≤BMI<30.0), and obese (BMI≥30.0). Estimates are shown for all non-pregnant women of reproductive age (15-49 years of age), as well as disaggregated by individual- and household-level characteristics. Individual characteristics include age and educational attainment. Household characteristics include gendered household type, household educational attainment, and wealth quintile.

In the Bangladesh ZOI, 10.9 percent of women 15-49 years of age are underweight. The highest proportions of underweight women are among women 15-19 years (22.0 percent), illiterate women (12.3 percent), and women living in the least wealthy households (16.1 percent). The difference is statistically significant at the 0.1 percent for women's age and household wealth status, and it is significant at the 5 percent level for education. However, the rate of overweight and obesity is 26.3 percent and 6.4 percent, respectively. Overweight and obesity are higher among older women compared to younger women. Women 45-49 years of age have the highest rate of obesity among all age groups within the 15-49-year age range (9.9 percent). There is a higher prevalence of overweight and obesity among women with higher educational attainment and among those living in the wealthiest households. Also, women living in male and female adult households have a slightly higher rate of obesity compared to women living in households with female adults only.

More than half of women in the ZOI (56.5 percent) are considered normal weight. Normal weight is higher among younger women and women from the least wealthy households compared to women belonging to older age groups and women from wealthier households.

BDHS 2017/2018 did not collect data on poverty and shock exposure; therefore, women's BMI cannot be analyzed by these disaggregates.

Table 9.1: Mean BMI and Prevalence of Underweight, Normal Weight, Overweight, and Obese Women of Reproductive Age in the ZOI, in Total and by Selected Woman and Household Characteristics

Characteristic	Mean BMI	BMI category					Number of women (*n*)[b]
		Underweight (%)	Sig.[a]	Normal weight (%)	Over-weight (%)	Obese (%)	
All non-pregnant women of reproductive age	23.4	10.9		56.5	26.3	6.4	4,907
Age			***				
15-19	21.1	22.0		66.5	10.5	1.0	448
20-24	22.4	15.6		61.4	19.4	3.7	749
25-29	23.6	9.3		56.9	27.1	6.7	778
30-34	23.9	7.3		54.6	30.6	7.5	842
35-39	24.0	6.9		54.5	32.0	6.6	803
40-44	23.9	10.5		50.6	31.3	7.6	653
45-49	24.0	9.1		53.6	27.4	9.9	634
Education			*				
No education	23.0	12.3		58.1	24.6	4.9	581
Less than primary	23.2	12.0		57.0	25.1	5.9	1,081
Completed primary	23.4	10.8		56.8	26.4	6.0	2,291
Completed secondary	24.2	5.2		59.3	27.4	8.1	232
Higher	24.1	9.5		51.3	29.7	9.5	722
Gendered household type			n/s				
Male and female adults	23.4	11.0		56.2	26.3	6.5	4,453
Female adults only	23.3	9.3		58.8	26.5	5.4	444
Male adults only	^	^		^	^	^	10
Children only (no adults)	^	^		^	^	^	0
Wealth quintile			***				
Highest (wealthiest)	25.8	5.2		38.4	39.6	16.7	846
Fourth	24.2	6.6		53.8	30.6	9.0	1,015
Middle	23.2	10.7		58.4	25.7	5.2	1,117
Second	22.6	13.8		60.1	22.9	3.2	1,023
Lowest (poorest)	21.9	16.1		65.2	17.0	1.6	906
Poverty status							
Poor	—	—	—	—	—	—	—
Non-poor	—	—	—	—	—	—	—
Shock exposure index							
Did not experience any shocks	—	—	—	—	—	—	—
Low	—	—	—	—	—	—	—
Moderate	—	—	—	—	—	—	—
High	—	—	—	—	—	—	—

— = Data are not available

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

Notes:

Indicator estimates and the gendered household type disaggregate are based on de facto household members.
The wealth quintile and poverty status disaggregates are calculated using de jure household members.
Source: Bangladesh Demographic and Health Survey (BDHS) 2017/2018

9.2 Stunting, wasting, and healthy weight among children under 5 years of age

This section reports on three anthropometric measurements of nutrition among children under 5 years of age in the ZOI: stunting (low height-for-age), wasting (low weight-for-height), and healthy weight (appropriate weight-for-height) children.

9.2.1 Stunting (low height-for-age)

Stunting, or linear growth retardation, is a consequence of an inadequate growth environment. Reducing the prevalence of stunting among children, particularly children 0–23 months of age, is important because linear growth retardation is causally linked to difficult birth and poor birth outcomes, and is associated with—but may not cause—delayed child development, reduced earnings in adulthood, and chronic diseases.[140] Stunting is a height-for-age measurement that reflects chronic undernutrition. This indicator measures the percentage of children 0-59 months of age with a height-for-age z-score more than two standard deviations (SDs) below the median of the 2006 WHO Child Growth Standard.[141]

Table 9.2.1 shows the prevalence of severe stunting (<-3 SD) and stunting (<-2 SD) and mean height-for-age z-scores for children under 5 years of age in the ZOI. Estimates are presented for all children and by child, caregiver, and household characteristics. Children's characteristics include sex and age. Caregivers' characteristics include educational attainment. Household characteristics include gendered household type, and wealth quintile.

The proportion of severe stunting and stunting among children 0-59 months of age is 7.0 percent and 27.4 percent, respectively. The mean height for age z-score is -1.3. There are higher proportions of female children that are severely stunted and stunted than male children. The difference between males and females in the prevalence of stunting is not statistically significant. Disaggregated by age groups, children 12-23 months of age have the highest rate of severe stunting (10.5 percent) and stunting (34.6 percent) compared to the other age groups. Severely stunted children are higher in male and female adult households than female adult only households (7.1 percent for male and female adults and 4.8 percent male adults only). Caregiver education and household wealth status are inversely associated with the reduction of stunting. Stunting is lowest among children living with caregivers with higher educational attainment and in the wealthiest households, whereas it is the highest among children living with less educated caregivers and in the least wealthy households. Differences by caregivers' education and wealth quintile are statistically significant at the 0.1 percent level.

BDHS 2017/2018 did not collect data on poverty and shock exposure; therefore, stunting cannot be analyzed by these disaggregates.

[140] Leroy & Frongillo (2019)
[141] WHO (2006)

Table 9.2.1: Prevalence of Stunting and Mean Height-for-Age Z-scores among Children under 5 Years of Age in the ZOI, in Total and by Selected Child, Caregiver, and Household Characteristics

Characteristic	Severely stunted (<−3 SD) (%)	Stunted (<−2 SD) (%)	Sig.[a]	Mean z-score	Number of children (*n*)[b]
All children under 5 years of age	7.0	27.4		-1.3	1,857
Child sex			n/s		
Male	6.0	25.9		-1.2	954
Female	8.0	28.9		-1.4	903
Child age			n/s		
0-11 months	6.1	19.5		-1.0	431
12-23 months	10.5	34.6		-1.4	373
24-35 months	7.5	32.5		-1.5	349
36-47 months	5.6	23.9		-1.3	321
48-59 months	5.1	27.3		-1.4	383
Caregiver education[c]			***		
No education	12.2	45.2		-1.7	77
Less than primary	9.9	34.1		-1.6	283
Completed primary	7.2	29.2		-1.4	1,037
Completed secondary	6.2	25.3		-1.3	104
Higher	2.3	10.8		-0.7	356
Gendered household type			n/s		
Male and female adults	7.1	27.2		-1.3	1,679
Female adults only	4.8	28.3		-1.3	169
Male adults only	^	^		^	9
Children only (no adults)	^	^		^	0
Wealth quintile			***		
Highest (wealthiest)	3.3	14.2		-0.8	283
Fourth	5.6	18.7		-1.1	358
Middle	6.2	26.5		-1.3	398
Second	10.2	33.5		-1.5	403
Lowest (poorest)	7.4	35.9		-1.5	415
Poverty status					
Poor	—	—		—	—
Non-poor	—	—		—	—
Shock exposure index					
Did not experience any shocks					
Low	—	—		—	—
Moderate	—	—		—	—
High	—	—		—	—

— = Data are not available

^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] The ZOI Survey identifies the primary caregiver of each age-eligible child. This person is likely, but not necessarily, the child's biological mother.

Notes:
Indicator estimates and the gendered household type disaggregate are based on de facto household members.
The wealth quintile and poverty status disaggregates are calculated using de jure household members.
Source: Bangladesh Demographic and Health Survey (BDHS) 2017/2018

9.2.2 Wasting (low weight-for-height) and healthy weight

Wasting is an indicator of acute malnutrition. Children who are wasted are too thin for their height and have a much greater risk of dying than children who are not wasted. The wasting ZOI indicator measures the percentage of children 0-59 months of age who are acutely malnourished, as defined by a weight-for-height z-score[142] more than 2 SDs below the median of the 2006 WHO Child Growth Standard, in the ZOI. The z-score indicates how many standard deviations the child is from the median weight-for-height for a child of the same sex and age using the 2006 WHO Child Growth Standards.[143]

A complementary indicator to the wasting indicator is the healthy weight indicator, which measures the percentage of children 0-59 months who are neither wasted nor overweight, as defined by a weight-for-height z-score between 2 SDs below the median and 2 SDs above the median of the 2006 WHO Child Growth Standard. Prevalence of children with a healthy weight is a measure of a well-nourished population, which is essential to enhance human potential, health, and productivity.

Table 9.2.2 shows the prevalence of severe wasting (<-3 SD), wasting (<-2 SD), healthy weight (≥-2 SD and ≤+2 SD), overweight (>+2 SD), and obesity (>+3 SD), and mean weight-for-height z-scores for children under 5 years of age in the ZOI. Estimates are presented for all children and by child, caregiver, and household characteristics. Children's characteristics include sex and age. Caregivers' characteristics include educational attainment. Household characteristics include gendered household type and wealth quintile.

The proportion of severe wasting and wasting among children under 5 years of age is 1.5 percent and 7.3 percent, respectively. More male children are severely wasted and wasted than female children. Children in the oldest age categories (i.e., 36-47 months and 48-59 months) report higher prevalences of wasting children under 36 months of age, although there is no statistically significant difference by child's age. Disaggregated by caregivers' education and wealth quintile, wasting is highest among caregivers with no formal education (15.8 percent) and among the poorest 20 percent of households (12.5 percent). Conversely, wasting is lowest among households where caregivers have completed secondary education (3.9 percent) and among the wealthiest 20 percent of households (3.2 percent). The difference by caregivers' education is statistically significant at the 1 percent level and at the 0.1 percent level for wealth quintile. Wasting is higher among children living in male and female adult only households compared to female adult only households (7.7 percent for male and female adults only and 4.6 percent for female adult only households), and this difference is statistically significant at the 5 percent level.

[142] A weight-for-length z-score is calculated for children 0-23 months of age and any other children who are measured lying down. A weight-for-height z-score is calculated for children 24-59 months of age who are measured standing up.
[143] WHO (2006)

The percentage of healthy weight among children under 5 years of age is 90.3 percent. The proportion of healthy weight children is higher among children living with educated caregivers compared to children living with uneducated or less educated caregivers, but the difference is not statistically significant. Wealth status is significantly associated with the healthy weight of the children under 5 years of age at the 5 percent level. Specifically, more children living with wealthier families have a healthy weight than children living in the poorest households. Furthermore, there is a higher prevalence of healthy children in female adult only households (94.6 percent) than male and female adult households (89.8 percent), and the difference is statistically significant at the 1 percent level.

The proportion of overweight and obesity is 2.4 percent and 0.6 percent for children under 5 years of age, respectively. Overweight is higher among male children than female children (males: 3.0 percent; females: 1.7 percent). The highest rate of overweight and obesity is among children 0-11 months of age (overweight: 3.3 percent; obesity:1.5 percent). Disaggregated by caregivers' education and wealth status of the household, children under 5 years of age who are living with educated mothers and in wealthier households are more overweight and obese compared to those living with illiterate caregivers and those belonging to relatively poorer households. A higher proportion of children from male and female adult only households are overweight and obese than children living in female adult only households. Note that significance tests were not conducted for overweight and obesity; therefore, statistical significance results are not reported.

BDHS 2017/2018 did not collect data on poverty and shock exposure; therefore, wasting, healthy weight, overweight, and obesity cannot be analyzed by these disaggregates.

Table 9.2.2: Prevalence of Wasting and Healthy Weight and Mean Weight-for-Height Z-scores among Children under 5 Years of Age in the ZOI, in Total and by Selected Child, Caregiver, and Household Characteristics

Characteristic	Severely wasted (<−3 SD) (%)	Wasted (<−2 SD) (%)	Sig.[a]	Healthy weight (-2 to +2 SD) (%)	Sig.[a]	Overweight (> +2SD) (%)	Obese (> +3SD) (%)	Mean z-score	Number of children (*n*)[b]
All children under 5 years of age	1.5	7.3		90.3		2.4	0.6	-0.4	1,851
Child sex			n/s		n/s				
Male	2.0	7.7		89.3		3.0	0.6	-0.4	949
Female	0.8	6.9		91.3		1.7	0.6	-0.4	902
Child age			n/s		n/s				
0-11 months	1.2	6.7		90.0		3.3	1.5	-0.2	426
12-23 months	1.7	7.9		89.4		2.6	0.5	-0.4	373
24-35 months	1.7	5.8		90.8		3.3	1.0	-0.4	349
36-47 months	1.9	8.0		91.5		0.5	0.0	-0.6	321
48-59 months	0.9	8.3		90.0		1.6	0.0	-0.7	382
Caregiver education[c]			**		n/s				
No education	1.8	15.8		84.2		0.0	0.0	-0.8	74
Less than primary	1.8	8.3		89.9		1.8	0.3	-0.5	284
Completed primary	1.5	7.6		90.8		1.6	0.6	-0.5	1,034
Completed secondary	2.4	3.9		92.9		3.3	0.6	-0.2	104
Higher	0.4	4.4		89.7		6.0	1.3	-0.1	355
Gendered household type			*		**				
Male and female adults	1.4	7.7		89.8		2.5	0.7	-0.4	1,673
Female adults only	2.1	4.6		94.6		0.8	0.0	-0.4	169
Male adults only	^	^		^		^	^	^	9
Children only (no adults)	^	^		^		^	^	^	0
Wealth quintile			***		*				
Highest (wealthiest)	0.4	3.2		91.4		5.4	1.0	-0.1	282
Fourth	1.0	4.9		91.1		4.1	1.0	-0.2	356
Middle	1.9	5.1		93.0		1.8	0.6	-0.4	396
Second	0.8	8.4		90.5		1.0	0.5	-0.5	403
Lowest (poorest)	2.6	12.5		86.3		1.2	0.4	-0.7	414
Poverty status									
Poor	—	—		—		—	—	—	—
Non-poor	—	—		—		—	—	—	—
Shock exposure index									
Did not experience any shocks	—	—		—		—	—	—	—
Low	—	—		—		—	—	—	—
Moderate	—	—		—		—	—	—	—
High	—	—		—		—	—	—	—

— = Data are not available
^ Results not statistically reliable, n<30

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[b] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[c] The ZOI Survey identifies the primary caregiver of each age-eligible child. This person is likely, but not necessarily, the child's biological mother.

Notes:

Indicator estimates and the gendered household type disaggregate are based on de facto household members.

The wealth quintile and poverty status disaggregates are calculated using de jure household members.

Source: Bangladesh Demographic and Health Survey (BDHS) 2017/2018

10 SUMMARY AND CONCLUSIONS

Feed the Future is the US Government's global hunger and food security initiative, which aims to address the root causes of poverty, hunger, and malnutrition to transform lives. The US Global Food Security Strategy (GFSS) intends to build upon the successes of the Feed the Future Initiative in 12 focal countries. In Bangladesh, the GFSS primarily focuses on promoting inclusive and sustainable agriculture-led economic growth, strengthening resilience among people and systems, and improving nutrition, especially among women and children.

IFPRI researchers under the USAID-funded Policy Research and Strategy Support Program (PRSSP) designed and conducted the Feed the Future Phase 2 ZOI baseline survey 2018/2019 to serve as the baseline for the GFSS in Bangladesh.

Results from the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 provide a glimpse into the status of the 21 southwestern districts of Bangladesh for household economic status, resilience, women's empowerment, agriculture, food security and dietary intake, and water, sanitation, and hygiene.

Household Economic Status

Economic status is an important indicator of a household's access to resources, such as food, healthcare, educational opportunities, material goods, and social networks. To this end, reducing poverty is a pragmatic objective for improving quality of life.

Among the baseline survey sample, the prevalence of people living on less than US$1.90 per day (2011 PPP) is 10.4 percent. Mean percent shortfall of the poor is 13.5 percent of the poverty line—that is, on average, the poor are short by $0.3 per capita per day from the poverty line.

Non-poor households that live close to the poverty line are susceptible to falling into poverty from economic shocks. Notably, 15.0 percent of households are only slightly above the poverty line and, therefore, are at high risk of falling into poverty with the onset of a shock. Female adult only households are slightly more insulated from being near poor compared with male and female households.

Very few (0.6 percent) households are below the poorest quintile of the Comparative Wealth Index.

Resilience

Resilience manifests itself at various levels, including the individual, household, community, and higher-level systems (e.g., nations, ecosystems).[144] Globally, Bangladesh is one of the most vulnerable countries to climate change and weather-related hazards. To this end, the GFSS Bangladesh Country Plan prioritizes strengthening the resilience of Feed the Future households.

[144] Frankenberger et al. (2013)

Feed the Future ZOI households have a relatively high ability to recover from shocks, as measured by ARSSI. Nearly three-quarters (73.8 percent) of Feed the Future ZOI households are confident that the Bangladesh Government has the institutional capacity to address stresses and shocks.

The mean social capital index among Feed the Future ZOI households is 66.8 out of a maximum score of 100. The social capital index builds off of Aldrich (2012)'s conceptual framework of social capital, which considers three sub-indices: (1) bonding social capital, (2) bridging social capital, and (3) linking social capital. These sub-indices assist communities to prepare for, cope with, and recover from various shocks and stresses, such as natural disasters, climate change, and market shocks. Feed the Future Phase ZOI households have a higher mean bonding score (72.1) than mean bridging score (61.5). This implies that households have moderately strong cooperation *within* the community to manage stresses and shocks, yet this social support and access to external assets *outside* of the community is relatively more limited. This is important because this highlights the relative vulnerability of households to covariate shocks that affect the whole community. Informal support from relatives, friends, or other people in the community are effective mainly when shocks are household-specific, but they tend to break down once a large shock strikes the entire community.[145]

Group-based savings are mechanisms for people in poor communities who otherwise have limited access to financial services to pool their savings and, in turn, strengthen their economic situations. Half of all Feed the Future ZOI households (50.7 percent) engage in group-based savings, micro-finance, or lending programs. Participation is higher among households with both male and female adults (52.4 percent) than female adult only households (38.4 percent).

Agriculture

USAID has identified rice, dairy, and fish as targeted value chain commodities in the Feed the Future ZOI in Bangladesh. The baseline survey data provide detailed information on the profile of ZOI households that engage in these agricultural activities, ZOI households' use of inputs, improved management and technologies, yields, and opportunities for enhancing productivity.

Rice

In the Bangladesh ZOI, 68.4 percent of rice farmers operate less than 0.5 hectares of land. Rice farmers follow various agricultural production management practices. Most ZOI rice farmers (91.1 percent) use power tillers for plowing land. About 70.5 percent of rice farmers use a pump system for irrigation (e.g., shallow tubewells, deep tubewells, axial flow pumps and low-lift pumps). About one-quarter (27.2 percent) rotate their rice crop. Most (84.3 percent) rice farmers in the ZOI use improved open-pollinated rice seed varieties. The baseline survey data indicate that older farmers (30+ years of age) are more likely to use traditional varieties than younger farmers. Almost one-third of the rice farmers (30.4 percent) do not purchase the seeds they use either because they save their own seeds from crops grown or receive seeds from friends or family at no cost. Virtually all (97.9 percent) apply fertilizers, with the most commonly used fertilizer being soil-based inorganic fertilizer. Nearly all (97.4 percent) harvest rice by hand. Three-quarters (74.9 percent) of rice farmers use bags as a storage and transport

[145] Ahmed (2020)

container. Most of the rice farmers store rice in their residential houses (83.3 percent). The average rice yield per farmer is 3.1 metric tons of milled rice per hectare.

Fish

One-fifth (21.2 percent) of fishpond farmers in the ZOI are 60+ years of age and over one-quarter (27.4 percent) have no education. Over half of fish farmers in the ZOI (55.6 percent) raise fish for consumption only.

Most farmers produce carp (91.5 percent) and tilapia (54.9 percent). Nearly two-fifths (39.0 percent) of fishpond farmers use supplemental feed, most of which is purchased (88.7 percent). A small proportion (17.9 percent) of fishpond farmers use manure, and even fewer use hormones on their fish (1.6 percent). One-quarter (25.3 percent) of fishpond farmers observed disease among fish, and 15.0 percent observed parasite cases among fish. Although water quality is an important factor affecting fish production, 86.0 percent of fishpond farmers do not monitor water quality, and 79.4 percent do not use any method to maintain good water quality. Among all surveyed ZOI fish farmers, 91.8 percent do not use any technique to improve fish production.

During the 30 days preceding the baseline survey, the average yield of fish produced from fishponds was 213.3 kilograms per hectare. Improved fisheries management practices, particularly modern input use, can enhance productivity and boost farmers' earnings for those who raise fish for income-generating purposes.

Dairy

The baseline survey data indicate that there are more female than male dairy farmers in the ZOI. Most dairy farmers have low educational attainment, either with no formal education (34.8 percent) or limited to primary education (40.7 percent).

Three-fifths (60.2 percent) of dairy cows are purchased, and 64.6 percent of dairy cow farm households in the ZOI use artificial insemination, more so among younger farmers than older. Two-thirds (66.4 percent) of the dairy cows owned are local, traditional breeds. Many dairy farmers in the ZOI do not undertake optimal practices to maintain the health and nutrition of their dairy cows. For example, grazing practices and the type of forage that dairy cows consume, contributes to dairy cows' ability to produce milk. However, less than half (46.8 percent) of dairy farmers have dairy cows that graze on forages. Slightly over half (54.8 percent) of farmers feed vitamins and minerals to their dairy cows. 38.1 percent of dairy farmers do not consult any trained health service provider for their cows, and 81.1 percent of dairy farmers did not vaccinate their cows. Moreover, there is relatively limited knowledge of certain key health issues faced by dairy cows, such as mastitis: half (50.3 percent) of the dairy farmers have never heard of this bacterial infection and 40.3 percent do not take any prevention methods against it.

One-third (32.4 percent) of dairy farmers in the ZOI sell the milk their cows produce, more so among farmers 30+ years (34.0 percent). Participation in milk marketing cooperatives was not reported by any dairy farmers in the ZOI. Although dairy farmers earn money from selling milk, the GFSS baseline data show that many farmers also sell their dairy cows to help make ends meet during economic hardships

(80.4 percent). Very few (10.1 percent) dairy farmers keep written records. Despite greater female engagement in dairy farming, men still dominate dairy cow production decisions: over half (55.1 percent) of female dairy farmers state that their spouses decide which bulls to breed and which vaccinations to give to the dairy cows (57.4 percent).

Dairy farmers did report various improved practices, including the use of improved fodder crop (99.3 percent) and improved livestock handling practices and housing (96.9 percent), yet other practices—using livestock health services and products (77.4 percent), improved waste management practices (49.9 percent)—were not as prevalent across dairy farmers in the ZOI. Average per farmer's milk yield is 26.0 liters per milking dairy cow per month, which is very low. Altogether, although there are some improved production and management practices undertaken by dairy cow farmers, there are opportunities during the production process to enhance productivity.

Women's Empowerment

Feed the Future prioritizes women's empowerment as a pathway to reduce hunger.[146] IFPRI research in Bangladesh shows that women's empowerment, as measured by A-WEAI, is positively associated with improving agricultural diversity and dietary diversity.[147]

A-WEAI is calculated using two sub-indices: 5DE, and GPI. Men and women perform similarly across various empowerment indicators in the baseline survey. For instance, 65.9 percent of men and 68.3 percent of women achieved empowerment. 5DE, which reflects the degree to which women are empowered in five domains of empowerment in agriculture, is 0.89 among women and 0.88 among men. According to the *Feed the Future Indicator Handbook*, a person is considered "empowered" if they achieve adequacy in at least 80 percent of the weighted indicators (equivalent to four out of five domains) (Feed the Future 2018).[148] disempowered men's average adequacy score is slightly higher than disempowered women's average adequacy score (21.7 for men and 18.8 for women). Among the baseline sample, the leading constraints to empowerment are shared between men and women, including access to and decision on credit, group membership, and workload. Over three-quarters of women (79.1 percent) are equally as empowered as men among the Feed the Future Phase 2 ZOI households, as measured by GPI.

Food Insecurity and Dietary Intake

Food insecurity is a major public health concern, referring to the uncertainty, lack of, or inability to acquire nutritious food. Therefore, food insecurity can affect dietary intake. Results from the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 show that 7.9 percent of households were moderately or severely food insecure due to a lack of money or resources during the 12 months preceding the 2018/2019 baseline survey. Very few (0.9 percent) of these households were severely food insecure. A higher proportion of female adult only households experienced moderate and severe food insecurity (9.5 percent) than households with male and female adults (7.7 percent).

[146] USAID (n.d.)
[147] Ahmed et al. (2013)
[148] Feed the Future (2018)

Analysis of BDHS 2017/2018 district-level data for the 21 ZOI districts shows that the prevalence of exclusive breastfeeding among children 0-5 months of age is 53.9 percent and exclusive breastfeeding is higher among female children compared to male children (58.1 percent for female and 50.4 percent for male). It is noticeable that the proportion of exclusive breastfeeding is the highest among children living in second wealth quintile family (57.4 percent) while it is lowest among the children living in the wealthiest family (46.6 percent).

Only around one-third (35.9 percent) of children 6-23 months of age consume acceptable diet. The prevalence of minimum acceptable diet increases with increasing the age of children. However, caregiver education and wealth status of the household influence achieving the minimum acceptable diet. Children living with illiterate caregiver and in the poorest household have the lowest proportion of acceptable diet.

Nearly two-thirds (65.7 percent) of women of reproductive age (15-49 years of age) achieved minimum dietary diversity by consuming at least five of 10 food groups in the 24 hours prior to the survey. Eggs, dairy products, and nuts and seeds were the least consumed food group among surveyed women of reproductive age (20.3 percent, 10.7 percent, and 0.9 percent, respectively).

Nutritional Status of Women and Children

District-level Bangladesh Demographic and Health Survey (BDHS) data for the 21 ZOI districts were analyzed for selected nutrition status of women and children's indicators. The prevalence of underweight among women of reproductive age is 10.9 percent. More women 15-19 years are underweight compared to the other age groups (women 20-49 years of age). Underweight is highest among women with no formal education and women from the poorest households. In contrast, around one-fourth (26.3 percent) women is overweight, and 6.4 percent of women are obese. Overweight and obesity increase with increasing the attainment of education and household wealth status.

The prevalence of stunting and wasting among children under 5 years of age is 27.4 percent and 7.3 percent, respectively. Female children are more stunted than male. Stunting rate is higher when the children become 12-35 months older; but the wasting was higher among older children 36-59 months of age compared to the younger age (0-35 months). Caregiver education and household wealth status are associated with stunting and wasting. The highest rate of stunted and wasted children is found in the poorest family and illiterate caregivers. However, the prevalence of overweight and obesity is 2.4 percent and 0.6 percent, respectively. Male children are more overweight than female children. Caregiver's education and household wealth status influence overweight and obesity. Overweight and obesity increase with increasing the attainment of caregiver education and household wealth status.

Water, Sanitation, and Hygiene

Improvements in water, sanitation, and hygiene are critical for enhancing nutritional outcomes by addressing immediate and underlying causes of malnutrition. Lack of sanitation is strongly associated with acute malnutrition and stunting. Only two-thirds (66.7 percent) of Feed the Future households have access to basic sanitation services at 2018/2019 baseline. Access to basic sanitation is slightly lower

among female adult only households than households with male and female adults (64.3 percent and 67.1 percent of households, respectively), but the difference is not statistically significant.

Handwashing before and after critical events helps to reduce diarrheal disease, which reduces the absorption of nutrients by the gut. Only half (53.3 percent) of ZOI households have soap and water available at their handwashing station. Female adult only households fare worse than male and female adult households (46.6 percent and 54.2 percent, respectively), and this difference is statistically significant at the 1 percent level.

Altogether, the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 data provide valuable benchmarks for tracking and building upon progress made during the first phase of Feed the Future.

REFERENCES

ACDI/VOCA. (n.d.). Feed the Future Bangladesh Rice and Diversified Crops Activity. Retrieved from: https://www.acdivoca.org/projects/bangladesh-rice-and-diversified-crops-activity/

Ahmed, F., D. Roy, M. Yanez-Pagans, N. Yoshida. (2017). *Design of a Multi-Stage Stratified Sample for Poverty and Welfare Monitoring with Multiple Objectives: A Bangladesh Case Study.* Policy Research Working Paper 7989. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/480321488461618499/pdf/WPS7989.pdf

Ahmed, A.U., K. Ahmad, V. Chou, R. Hernandez, P. Menon, F. Naeem, F. Naher, W. Quabili, E. Sraboni, & B. Yu. (2013). The Status of Food Security in the Feed the Future Zone and Other Regions of Bangladesh: Results from the 2011-2012 Bangladesh Integrated Household Survey. Retrieved from: https://www.ifpri.org/publication/status-food-security-feed-future-zone-and-other-regions-bangladesh-results-2011-2012

Ahmed, A.U. (2020). Mitigating Shocks Amid COVID-19: What Role for Social Protection? Presented at: "Online dialogue on Making Social Protection Programmes in Bangladesh Covid-19-Sensitive." April 8, 2020.

Ahmed, A.U., N.L. Aberman, M. Jabbar, & N. Akhtar. (2011). "Policy Perspectives on the Country Investment Plan for Food and Nutrition Security in Bangladesh." Report prepared for the Bangladesh Food Security Investment Forum, May 2010, Dhaka, Bangladesh. Dhaka: International Food Policy Research Institute.

Ahmed, A.U., & M. Mehrab Bakhtiar. (2020). Boro rice procurement in Bangladesh: Implications for policy. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.133724

Ahmed A.U., M. Mehrab Bakhtiar, N. Abedin, S. Anowar, N.Z. Hossain, W. Quabili, & J. Ghostlaw. (2021). Research-Based Evidence to Support the Formulation of the Country Strategic Opportunities Program (COSOP) for IFAD-Bangladesh. International Food Policy Research Institute.

Aimiuwu, O. (n.d.). Collaborating, Learning and Adapting to Develop the Bangladesh Dairy Sector. USAID Learning Lab. Retrieved from: https://usaidlearninglab.org/sites/default/files/resource/files/bangladesh_cla_for_the_dairy_sector.pdf

Alam, G.M. (2016). An assessment of the livelihood vulnerability of the riverbank erosion hazard and its impact on food security for rural households in Bangladesh (Doctoral dissertation, University of Southern Queensland).

Alkire, S., R. Meinzen-Dick, A. Peterman, A.R. Quisumbing, G. Seymour, & A. Vaz. (2013). The Women's Empowerment in Agriculture Index. *World Development, 52*l, 71-91.

Ballard, T., J. Coates, A. Swindale, & C. Cafiero. (2013). *The Food Insecurity Experience Scale – Development of a global standard for monitoring hunger worldwide.* Technical Paper. Rome: Food and

Agriculture Organization of the United Nations. Retrieved from http://www.fao.org/economic/ess/ess-fs/voices/en/.

BBS (Bangladesh Bureau of Statistics), Informatics Division, Ministry of Planning. (2017). Preliminary Report on Household Income and Expenditure Survey 2016 [Internet]. Available from: https://catalog.ihsn.org/catalog/7399/related-materials

———. (2018). Report on Labour Force Survey (LFS) 2016-17. Dhaka: Improving of Labour Statistics and Labour Market, Information System through Panel Survey (LMIS) Project, BBS.

Beck, T. (2015). *Microfinance: A Critical Literature Survey* (Independent Evaluation Group Working Paper 2015/No.4). Retrieved from: https://openknowledge.worldbank.org/bitstream/handle/10986/23546/Microfinance000al0literature0survey.pdf?sequence=1&isAllowed=y.

Boukary, A.G., A. Diaw, & T. Wünscher. (2016). Factors affecting rural households' resilience to food insecurity in Niger. *Sustainability, 8*(3), 181. Doi:10.3390/su8030181

BRRI (Bangladesh Rice Research Institute). (2011). Bangladesh Rice Knowledge Bank. *Website*. Retrieved from: http://www.knowledgebank-brri.org/riceinban.php

Cafiero, C., S. Viviani, & M. Nord. (2018). Food security measurement in a global context: The food insecurity experience scale. *Measurement, 116*, 146-152. Doi:10.1016/j.measurement.2017.10.065

Chakraborty, N.M., K. Fry, R. Behl, & K. Longfield. (2016). Simplified asset indices to measure wealth and equity in health programs: A reliability and validity analysis using survey data from 16 countries. *Global Health: Science and Practice, 4*(1), 141-154. Doi:10.9745/ghsp-d-15-00384

Choudhury, S., & Headey, D.D. (2018). Household dairy production and child growth: Evidence from Bangladesh. Economics & Human Biology, 30, 150-161.

Coates, J., E.A. Frongillo, B.L. Rogers, P. Webb, P.E. Wilde, & R. Houser. (2006). Commonalities in the experience of household food insecurity across cultures: what are measures missing? *Journal of Nutrition*, 136: 1438S-1448S.

Cull, R., & J. Morduch. (2017). *Microfinance and Economic Development* (Policy Research Working Paper 8252). Retrieved from: http://documents.worldbank.org/curated/en/107171511360386561/pdf/WPS8252.pdf.

Darnton-Hill, I., P. Webb, P.W.J. Harvey, J.M. Hunt, N. Dalmiya, M. Chopra, M.J. Ball, M.W. Bloem, & B. De Benoist. (2005). Micronutrient deficiencies and gender: social and economic costs. *American Journal of Clinical Nutrition*, 81(Supplement): 1198S-1205S.

Deaton, A. (2008). *The analysis of household surveys: A microeconomic approach to development policy*. Baltimore, MD: The Johns Hopkins University Press.

Deaton, A., & S. Zaidi. (2002). *Guidelines for constructing consumption aggregates for welfare analysis*. Working Paper No. 135. Washington, DC: The World Bank.

Dekker, M. (2006). Estimating wealth effects without expenditure data: evidence from rural Ethiopia. *Ethiopian Journal of Economics*, 15(1). 35-54. DOI:10.4314/eje.v15i1.39817.

Diwakar, V., J.R. Albert, J.F. Vizamos, & A. Shepherd. (2019). *Resilience, near poverty and vulnerability dynamics: Evidence from Uganda and the Philippines.* Washington, DC: United States Agency for International Development, Center for Resilience. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/usaid-report-nearpoor_clean_march_508.pdf.

Djagba, J.F., J. Rodenburg, S.J. Zwart, C.J. Houndagba, & P. Kiepe. (2014). Failure and success factors of irrigation system developments: A case study from the Ouémé and Zou valleys in Benin. *Irrigation and Drainage, 63*(3), 328-329.

Dupuis, G., H. Useem, & K. Johnson. (2019). Feed the Future Zone of Influence Surveys: Data Processing and Finalization Procedures for the Feed the Future Zone of Influence Survey. Washington, DC: Bureau for Food Security, USAID. https://drive.google.com/drive/folders/1bU0_n9wfy4T-2kTte51BS1t34tq4egjX

Eckstein, D., V. Künzel, L. Schäfer, & M. Winges. (2019). Global Climate Risk Index 2020. Germanwatch. https://germanwatch. Org/sites/germanwatch. Org/files/20-2-01e% 20Global, 20.

Edmeades, G.O. (2015). *Maize – Improved varieties*. Paper prepared for Food and Agriculture Organization of the United Nations (FAO) Save and Grow: Maize, Rice and Wheat. Rome: FAO.

El-Mashad, H.M., Loon, W.K.V., Zeeman, G., Bot, G.P., & Lettinga, G. (2003). Reuse potential of agricultural wastes in semi-arid regions: Egypt as a case study. *Reviews in Environmental Science and Bio/Technology*, *2*(1), 53–66. Doi: 10.1023/b:resb.0000022933.77648.09

Ejemot-Nwadiaro, R.I., Ehiri, J.E., Arikpo, D., Meremikwu, M.M., & Critchley, J.A. (2015). Hand washing promotion for preventing diarrhoea. *Cochrane Database of Systematic Review, 3*(9). Doi: 10.1002/14651858.CD004265.pub3.

Faisal, B.M.R., H. Rahman, N. Sharifee, N. Sultana, M. Islam, S. Habib, and T. Ahammad. (2020). Integrated Application of Remote Sensing and GIS in Crop Information System—A Case Study on Aman Rice Production Forecasting Using MODIS-NDVI in Bangladesh. *AgriEngineering* 2(17). Doi:10.3390/agriengineering2020017

Faisal, I.M., & S. Parveen. (2004). Food security in the face of climate change, population growth, and resource constraints: implications for Bangladesh. *Environmental Management*, 34(4), 487-498. Famine Early Warning Systems Network. (n.d.). Retrieved from http://fews.net/.

FAO (Food and Agriculture Organization of the United Nations). (2003). Maize: Post-harvest operation. Retrieved from http://www.fao.org/fileadmin/user_upload/inpho/docs/Post_Harvest_Compendium_-_MAIZE.pdf.

———. (2011). *Save and grow. A policymaker's guide to the sustainable intensification of smallholder crop production.* Rome: FAO.

———. (2014). *World aquaculture production of fish, crustaceans, molluscs, etc., by principal species in 2013. FAO Yearbook of Fisheries Statistics 2014.* Rome: FAO.

FAO (2016). *Save and grow in practice: Maize, rice, wheat: A guide to sustainable cereal production.* Rome: Food and Agriculture Organization of the United Nations. Retrieved from http://www.fao.org/3/a-i4009e.pdf.

———. (2019). Gateway to dairy production and products. Animal health. Retrieved from: http://www.fao.org/dairy-production-products/production/animal-health/en/.

———. (2019). Gateway to dairy production and products. Breeding. Retrieved from: http://www.fao.org/dairy-production-products/production/breeding/en/.

———. (2019). Gateway to dairy production and products. Farm practices. Retrieved from: http://www.fao.org/dairy-production-products/production/farm-practices/en/.

———. (2019). The Food Insecurity Experience Scale. Retrieved from http://www.fao.org/in-action/voices-of-the-hungry/fies/en/.

———. (n.d.). Small-scale dairy farming manual, volume 4. Husbandry Unit 6.1. Artificial insemination in dairy buffalo and cattle. Retrieved from http://www.fao.org/ag/againfo/resources/documents/Dairyman/Dairy/V4U6_1.htm.

———. (n.d.). Small-scale dairy farming manual, volume 4. Husbandry Unit 7.3. Milk recording. Retrieved from: lhttp://www.fao.org/3/t1265e/t1280e05.htm.

———. (n.d.). 4. Mastitis control. Retrieved from: http://www.fao.org/3/t0218e/t0218e04.htm.

———. (n.d.). 2. Improving pond water quality. Retrieved from: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e02.htm.

———. (n.d.). 6. Fertilizing fish ponds. Retrieved from: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e06.htm.

———. (n.d.). 8. Handling live fish on the farm. Retrieved from: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e08.htm.

———. (n.d.). 11. Fish harvesting from ponds. Retrieved from: http://www.fao.org/tempref/FI/CDrom/FAO_Training/FAO_Training/General/x6709e/x6709e11.htm.

———. (n.d.). 15. Disease prevention and treatment. Retrieved from: http://www.fao.org/fishery/static/FAO_Training/FAO_Training/General/x6709e/x6709e15.htm.

FAO/WHO (Food and Agriculture Organization of the United Nations/World Health Organization). (2014). Bangladesh Country Nutrition Paper. International Conference on Nutrition 21Years Later (Rome). Rome and Geneva.

Feed the Future. N.d. Empowering Women for Food Security: WEAI Fact Sheet. Retrieved from: https://cg-281711fb-71ea-422c-b02c-ef79f539e9d2.s3.us-gov-west-1.amazonaws.com/uploads/2019/02/FTF_WomensEmpowerment_Factsheet.pdf

Filmer, D., & Pritchett, L.H. (2001). Estimating wealth effects without expenditure data-or tears: An application to educational enrollments in states of India. *Demography, 38*(1), 115-132. Doi:10.2307/3088292

Food Security and Nutrition Network. (2018). Resource Library: Resilience and resilience capacities measurement options. Retrieved from: https://www.fsnnetwork.org/resilience-and-resilience-capacities-measurement-options.

FPMU (Food Planning and Monitoring Unit). (2019). Monitoring Report 2019 of the Bangladesh Second Country Investment Plan. Food Planning and Monitoring Unit, Ministry of Food, Government of the People's Republic of Bangladesh. Retrieved from: http://fpmu.gov.bd/agridrupal/sites/default/files/file/MR-2019/CIP2MonitoringReport2019.pdf

———. (2020). Monitoring Report 2020 of the Bangladesh Second Country Investment Plan. Food Planning and Monitoring Unit, Ministry of Food, Government of the People's Republic of Bangladesh. Retrieved from: http://fpmu.gov.bd/agridrupal/sites/default/files/file/MR-2020/MonitoringReport2020.pdf

Francis-Floyd, R. (2011). Dissolved oxygen for fish production. Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Retrieved from: https://agrilifecdn.tamu.edu/fisheries/files/2013/09/Dissolved-Oxygen-for-Fish-Production1.pdf.

Frankenberger, T., Mueller M., Spangler T., and Alexander S. October 2013. Community Resilience: Conceptual Framework and Measurement Feed the Future Learning Agenda. Rockville, MD: Westat.

Food Security and Nutrition Network. (2018). Resource Library: Resilience and resilience capacities measurement options. Retrieved from: https://www.fsnnetwork.org/resilience-and-resilience-capacities-measurement-options.

Headey, D.D. (2013). Developmental drivers of nutritional change: a cross-country analysis. *World Development*, 42, 76-88.

Hernandez, R., B. Belton, T. Reardon, C. Hu, X. Zhang, and A.U. Ahmed. (2018). "The 'quiet revolution' in the aquaculture value chain in Bangladesh." Aquaculture, 493, 456-468. https://doi.org/10.1016/j.aquaculture.2017.06.006

Jaja, N. (2016). Understanding the texture of your soil for agricultural productivity. Communications and Marketing, College of Agriculture and Life Sciences, Virginia Tech. Retrieved from: https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/CSES/CSES-162/CSES-162-PDF.pdf.

Lal, R. (2010). Eco-efficiency in agro-ecosystems through soil carbon sequestration. C*rop Science*, *50*(Supplement 1). Doi: 10.2135/cropsci2010.01.0012.

Leroy, J.L., & Frongillo, E.A. (2019). Perspective: What does stunting really mean? A critical review of the evidence. *Advances in Nutrition*, 10, 196-204.

Looper, M. (n.d.). Reducing somatic cell count in dairy cattle. University of Arkansas Division of Agriculture Research and Extension. Retrieved from: https://www.uaex.edu/publications/PDF/FSA-4002.pdf

Malapit, H., K. Sproule, C. Kovarik, R.S. Meinzen-Dick, A.R. Quisumbing, F. Ramzan, E. Hogue, & S. Alkire. (2014). *Measuring progress toward empowerment: Women's empowerment in agriculture index: Baseline report.* Washington, DC: International Food Policy Research Institute. Retrieved from: https://www.ifpri.org/publication/measuring-progress-toward-empowerment-womens-empowerment-agriculture-index-baseline.

Malapit, H., C. Kovarik, K. Sproule, R.S. Meinzen-Dick, & A.R. Quisumbing,. (2015). *Instructional guide on the abbreviated Women's Empowerment in Agriculture Index (A-WEAI).* Washington, DC: International Food Policy Research Institute. Retrieved from: http://www.ifpri.org/publication/instructional-guide-abbreviated-womens-empowerment-agriculture-index-weai.

Mercy Corps. (n.d.). *Our resilience approach to relief, recovery, and development.* Portland, OR: Mercy Corps. Retrieved from https://www.mercycorps.org/sites/default/files/Resilience_Approach_Booklet_English_121416.pdf.

Müller, C. & Elliott, J. (2015). The Global Gridded Crop Model intercomparison: approaches, insights and caveats for modelling climate change impacts on agriculture at the global scale. In A. Elbehri, ed. Climate change and food systems: global assessments and implications for food security and trade. Rome, FAO.

NIPORT (National Institute of Population Research and Training). (2020). Bangladesh Demographic and Health Survey 2017-18: Final Report.
Retrieved from: https://dhsprogram.com/pubs/pdf/FR344/FR344.pdf

Osmani, S. R., A.U. Ahmed, T. Ahmed, N. Hossain, S. Huq, and A. Shahan. (2016). Strategic review of food security and nutrition in Bangladesh. Dhaka: World Food Programme. https://www.wfp.org/sites/default/files/Bangladesh_Strategic_Review_full_report.pdf

Oerke, E.C. (2005). Crop losses to pests. *Journal of Agricultural Science, 144*(1), 31-43. Retrieved from: https://www.cambridge.org/core/journals/journal-of-agricultural-science/article/crop-losses-to-pests/AD61661AD6D503577B3E73F2787FE7B2.

Oregon State University Forage Information System. (2019). Discuss the role of grazing in a pasture-livestock system. The National Forage & Grasslands Curriculum project 2019. Retrieved from: https://forages.oregonstate.edu/nfgc/eo/onlineforagecurriculum/instructormaterials/availabletopics/grazing/role.

Oswald, A., & Ransom, J. (2001). *Striga* control and improved farm productivity using crop rotation. *Crop Protection, 20*(2), 113-120.

Oxfam International. (2017). *The future is a choice: Absorb, adapt, transform resilience capacities.* Oxford, UK: Oxfam International. Retrieved from: https://oxfamilibrary.openrepository.com/bitstream/handle/10546/620178/gd-resilience-capacities-absorb-adapt-transform-250117-en.pdf?sequence=4&isAllowed=y.

Phadera, L., H. Michelson, A. Winter-Nelson, & P. Goldsmith. (2019). Do asset transfers build household resilience? *Journal of Development Economics*, 138, 205-227.

Practical Action. (2012). Promoting adaptation to climate change in Bangladesh. Dhaka: Practical Action. Retrieved from: https://www.unisdr.org/preventionweb/files/20408_adaptationtoclimatechangebangladesh.pdf

Rahaman, M.M., S.I. Khandakar, and M. Jahan (2018). Rice Farmers' Knowledge of the Risks of Pesticide Use in Bangladesh. *Journal of Health and Pollution*: December 2018, Vol. 8, No. 20, 181203. https://doi.org/10.5696/2156-9614-8.20.181203

Resilience Evaluation, Analysis and Learning. (n.d.). Food Security and Nutrition Network. Retrieved from https://www.fsnnetwork.org/REAL

Rutstein, S.O., & S. Staveteig. (2014). Making the Demographic and Health Surveys Wealth Index Comparable. DHS Methodological Reports No. 9. Rockville, Maryland, USA: ICF International.

Shelley, I.J., Takahashi-Nosaka, M., Kano-Nakata, M., Haque, M.S., & Inukai, Y. (2016). Rice cultivation in Bangladesh: present scenario, problems, and prospects. Journal of International Cooperation for Agricultural Development, 14(4), 20-29.

Shepherd, A. (1999). *A guide to maize marketing for extension officers.* Rome: Food and Agriculture Organization of the United Nations.

Smith, K.R., & Pillarisetti, A. (2019). "Chapter 7. Household Air Pollution from Solid Cookfuels and Its Effects on Health." *Injury Prevention and Environmental Health. 3rd edition*. Washington, D.C.: The International Bank for Reconstruction and Development / The World Bank. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK525225/.

Snapp, S.S., Mafongoya, P.L. & Waddington, S. (1998). Organic matter technologies for integrated nutrient management in smallholder cropping systems of southern Africa. *Agriculture, Ecosystems and Environment, 71,* 185-200.

Solh, M., H.J Braun, H-J., & Tadesse, W. (2014). *Save and grow: Wheat.* Paper prepared for the Food and Agriculture Organization of the United Nations Technical Consultation on Save and Grow: Maize, Rice and Wheat, Rome, 15-17 December 2014. Rabat, ICARDA.

Stukel, D.M. (2018). *Feed the Future population-based survey sampling guide.* Washington, DC: Food and Nutrition Technical Assistance Project, FHI 360.

UN, L., Michelson, H., Winter-Nelson, A., & Goldsmith, P. (2019). Do asset transfers build household resilience? *Journal of Development Economics, 138*, 205-227. Doi:10.1016/j.jdeveco.2019.01.003

UNICEF & World Health Organization (WHO). (2018). Core questions on water, sanitation and hygiene for household surveys: 2018 update. New York, NY: UNICEF and WHO.

United Nations Development Group. (2003). *Indicators for monitoring the Millennium Development Goals: Definitions, rationale, concepts and sources*. New York, NY: United Nations.

United Nations Statistics Division. (n.d.). *E-Handbook on Sustainable Development Goals Indicators*. Retrieved from: https://unstats.un.org/wiki/display/SDGeHandbook/Home.

UNSTATS. (n.d.). SDG Indicators – Metadata repository. Retrieved from: https://unstats.un.org/sdgs/metadata/.

U.S. Department of Agriculture, National Resources and Conservation Service. (1999). Guide to texture by feel. Retrieved from: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054311.

U.S. Department of Agriculture. (n.d.). *Natural Resources Conservation Service national soil survey handbook, part 622.*

United States Agency for International Development (USAID). (2012). *Building resilience to recurrent crisis, USAID policy and program guidance.* Washington, DC: USAID. Retrieved from https://www.usaid.gov/sites/default/files/documents/1870/USAIDResiliencePolicyGuidanceDocument.pdf

———. (2018). *Feed the Future ZOI survey methods toolkit.* Washington, DC: USAID. Retrieved from: https://www.agrilinks.org/post/feed-future-zoi-survey-methods.

———. (2014). *Feed the Future M&E guidance series. Volume 6: Measuring the gender impact of FTF.* Washington, DC: USAID. Retrieved from: http://www.feedthefuture.gov/resource/volume-6-feed-future-measuring-gender-impact-guidance.

———. (2013). *Feed the Future indicator handbook: Definition sheets* (updated October 18, 2014). Washington, DC: USAID.

———. (2012). *Building resilience to recurrent crisis, USAID policy and program guidance.* Washington, DC: USAID. Retrieved from https://www.usaid.gov/sites/default/files/documents/1870/USAIDResiliencePolicyGuidanceDocument.pdf

Vaughan, E. (2018). *Resilience measurement practical guidance note series 3: Resilience capacity measurement.* Produced by Mercy Corps as part of the Resilience Evaluation, Analysis and Learning (REAL) Associate Award.

Wagner-Riddle, C. (2005). Agroclimatology. In: Oliver, J.E. (ed.), *Encyclopedia of world climatology. Encyclopedia of earth sciences series.* Springer, Dordrecht. Retrieved from: https://link.springer.com/content/pdf/bfm%3A978-1-4020-3266-0%2F1.pdf.

Wang, Y., L. Wang, J. Zhou, S. Hu, H. Chen, J. Xiang, Y. Zhang, Y. Zeng, Q. Shi, D. Zhu, and Y. Zhang. (2019). Research Progress on Heat Stress of Rice at Flowering Stage. *Rice Science*, 26(1): 1-10. URL: https://www.sciencedirect.com/science/article/pii/S1672630818300829

Western Dairy Digest. (2005). Manure production estimates. Retrieved from: http://www.dairyweb.ca/Resources/WDD62/WDD6222.pdf.

WHO (World Health Organization). (2017). *Diarrhoeal disease*. Retrieved from: https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease.

———. (2018a). *Rift Valley fever.* Retrieved from: https://www.who.int/news-room/fact-sheets/detail/rift-valley-fever.

———. (2018b). *Infant and young child feeding*. Retrieved from: https://www.who.int/news-room/fact-sheets/detail/infant-and-young-child-feeding.

———. (2018c). Indicators for assessing infant and young child feeding practices. Part 1 Definitions. Conclusions of a consensus meeting held 6-8 November 2017, Washington, DC.

World Health Organization (WHO) & UNICEF. (2006). *WHO child Growth standards and the identification of severe acute malnutrition in infants and children*. Geneva, Switzerland: WHO and UNICEF.

———. (2018). *JMP methodology. 2017 Update & SDG Baselines.* Retrieved from: https://washdata.org/sites/default/files/JMP%20methodology-Apr-2018-5.pdf.

World Health Organization Regional Office for Europe. (2017). *Strengthening resilience: A priority shared by Health 2020 and the Sustainable Development Goals*. Retrieved from: http://www.euro.who.int/__data/assets/pdf_file/0005/351284/resilience-report-20171004-h1635.pdf

Wilkins, R.J. (2008). Eco-efficient approaches to land management: A case for increased integration of crop and animal production systems. *Philosophical Transactions of the Royal Society B: Biological Sciences, 363(*1491), 517-525.

World Bank. (2015). Poverty & Equality Data FAQs. Retrieved from: http://go.worldbank.org/PYLADRLUN0.

———. (2018). The Global Findex Database 2017. Retrieved from: http://www.worldbank.org/en/programs/globalfindex.

WorldFish. (n.d.). Feed the Future Bangladesh Aquaculture and Nutrition Activity. Retrieved from: https://www.worldfishcenter.org/content/feed-future-bangladesh-aquaculture-and-nutrition-activity

Zalisk, K., Dupuis, G., Gauthier, M., Kaur, J., Khan, N., Swindale, A. and Johnson, K.B. (2019). *Feed the Future Zone of Influence Surveys: Guide to Feed the Future Statistics*. Washington, DC: Bureau for Food Security, United States Agency for International Development. Retrieved from: https://drive.google.com/drive/folders/1pgXHkUPJtf0og95ue_vq7cpl0z_GqVDx?usp=sharing

Zhang, X., S. Rashid, K. Ahmad, & A.U. Ahmed. (2014). Escalation of real wages in Bangladesh: Is it the beginning of structural transformation? *World Development*, 64, 273-285.

APPENDIX 1. SUPPLEMENTARY DATA

A1.1 Feed the Future ZOI Survey indicator estimates and module response rates

Table A1.1: Feed the Future ZOI Survey Indicator Estimates, by Key Disaggregates, Bangladesh 2018/2019

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
Prevalence of poverty: Percent of people living on less than $1.90 per day (2011 PPP)								
All households	10.4	30.5	8.8 – 12.0		1.9	0.0	2,525	2,525
Gendered household type				n/s				
Male and female adults	10.3	29.9	8.5 – 12.1		2.0	0.0	2,297	2,222
Female adults only	11.4	36.6	7.3 – 15.6		1.0	0.0	224	296
Male adults only	^	^	^		^	^	^	6
Children only	^	^	^		^	^	^	1
Depth of poverty of the poor: Mean percent shortfall of the poor relative to $1.90 per day (2011 PPP) poverty line								
All households	13.5	11.1	11.9 – 15.1		1.1	0.0	262	223
Gendered household type				n/s				
Male and female adults	13.5	10.8	11.8 – 15.1		1.2	0.0	237	193
Female adults only	13.6	13.9	8.7 – 18.6		0.7	0.0	24	30
Male adults only	^	^	^		^	^	^	6
Children only	^	^	^		^	^	^	1
Percent of people who are near-poor, living on 100% to less than 125% of the $1.90 per day (2011 PPP) poverty line								
All households	15.0	35.7	13.2 – 16.7		1.5	0.0	2,525	2,525
Gendered household type				n/s				
Male and female adults	15.2	35.0	13.4 – 17.1		1.6	0.0	2,297	2,222
Female adults only	12.2	37.7	8.4 – 16.1		0.8	0.0	224	296
Male adults only	^	^	^		^	^	^	6
Children only	^	^	^		^	^	^	1
Percent of households below the comparative threshold for the poorest quintile of the asset-based comparative wealth index								
All households	0.6	7.6	0.3 – 0.9		1.2	0.0	2,525	2,525
Gendered household type				n/s				
Male and female adults	0.5	7.2	0.2 – 0.8		1.0	0.0	2,297	2,222
Female adults only	1.0	10.0	0.0 – 2.2		1.0	0.0	224	296
Male adults only	^	^	^		^	^	^	6
Children only	^	^	^		^	^	^	1
Ability to recover from shocks and stresses index								

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
All households	5.5	1.0	5.4 – 5.6		1.9	0.0	1,262	1,261
Gendered household type				n/s				
Male and female adults	5.5	1.0	5.4 – 5.6		1.9	0.0	1,137	1,135
Female adults only	5.5	1.0	5.4 – 5.7		1.1	0.0	124	125
Male adults only	^	^	^		^	^	1	1
Children only	n/a	n/a	n/a		n/a	n/a	0	0
Index of social capital at the household level								
Overall index								
All households	66.8	32.6	63.7 – 69.9		5.8	0.0	2,525	2,525
Gendered household type				n/s				
Male and female adults	66.7	32.6	63.6 – 69.8		5.2	0.0	2,223	2,222
Female adults only	67.2	32.1	62.2 – 72.1		1.8	0.0	295	296
Male adults only	^	^	^		^	^	6	6
Children only	^	^	^		^	^	1	1
Bonding sub-index								
All households	72.1	36.2	69.0 – 75.2	n/s	4.8	0.0	2,525	2,525
Gendered household type								
Male and female adults	72.0	36.2	68.7 – 75.2		4.6	0.0	2,223	2,222
Female adults only	72.1	36.5	67.1 – 77.2		1.4	0.0	295	296
Male adults only	^	^	^		^	^	6	6
Children only	^	^	^		^	^	1	1
Bridging sub-index								
All households	61.5	36.6	58.1 – 64.9	n/s	5.5	0.0	2,525	2,525
Gendered household type								
Male and female adults	61.4	36.6	58.0 – 64.8		4.8	0.0	2,223	2,222
Female adults only	62.2	36.4	56.3 – 68.0		1.9	0.0	295	296
Male adults only	^	^	^		^	^	6	6
Children only	^	^	^		^	^	1	1
Percent of households that believe local government will respond effectively to future shocks and stresses								
All households	73.8	44.0	69.7 – 77.8		5.3	0.02	2,485	2,485
Gendered household type				n/s				
Male and female adults	73.7	44.0	69.7 – 77.7		4.6	0.01	2,192	2,191

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
Female adults only	73.7	44.1	66.6 – 80.7		1.9	0.03	286	287
Male adults only	^	^	^		^	^	6	6
Children only	^	^	^		^	^	1	1
Percent of households participating in group-based savings, micro-finance, or lending programs								
All households	50.7	50.0	47.7 – 53.8		2.4	0.003	2,518	2,518
Gendered household type				***				
Male and female adults	52.4	50.0	49.2 – 55.5		2.3	0.0	2,223	2,222
Female adults only	38.4	48.7	32.8 – 44.1		1.0	0.0	295	296
Male adults only	n/a	n/a	n/a		n/a	n/a	n/a	n/a
Children only	n/a	n/a	n/a		n/a	n/a	n/a	n/a
Abbreviated Women's Empowerment in Agriculture Index (A-WEAI)								
All women	0.89	0.18	0.88 – 0.91		2.2	2.0	2,327	2,327
Women's age				**				
18-29 years	0.87	0.20	0.85 – 0.89		1.2	3.1	556	556
30 years and older	0.90	0.16	0.89 – 0.91		2.1	1.7	1,771	1,771
Percent of women achieving adequacy across the six indicators of the A-WEAI								
All women	18.8	11.8	9.3 – 28.2		1.0	2.0	2,327	2,327
Women's age				n/s				
18-29 years	19.3	11.7	10.0 – 28.6		1.0	3.1	556	556
30 years and older	18.6	11.9	9.0 – 28.1		1.0	1.7	1,771	1,771
Percent of producers who have applied targeted improved management practices or technologies in targeted areas								
All producers	93.6	24.5	92.2 – 95.0		2.5	0.0	2,313	2,313
Farmers' sex				***				
Male	92.4	7.8	90.6 – 94.3		3.1	0.0	1,701	1,680
Female	96.7	26.5	95.3 – 98.2		3.7	0.0	612	633
Farmers' age				*				
15-29 years	92.0	27.1	88.8 – 95.2		5.3	0.0	400	401
30 years and older	93.9	23.9	92.5 – 95.4		2.5	0.0	1,913	1,912
Commodity				n/a				
Rice	84.9	35.8	81.9 – 87.9		4.6	0.0	1,597	1,597
Fishponds	98.6	11.9	97.4 – 99.7		1.3	0.0	6,206,487	548
Dairy cows	100	n/a	n/a		n/a	0.0	2,254,639	844
Management practice or technology type				n/a				

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
Agriculture water management non-irrigation based	—	—	—		—	—	—	—
Aquaculture management	23.2	42.2	19.1 – 26.7		2.1	0.0	2,313	2,313
Climate adaptation, climate risk management	—	—	—		—	—	—	—
Crop genetics	6.5	24.6	4.0 – 9.0		6.2	0.0	2,313	2,313
Cultural practices	2.7	16.3	1.8 – 3.9		2.1	0.0	2,313	2,313
Irrigation	0.7	8.1	0.0 – 1.6		14.7	0.0	2,313	2,313
Livestock management	36.5	48.1	33.7 – 38.7		1.6	0.0	2,313	2,313
Marketing and distribution	29.8	45.8	26.0 – 33.5		3.9	0.0	2,313	2,313
Natural resource or ecosystem management	—	—	—		—	—	—	—
Pest and disease management	18.6	38.8	15.0 – 22.5		2.3	0.0	2,313	2,313
Post-harvest handling and storage	—	—	—		—	—	—	—
Soil-related fertility and conservation	34.4	47.5	30.9 – 38.4		5.0	0.0	2,313	2,313
Value-added processing	—	—	—		—	—	—	—
Wild-caught fisheries management	—	—	—		—	—	—	—
Other	31.3	46.4	30.2 – 36.8		2.6	0.0	2,313	2,313
Yield of targeted agricultural commodities within target areas								
Rice (mt/ha)	3.1	1.1	3.0 – 3.3		9.1	1.0	1,591	1,591
Rice (mt/ha)								
Farm size								
Smallholder	3.1	1.1	3.0 – 3.3		9.6	1.0	1,589	1,589
Farmers' sex				n/s				
Male	3.1	1.1	3.0 – 3.3		10.1	1.0	1,444	1,445
Female	3.2	1.1	2.9 – 3.4		9.7	1.0	145	144
Farmers' age				n/s				
15-29 years	3.3	1.2	3.1 – 3.5		8.7	0.0	719,789	269
30 years and older	3.1	1.1	3.0 – 3.3		9.8	1.0	1,320	1,320
Non-smallholder	^	^	^		^	^	^	2
Farmers' sex				n/a				

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
Male	^	^	^		^	^	^	2
Female	^	^	^		^	^	^	0
Fishponds (kg/ha)	213.3	270.0	180.2 – 246.3		1.3	38.1	339	339
Farmers' sex				n/s				
Male	215.5	264.0	181.2 – 249.7		1.3	37.1	308	300
Female	191.8	328.2	94.2 –289.4		0.9	38.1	31	39
Farmers' age				*				
15-29 years	148.8	236.6	83.5 – 214.1		0.7	38.6	33	35
30 years and older	220.3	272.3	185.3 – 255.3		1.3	38.1	306	304
Dairy cows (liters/milking cow)	30.1	55.9	24.1 – 36.1		1.5	0.0	500	500
Production system				—				
Agro-pastoral/extensive grassland	—	—	—		—	—	—	—
Farmers' sex				—				
Male	—	—	—		—	—	—	—
Female	—	—	—		—	—	—	—
Farmers' age				—				
15-29 years	—	—	—		—	—	—	—
30 years and older	—	—	—		—	—	—	—
Smallholder mixed livestock-crop	—	—	—		—	—	—	—
Farmers' sex				n/s				
Male	29.8	62.7	21.3 – 38.3		0.9	0.0	197	197
Female	30.2	52.3	22.2 – 38.1		1.4	0.0	235	235
Farmers' age				n/s				
15-29 years	27.3	52.9	12.6 – 42.1		1.1	0.0	57	57
30 years and older	30.4	30.4	24.0 – 36.9		1.2	0.0	375	375
Urban/peri-urban	—	—	—		—	—	—	—
Farmers' sex				—				
Male	—	—	—		—	—	—	—
Female	—	—	—		—	—	—	—
Farmers' age				—				
15-29 years	—	—	—		—	—	—	—
30 years and older	—	—	—		—	—	—	—

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
Intensive industrial	—	—	—		—	—	—	—
Farmers' sex				—				
Male	—	—	—		—	—	—	—
Female	—	—	—		—	—	—	—
Farmers' age				—				
15-29 years	—	—	—		—	—	—	—
30 years and older	—	—	—		—	—	—	—
Prevalence of moderate and severe food insecurity in the population, based on the Food Insecurity Experience Scale								
All households	7.9	n/a	6.4 – 9.4		3.2	0.0	2,525	2,525
Gendered household type				n/s				
Male and female adults	7.7	n/a	6.2 – 9.2		2.8	0.0	2,223	2,222
Female adults only	9.5	n/a	6.3 – 12.7		1.3	0.0	295	296
Male adults only	^	^	^		^	^	6	6
Children only	^	^	^		^	^	1	1
Severity				**				
Moderate	7.0	n/a	5.7 – 8.4		3.3	0.0	326	328
Severe	0.9	n/a	0.6 – 1.1		1.5	0.0	125	125
Prevalence of exclusive breastfeeding among children under 6 months of age[d]								
All children	53.9	50.0	46.3 – 61.5		1.5	0.0	247	247
Children's sex								
Male	50.4	50.2	41.0 – 59.9		1.2	0.0	139	139
Female	58.1	49.6	47.1 – 69.1		1.4	0.0	108	108
Percent of children 6-23 months of age receiving a minimum acceptable diet[d]								
All children	35.9	48.0	31.9 – 39.9		1.0	0.0	562	562
Children's sex								
Male	34.3	47.6	28.4 – 40.2		1.0	0.0	271	271
Female	37.3	48.4	30.5 – 44.1		1.5	0.0	291	291
Percent of women of reproductive age consuming a diet of minimum diversity[d]								
All women	65.7	47.5	62.8 – 68.6		2.6	3.2	2,758	2,758
Women's age				*				
15-18 years	70.1	44.4	65.2 – 75.1		1.3	8.6	426	402
19-49 years	64.9	48.0	62.0 – 67.8		2.2	2.2	2,332	2,356
Prevalence of stunted children under 5 years of age[d]								
All children	27.4	44.6	24.5 – 30.3		2.0	3.9	1,857	1,857
Children's sex								

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
Male	25.9	43.8	22.4 – 29.4		1.5	3.6	954	954
Female	28.9	45.4	24.7 – 33.2		2.1	4.2	903	903
Children's age								
0-23 months	26.6	44.2	22.7 – 30.5		1.6	2.2	804	804
24-59 months	28.0	44.9	24.3 – 31.7		1.8	5.2	1,053	1,053
Prevalence of wasted children under 5 years of age[d]								
All children	7.3	26.1	6.0 – 8.7		1.3	4.2	1,851	1851
Children's sex								
Male	7.7	26.7	5.9 – 9.5		1.1	4.1	949	949
Female	6.9	25.4	5.0 – 8.9		1.4	4.3	902	902
Children's age								
0-23 months	7.3	26.0	5.1 – 9.5		1.5	2.8	799	799
24-59 months	7.4	26.2	5.7 – 9.1		1.2	5.3	1,052	1,052
Prevalence of healthy weight children under 5 years of age[d]								
All children	90.3	29.6	88.8 – 91.8		1.3	4.2	1,851	1,851
Children's sex								
Male	89.3	30.9	87.0 – 91.6		1.3	4.1	949	949
Female	91.3	28.2	89.2 – 93.4		1.3	4.3	902	902
Children's age								
0-23 months	89.7	30.4	87.3 – 92.2		1.3	2.8	799	799
24-59 months	90.7	29.0	88.9 – 92.6		1.1	5.3	1,052	1,052
Prevalence of underweight women of reproductive age[d]								
All non-pregnant women 15-49 years	10.9	31.2	9.6 – 12.2		2.1	1.0	4,907	4,907
Women's age								
15-18 years	24.8	43.2	19.1 – 30.4		1.5	1.0	313	313
19-49 years	9.9	29.8	8.6 – 11.2		2.2	1.0	4,594	4,594
Percent of households with access to basic sanitation service								
All households	66.7	47.1	64.3 – 69.1		1.7	0.0	2,525	2,525
Gendered household type				n/s				
Male and female adults	67.1	47.0	64.5 – 69.6		1.7	0.0	2,223	2,222
Female adults only	64.3	48.0	58.6 – 70.0		1.1	0.0	295	296
Male adults only	^	^	^		^	^	6	6
Children only	^	^	^		^	^	1	1
Residence				n/a				

Feed the Future indicator	Estimate	SD	95% CI	Sig.[a]	DEFF	Non-response rate[b]	Weighted number	Unweighted number[c]
Urban	—	—	—		—	—	—	—
Rural	66.7	47.1	64.3 – 69.1		1.7	0.0	2,525	2,525
Percent of households with soap and water at handwashing station on premises								
All households	53.3	49.9	49.6 – 57.1		3.6	0.0	2,525	2,525
Gendered household type				**				
Male and female adults	54.2	49.8	50.2 – 58.2		3.6	0.0	2,223	2,222
Female adults only	46.6	50.0	41.2 – 52.1		0.9	0.0	295	296
Male adults only	^	^	^		^	^	6	6
Children only	^	^	^		^	^	1	1
Residence				n/a				
Urban	—	—	—		—	—	—	—
Rural	53.3	49.9	49.6 – 57.1		3.6	0.0	2,525	2,525

— = Data are not available
n/a=not applicable
^ Results not statistically reliable, n<30
SD=standard deviation, CI=confidence interval, DEFF=design effect, PPP=purchasing power parity, n/a=not applicable
[a] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.
[b] Non-response rate is defined as: (Number of eligible individuals or households – Number of individuals or households included in the reported indicator)/Number of eligible individuals or households.
[c] Number of units (individuals, households) in the sample.
[d] Estimates are based on de facto household members.
Note: Estimates are based on de jure household members, except where noted.
Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019; Bangladesh Demographic and Health Survey (BDHS) 2017/2018

Table A1.2: Response Rates by Survey Module, Feed the Future Bangladesh ZOI Survey 2018/2019

Response rate[a]	Value
Module 1: Household roster	
Number of households selected	2,525
Number of households occupied	2,525
Number of households interviewed	2,525
Household response rate (%)	100.0
Module 2: Dwelling characteristics	
Number of eligible households	2,525
Number of eligible households interviewed	2,525
Module 2 response rate (%)	100.0
Module 3: Resilience and food security	
Number of eligible households	2,525
Number of eligible households interviewed	2,525
Module 3 response rate (%)	100.0
Module 4: Women's nutrition	
Number of eligible women (15-49 years of age)	2,850
Number of eligible women interviewed	2,758
Module 4 response rate (%)	96.8
Module 4A: Women's anthropometry[b]	
Number of eligible women (15-49 years of age, non-pregnant)	—
Number of eligible women interviewed	—
Module 4A response rate (%)	—
Module 5: Children's nutrition	
Number of eligible children (0-23 months of age)	—
Number of caregivers of eligible children interviewed	—
Module 5 response rate (%)[b]	—
Module 5A: Children's anthropometry[c]	
Number of eligible children (0-59 months of age)	—
Number of caregivers of eligible children interviewed	—
Module 5A response rate (%)	—
Module 6A: A-WEAI, women	
Number of eligible women	2,375
Number of eligible women interviewed	2,327
Module 6A response rate (%)	98.0
Module 6B: A-WEAI, men	
Number of eligible men	2,096
Number of eligible men interviewed	2,008

Response rate[a]	Value
Module 6B response rate (%)	95.8
Module 7.1 Rice farmers	
Number of eligible farmers	1,598
Number of eligible farmers interviewed	1,597
Module 7.1 response rate (%)	99.9
Module 7.50: Dairy farmers	
Number of eligible farmers	844
Number of eligible farmers interviewed	844
Module 7.50 response rate (%)	100.0
Module 7.80: Fishpond farmers	
Number of eligible farmers	548
Number of eligible farmers interviewed	548
Module 7.80 response rate (%)	100.0
Module 7.91: Plot area	
Number of eligible farmers	1,597
Number of eligible farmers interviewed	1,597
Module 7.91 response rate (%)	100.0
Module 7.92: Crop yield	
Number of eligible farmers	1,597
Number of eligible farmers interviewed	1,592
Module 7.92 response rate (%)	99.7
Module 7.96: Pond area	
Number of eligible farmers	548
Number of eligible farmers interviewed	548
Module 7.96 response rate (%)	100.0
Module 8: Consumption expenditures	
Number of eligible households	2,525
Number of eligible households interviewed	2,525
Module 8 response rate (%)	100.0

—= Data are not available

[a] Module response rates are calculated based on the module outcome codes, except where otherwise noted. The response rates are defined as the number of eligible individuals or households interviewed divided by the number of eligible individuals or households. All occupied households are eligible for Modules 1, 2, 3, and 8. Eligibility determination for Modules 4, 4A, 5, 5A, and 6 is initiated in the household roster and confirmed in the respective module. Eligibility determination for sections of Module 7 is initiated in the Module 2 and confirmed in the respective sections of Module 7. Note that for Module 5, the primary caregivers of the children served as the respondents, not the children directly.

[b] Module 4A does not include an outcome code, so the module is considered to be complete if the currently pregnant field is complete, and the height and weight fields have values less than 999.4.

[c] Module 5A does not include an outcome code, so the module is considered to be complete if the length or height field is complete, the height field has a value less than 999.4, and the weight field has a value less than 99.94.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

A1.2 Abbreviated Women's Empowerment in Agriculture Index results for indicators that compose the five domains of empowerment, using uncensored headcount ratios

Table A1.3: Percent of Primary Adult Decisionmakers with Adequate Achievement in Each A-WEAI Indicator Using Uncensored Headcount Ratios, by Sex and Age

	Female		Male		
A-WEAI indicator	Percent	n	Percent	n	Sig.[a]
Input in productive decisions	98.2	2,327	96.6	2,008	**
18-29	96.8	556	95.1	199	n/s
30+	98.7	1,771	96.8	1,809	***
Ownership of assets	96.2	2,327	99.6	2,008	***
18-29	95.7	556	99.0	199	**
30+	96.3	1,771	99.7	1,809	***
Access to and decisions on credit	72.9	2,327	80.7	2,008	***
18-29	71.8	556	71.9	199	n/s
30+	73.2	1,771	81.6	1,809	***
Control over income	97.6	2,327	99.3	2,008	***
18-29	95.7	556	98.0	199	n/s
30+	98.2	1,771	99.5	1,809	**
Group membership	73.4	2,327	68.3	2,008	**
18-29	73.4	556	62.8	199	*
30+	73.3	1,771	68.9	1,809	**
Workload	86.7	2,327	81.3	2,008	***
18-29	81.7	556	82.9	199	n/s
30+	88.3	1,771	81.2	1,809	***

A-WEAI=Abbreviated Women's Empowerment in Agriculture Index

[a] Significance tests were performed to determine whether an association exists between the outcome indicator and primary adult decisionmakers' sex. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

Note: Estimates are based on primary adult decisionmakers who are de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

A1.3 Poverty indicators at the USD $1.25 (2005 PPP) per person per day threshold

Table A1.4: Poverty Indicators at the USD $1.25 (2005 PPP) per Person per Day Threshold in the ZOI, in Total and by Selected Household Characteristics

Household characteristic	Prevalence of poverty[a]		Prevalence of near-poor[c]			Depth of poverty of the poor[e]		
	Percent	Sig.[b]	Percent	Sig.[b]	Number of households (*n*)[d]	Percent of poverty line	Sig.[b]	Number of households (*n*)[d]
All households	18.3		17.63		2,525	16.1		394
Gendered household type		n/s		n/s			n/s	
Male and female adults	18.5		17.8		2,222	15.9		350
Female adults only	16.5		15.9		296	18.2		44
Male adults only	^		^		6	^		0
Children only (no adults)	^		^		1	^		0
Household education		***		***			n/s	
No education	27.1		19.9		146	17.7		30
Less than primary	29.8		18.1		265	17.5		68
Completed primary	20.9		20.4		1,368	15.8		239
Completed secondary	12.4		13.4		354	15.0		35
Higher	6.6		11.6		392	^		22
Wealth quintile		***		***			n/s	
Highest (wealthiest)	3.8		7.2		493	^		14
Fourth	14.2		18.4		486	12.8		56
Middle	18.0		23.1		503	15.2		77
Second	24.6		19.1		511	17.5		105
Lowest (poorest)	31.0		20.3		532	17.4		142
Shock exposure index		*		n/s			n/s	
Did not experience any shocks	17.6		18.1		1,263	15.9		186
Low	13.7		16.1		480	14.4		57
Moderate	20.9		16.9		494	17.9		88
High	24.6		19.4		288	15.6		63

^ Results not statistically reliable, n<30

[a] The prevalence of poverty is the percentage of individuals living below the $1.25 2005 PPP per person per day poverty threshold.

[b] Significance tests were performed to determine whether an association exists between the outcome indicator and the disaggregate variables. Associations found to be statistically significant are indicated by level: * p<0.05, ** p<0.01, *** p<0.001; n/s=not significant.

[c] The prevalence of near-poor is the percentage of individuals living at or above the $1.25 per person per day poverty threshold (2005 PPP) but below 125 percent of that threshold.

[d] Records missing information for the disaggregate variables have been excluded from the disaggregated estimates. The unweighted sample size reflects this loss in observations; therefore, the sum of disaggregate sample sizes may not equal the overall sample size.

[e] The depth of poverty of the poor measures, on average, how far the consumption of the poor is below the $1.25 (2005 PPP) per person per day poverty threshold.

Note: Indicator estimates and disaggregate categories based on individual household members (i.e., gendered household type, household education, and wealth quintile) are calculated using de jure household members.

Source: Feed the Future Bangladesh ZOI Baseline Survey 2018/2019

APPENDIX 2. METHODOLOGY

A2.1 Sampling and weighting

Sampling

The Feed the Future Bangladesh ZOI Baseline Survey 2018/2019included a representative, random sample of the entire population living in the ZOI. A sound and appropriate statistical method was used to calculate the total baseline sample size of 2,500 households in 125 PSUs.[149] The sample design of the ZOI survey followed a stratified sampling in two stages: (1) randomly select 125 PSUs with probability proportional to size (PPS) sampling using the number of households in each PSU as the size, and (2) after a complete census in each of the selected PSUs was conducted, randomly select 20 households per PSU from the census list—using the sampling frame developed from the community series of the 2011 population census of Bangladesh.

This Feed the Future Phase 2 ZOI sample size was the largest required to capture an estimated meaningful amount of change over a six-year period across three Feed the Future goal-level indicators (prevalence of poverty, prevalence of food insecurity, and prevalence of stunting).

IFPRI conducted sample size calculations to ensure adequate power to capture change over time in the estimates of the three goal-level indicators of poverty, hunger, and stunting in the Phase 2 ZOI.[150]

The sample size for the three goal-level indicators collected in the survey was calculated. The largest sample size resulting from the sample sizes computed was chosen as the overall sample size for the survey. For the Feed the Future Bangladesh ZOI baseline survey 2018/2019, the goal-level indicators that were used as a basis for calculating the sample size were:

- Prevalence of stunting among children under five years of age
- Prevalence of moderate and severe hunger
- Prevalence of poverty at USD $1.25 per day

Because these three high-level indicators are likely to have the smallest amount of targeted change among all Feed the Future ZOI PBS indicators, the required sample size should be large enough to capture statistically significant changes in lower-level Feed the Future ZOI PBS indicators, where the amount of change achieved should be greater and thus the sample size required to capture it smaller. In other words, most other indicators likely will have a larger sample size than is required, and a statistical test of differences that is calculated over time for these indicators likely will have more power than necessary.

[149] The BIHS sampling was done by a consultant statistician, former Chief Statistician at the Bangladesh Bureau of Statistics, Ministry of Planning.

[150] Further descriptions and calculations on adjustments are available in the Sampling Guide. Diana Maria Stukel. 2018. *Sampling Guide for Population-Based Surveys in Support of Feed the Future Zone of Influence Indicators.* Washington, DC: Food and Nutrition Technical Assistance Project, FHI 360.

Computing the initial sample size of the survey

Table A2.1 presents the calculation of the initial sample size for the three key Feed the Future ZOI PBS indicators, using the input parameters given in the table and the formula below.

Table A2.1: Calculation of Initial Sample Size for Three Key Feed the Future ZOI PBS Indicators

Indicator	$P_{1, est}$	δ	$P_{2, est}$	$\bar{P}$	$z_{1-\alpha}$	$z_{1-\beta}$	D_{est}	$n_{initial}$
Prevalence of stunted children	0.32	0.064	0.256	0.288	1.64	0.84	2.25	1,383
Prevalence of moderate and severe hunger	0.056	0.022	0.034	0.045	1.64	0.84	1.8	1,886
Prevalence of poverty	0.34	0.068	0.272	0.306	1.64	0.84	3.2	1,804

For an indicator of proportions, the initial sample size formula is given by:

$$n_{initial} = D_{est} * \left[\frac{z_1 - \propto \sqrt{2\bar{P}(1-\bar{P})} + z_1 - \beta \sqrt{P_1,est\,(1-P_1,est) + P_2,est\,(1-P_2,est)}}{\delta}\right]^2$$

where:

$n_{initial}$ is the initial sample size required by the surveys for each of the two time points (i.e., for both the baseline and end-line PBSs).

δ represents the minimum meaningful effect size to be achieved over the time frame specified by the two surveys; note that $\delta \neq 0$ in order to compute formula.

$P_{1,est}$ represents a survey estimate of the true (but unknown) population proportion P_1 at baseline. The values for prevalence of hunger (5.6 percent) and poverty (34 percent) were obtained from the Feed the Future P1-ZOI midterm survey of 2015, and the value for prevalence child stunting (32 percent) was obtained from the Bangladesh Demographic and Health Survey of 2014, estimated for the Feed the Future ZOI.

$P_{2,est}$ represents a survey estimate of the true (but unknown) population proportion P_2 at end-line.

Since $P_{2,est}$ represents a future value that is unknown at baseline when the initial sample size must be computed, it can be approximated by $P_{1,est} - \delta$ for indicators where a decrease is expected over time.

For the Phase 2 ZOI, we assume an endline PBS will be conducted after 6 years to test for statistical change in the indicators. We set targets of reducing stunting by 25 percent; hunger, by 50 percent; and poverty, by 25 percent of the baseline values over the 6-year period. Following example illustrates the $P_{2,est}$ computation for child stunting reduction. The stunting level for children under 5 years of age was 32 percent based on the DHS conducted in 2014 in the same region of Bangladesh where the ZOI is located. We decide to set the minimum meaningful effect size to be 80 percent of the expected target

change of 25 percent reduction in stunting over the 6-year period, which gives 80 percent of 25 percent target reduction from 32 percent stunting, or 20 percent reduction from 32 percent stunting, which is equivalent to 6.4 percentage points reduction in stunting, and so δ = 0.064. Thus, the value of $P_{2,est}$ is 0.256 or 25.6 percent.

$$\bar{P} = \frac{P_{1,est} + P_{2,est}}{2}$$

$Z_{1-\propto}$ is the value from the Normal Probability Distribution corresponding to a confidence level $1-\alpha$. For $1-\alpha$ = 0.95, the corresponding value is $Z_{0.95}$ = 1.64.
$Z_{1-\beta}$ is the value from the Normal Probability Distribution corresponding to a power level of $1-\beta$. For $1-\beta$ = 0.80, the corresponding value is $Z_{0.80}$ = 0.84.

D_{est} is the estimated design effect (DEFF) of the survey, which represents the ratio of the statistical variance (square of the standard error) under the two-stage cluster sampling design for the P2-ZOI baseline survey to the statistical variance under a design using simple random sampling (SRS). The contribution to the DEFF due to clustering of PSUs depends on the size of the sampled PSUs and the degree of homogeneity within PSUs with respect to the indicator in question, the latter of which is normally measured using an intra-class correlation coefficient (ICC). IFPRI-PRSSP researchers estimated the ICC (which is denoted by ρ) for the indicators of poverty (ρ = 0.117) and hunger (ρ = 0.042) using data from the 2011-2012 Bangladesh Integrated Household Survey; and for the indicator of stunting (ρ = 0.066), using data from 2014 the Bangladesh Demographic and Health Survey. From the estimated ICCs, the DEFF is estimated by:

$$DEFF_{clustering} = 1 + (\rho * (\bar{n} - 1))$$

where $\bar{n}$ is the average sample size of households per PSU across all sampled PSUs in the survey. For the P2-ZOI baseline survey, the size of households per PSU is set at 20.

The computation produced initial sample sizes of $n_{initial} = 1{,}383$, $n_{initial} = 1{,}886$, and $n_{initial} = 1{,}804$ for "prevalence of stunted children," "prevalence of moderate and severe hunger," and "prevalence of poverty," respectively.

Computing the final Bangladesh ZOI baseline survey 2018/2019 sample size

Before the survey sample size was finalized, two adjustments to these computations were made: (1) inflation for the number of households to contact and (2) inflation for anticipated household non-response.[151]

[151] Further descriptions and calculations on adjustments are available in the Sampling Guide. Diana Maria Stukel. 2018. *Sampling Guide for Population-Based Surveys in Support of Feed the Future Zone of Influence Indicators.* Washington, DC: Food and Nutrition Technical Assistance Project, FHI 360.

The final sample size, denoted by n_{final}, which is a product of the initial sample size and both adjustments, then becomes:

$$n_{final} = n_{initial} * adj_1 * adj_2 = n_{adj\_1} * adj_2$$

Table A2.2 illustrates the computation of the final sample size for three key Feed the Future ZOI PBS indicators.

Table A2.2: Calculation of Final Phase 2 ZOI Baseline Sample Size for Three Key Feed the Future ZOI PBS Indicators

Indicator	$n_{initial}$	λ	adj_1	n_{adj_1}	adj_2	n_{final}
Prevalence of stunted children	1,383	0.4357	1.7630	2,439	1.020	2,488
Prevalence of moderate and severe hunger	1,886	n/a	1.0	1,886	1.020	1,925
Prevalence of poverty	1,804	n/a	1.0	1,804	1.020	1,841

n/a=not applicable

The "prevalence of stunted children" indicator has the greatest final sample size requirement. Therefore, the overall sample size for the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019will be $n_{final-overall} = 2{,}488$ households. Because the largest sample size is chosen as the overall sample size for the survey, it meets and exceeds the needs of the other two indicators, "prevalence of moderate and severe hunger" and "prevalence of poverty."

Note: The initial sample size, $n_{initial,}$ was inflated to determine the number of households to contact to meet the required sample for individual-level sampling groups, using the following formula:

$$adj_1 = \left[A * \frac{1}{(1-e^{-\lambda})}\right] + 0.5\left[(1-A) * \frac{1}{(1-e^{-\lambda})}\right],$$

where

$$A = (1+\lambda) * e^{-\lambda}$$

The parameter λ is the estimated average number of individuals in the sampling group per household. For the stunting indicator with the unit of analysis being children 0–59 months of age, the average household size is 4.11 (from the Feed the Future ZOI sample of the 2011 baseline survey) and the proportion of children in the rural population that are 0–59 months is 10.6 percent (from the 2014 DHS), the estimated average number of children 0–59 months of age per household is λ = 4.11∗0.106 = 0.4357.

The sample size adjusted for the number of households to contact is then given by:

$$n_{adj_1} = n_{initial} * adj_1$$

where $n_{initial}$ is given by equation (1).

We assume that all eligible children age 0–59 months within a sampled household will be selected for the survey. Therefore, using equation (2):

$$A = (1 + 0.4357) * e^{-0.4357} = (1.4357) * 0.6468 = 0.9286$$

and

$$adj_1 = \left[0.9286 * \frac{1}{1 - 0.6468}\right] + 0.5\left[(1 - 0.9286) * \frac{1}{(1 - 0.6468)}\right] = 1.7630$$

Finally,

$$n_{adj_1} = 1{,}383 * 1.7630 = 2{,}439$$

Therefore, 2,439 households will be sampled to achieve the goal of collecting data on 1,383 children age 0–59 months, assuming all sampled households respond.

Note that the sample size calculation based on household-level indicators—the "Prevalence of Poverty" and the "Prevalence of Moderate and Severe Food Insecurity"—the inflation factor described above is not required because the household is the sample unit for the indicator, so we set adj1 =1.
Another adjustment that needs to be made relates to the anticipated household non-response (denoted by adj_2). It is expected that some proportion of households selected for the survey will be unreachable, unavailable, or unwilling to respond to any of the survey questions.

In the Feed the Future Phase 1 ZOI baseline survey, the response rate was only 99.5 percent. For the Phase 2 ZOI baseline survey, we assume a response rate of 98 percent. Therefore, the sample size should be multiplied by adj_2 =1/0.98=1.02.

The final sample size (denoted by n_{final}), which is a product of the initial sample size and both adjustments, then becomes:

$$n_{final} = n_{initial} * adj_1 * adj_2 = n_{adj_1} * adj_2$$

For the "Prevalence of Stunted Children under Five" indicator, with $n_{adj\text{-}1}$ =2,439 households and $n_{adj\text{-}2}$ = 1/0.98=1.02, the n_{final} = 2,439∗1.02 =2,488. This means that 2,488 households should be sampled to ensure that anthropometric data on 1,383 children age 0–59 months are collected, after accounting for the number of households that need to be visited and household non-response.

Weighting

Data required for weighting of survey data were collected throughout the sampling process and included: (1) PSU measure of size (where size is in terms of number of population or number of households) used for selection of PSUs; (2) measure of size of strata from which PSUs are drawn; (3)

measure of size of PSUs at the time of listing; and (4) response rates among households, women, and men. Sampling probability was computed separately for each sampling stage and for each village (that is, PSU). Weights were calculated for households, women, men, and children in the sample.

Design weights were calculated based on the separate sampling probabilities for each sampling stage and for each cluster:

$f_{1hi} =$ first-stage sampling probability of the *i*-th cluster (village) in stratum *h*

$f_{2hi} =$ second-stage sampling probability within the *i*-th cluster (household selection)

$f_{3hi} =$ third-stage sampling probability within the sampled household (individual selection)

The probability of selecting cluster *i* in the sample is:

$f_{1hi} = \frac{m_h \times N_{hi}}{N_h}$

The second-stage probability of selecting household in cluster *i* is:

$f_{2hi} = \frac{n_{hi}}{L_{hi}}$

and the third stage probability of selecting all individuals within the sampled household is:

$f_{3hi} = 1,$

where

$m_h =$ number of sample clusters selected in stratum *h*

$N_{hi} =$ total population in the frame for the *i*-th sample cluster in stratum *h*

$N_h =$ total population in the frame in stratum *h*

$n_{hi} =$ number of sample households selected for the *i*-th sample cluster in stratum *h*

$L_{hi} =$ number of households listed in the household listing for the *i*-th sample cluster in stratum *h*

The overall selection probability of each household in cluster *i* of stratum *h* is the product of the selection probabilities of the two stages:

$$f_{hi} = f_{1hi} \times f_{2hi} \times f_{3hi} = \frac{m_h \times N_{hi}}{N_h} \times \frac{n_{hi}}{L_{hi}}$$

The design weight for each household in cluster *i* of stratum *h* is the inverse of its overall selection probability:

$$W_{hi} = \frac{1}{f_{hi}} = \frac{N_h \times L_{hi}}{m_h \times N_{hi} \times n_{hi}}$$

The sampling weight was calculated with the design weight corrected for non-response for each of the selected clusters. Response rates were calculated at the cluster level as ratios of the number of interviewed units over the number of eligible units, where units could be household or individual (woman, child).

Post adjustment of weights

Since the measure of size that was used for selecting the PSUs (that is, villages) was extrapolated from the total household size of the 2001 Population Census conducted by the BBS, the current value of this size measure may be very different at endline. Therefore, it is required to project the number of households at the selected PSU level. However, for controlling design effect, it is desirable that the survey weights do not vary widely within each division/stratum. A wide variation of weights within division/stratum may unnecessarily increase the variances of the estimates. Hence, efforts should be made to maintain the similar or almost similar base weights within a division. Base weight is the inverse of the selection probability of an ultimate sampling unit (that is, household). To ensure similar or uniform weight within a division/stratum, the base weight was modified using an adjustment factor. The adjustment factor was determined based on the 2011 Population Census, which is the latest population census available.

The weighting of survey data used information available from the PSU sampling frame (i.e., the first-stage sampling frame), as well as information collected during the listing and data collection processes. This information included the following: (1) measure of size of PSUs (where size is in terms of the size of the population or number of households) used for selection of PSUs; (2) measure of size of strata from which PSUs were drawn; (3) measure of size of PSUs at time of listing; and (4) response rates among households, women, and men. Weights were calculated for the following to account for differing levels of non-response:

1. Households (household-level indicators derived from Modules 2, 3, and 8)
2. Children under 5 years of age (Module 5—children's anthropometry indicators)
3. Children under 2 years of age (Module 5—children's nutrition indicators)
4. Women 15-49 years of age (Module 4—women's dietary and underweight indicators)
5. Primary adult female decisionmakers (Module 6—female A-WEAI indicators)
6. Primary adult male decisionmakers (Module 6—male A-WEAI indicators)

For household level analysis household level weight was used and for children and women individual weights from BDHS were used. For primary adult male and female decisionmakers the design weights were calculated based on individual level non-response adjustment.

Design weights were calculated based on the separate sampling probabilities for each sampling stage and for each PSU. The following notation was used:

f_{1hi} =first-stage sampling probability of the i-th PSU in stratum *h*.
f_{2hi} =second-stage sampling probability within the i-th PSU (household selection).
f_{3hi} = third-stage sampling probability within the sampled household (individual selection)

The probability of selecting PSU *i* from stratum *h*, in the sample is calculated as follows:

$$f_{1hi} = \frac{m_h \times N_h}{N_{hi}},$$

where

$m_h =$ number of sample PSUs selected in stratum *h*.

$N_h =$ total number of households according to the sampling frame in all PSUs in stratum *h*.

$N_{hi} =$ total number of households in selected PSU *i* in stratum *h* (as per the first-stage sampling frame).

The second-stage probability of selecting a household from PSU *i* in stratum *h*, (**assuming that there is no segmentation within sampled PSU *i***) is:

$$f_{2hi} = \frac{n_{hi}}{N^*_{hi}}$$

where

$n_{hi} =$ number of sample households selected for the *i*-th sample PSU in stratum *h.*

$N^*_{hi} =$ total number of households listed for the *i*-th PSU in stratum *h.*

Therefore, the overall selection probability of selecting a household from PSU *i* of stratum *h* is the product of the selection probabilities of the two stages:

$$f_{hi} = f_{1hi} \times f_{2hi} = \frac{m_h \times N_{hi}}{N_h} \times \frac{n_{hi}}{N^*_{hi}} \approx \frac{m_h \times n_{hi}}{N_h} \quad , \quad if\ N_{hi} \approx N^*_{hi}$$

The design weight for each household in PSU *i* of stratum *h* is the inverse of its overall selection probability:

$$W_{hi} = \frac{1}{f_{hi}} = \frac{N_h \times N^*_{hi}}{m_h \times N_{hi} \times n_{hi}} \approx \frac{N_h}{m_h \times n_{hi}} \quad , \quad if\ N_{hi} \approx N^*_{hi}$$

The sampling weight was calculated with the design weight corrected for non-response for each of the selected PSUs. Response rates were calculated at the PSU level as ratios of the number of interviewed units over the number of eligible units within adjustment classes, where units could be households or individuals (women, children, or primary adult female or male decisionmakers).

To calculate the weight adjustments for household non-response, the survey tracked both the selected households that do not respond and the selected households that do respond. Both responding and non-responding households have probabilities of selection. However, since no interview has taken place for the non-responding selected households, the sample weights of the responding selected households are adjusted to compensate for those that did not respond.

The weight adjustment for household non-response is calculated as:

$$w_{HH\_NR\_h} = \frac{sum\ of\ w_h over\ all\ households\ selected\ to\ be\ interviewed\ in\ stratum\ h}{sum\ of\ w_h\ over\ all\ households\ responding\ in\ stratum\ h},$$

where w_h is the sampling weight across all stages of sampling (design weight). The above formula implies that a weight adjustment for household non-response should be calculated separately for each stratum. The adjustment is computed at the stratum level to preserve self-weighting.[152]

The sampling weight also corrected for Individual non-response (i.e., primary adult male decision maker, primary adult decision maker). This occurs when an eligible individual within a sampled household is not available for, refuses, or does not respond to a request for an interview. For individual non-response, a separate adjustment must be made for each sampling group to which the individual belongs, corresponding to the relevant associated indicators.

To calculate the weight adjustments for individual non-response for any of the sampling groups in question, the survey tracked both the selected individuals who do not respond and the selected individuals who do respond. Both respondent and non-respondent individuals have probabilities of selection. But because no interview takes place for the non-responding selected individuals, the sample weights of the responding selected individuals are adjusted to compensate for those that did not respond.

The weight adjustment for individual non-response for a specific sampling group is calculated as:

$$w_{IN\_NR\_h} = \frac{sum\ of\ w_h\ over\ all\ individuals\ from\ sampling\ group\ selected\ to\ be\ interviewed\ in\ stratum\ h}{sum\ of\ w_h\ over\ all\ individuals\ from\ sampling\ group\ responding\ in\ stratum\ h},$$

where w_h is the sampling weight across all stages of sampling (design weight). The above formula implies that, similar to the case of household non-response adjustments, a weight adjustment for individual non-response should be calculated separately for each stratum. The adjustment is computed at the stratum level to preserve self-weighting.[153]

So, the final household level weights (computed within each stratum separately) are formed by multiplying the sampling weights for the first three stages (which is the same as the sampling weight for all four stages) by the weight adjustment for non-response at the household-level only:

$$w_{final,HH,h} = w_h \times w_{HH\_NR\_h},$$

where w_h is the sampling weight across all stages of sampling and $w_{HH\_NR\_h}$ weight adjustment for household non-response.

[152] Further descriptions and calculations on adjustments are available in the Sampling Guide. Diana Maria Stukel. 2018. *Sampling Guide for Population-Based Surveys in Support of Feed the Future Zone of Influence Indicators.* Washington, DC: Food and Nutrition Technical Assistance Project, FHI 360.

[153] Further descriptions and calculations on adjustments are available in the Sampling Guide. Diana Maria Stukel. 2018. *Sampling Guide for Population-Based Surveys in Support of Feed the Future Zone of Influence Indicators.* Washington, DC: Food and Nutrition Technical Assistance Project, FHI 360.

And, for individual level indicators, the final weights (computed within each stratum separately) are formed by multiplying the sampling weights for all three stages by the weight adjustment for non-response at both the household and individual levels:

$$w_{final,INDIV,h} = w_h \times w_{HH\_NR\_h} \times w_{IN\_NR\_h},$$

where w_h is the sampling weight across all stages of sampling and $w_{HH\_NR\_h}$ is the weight adjustment for household non-response and $w_{IN_NR_h}$is the weight adjustment for individual non-response.

A2.2a Poverty prevalence and consumption expenditure methods

Data source

Prevalence of poverty at $1.90 (2011 PPP) per person per day, depth of poverty of the poor at $1.90 (2011 PPP) per person per day, and prevalence of near-poor (households living on and above $1.90 (2011 PPP) per person per day, but less than $2.38 per person per day (2011 PPP)) were calculated using the data from the Feed the Future Bangladesh ZOI baseline survey 2018/2019.

The Household Roster and Household Consumption Expenditure modules of the BIHS questionnaire are used to calculate the per capita expenditures and prevalence of poverty indicators. The household consumption expenditure module is similar to the LSMS, where households' consumption of various food and non-food items is measured to infer household income and well-being. Food and non-food consumption are covered in separate modules in the BIHS questionnaire.

Food consumption expenditure was calculated from Module O1 of the BIHS questionnaire. This module collected information on total quantity of food consumed, by source (including own production, purchase, gifts, etc.), and price per unit of food consumed on more than 300 food items, with a recall period of last 7 days. All food quantities were converted to kg for solid foods and liters for liquid foods, as per Step 2a under "**Section 9.2.1: Food consumption expenditures for the past 7 days**" from the *Guide to Feed the Future Statistics*. Outliers were flagged and confirmed as per Step 3 in **Section 9.2.1**. Missing prices were replaced by median prices at the smallest local administrative unit available as per Step 4 of **Section 9.2.1**. Per capita daily expenditure on food was calculated by dividing total food expenditure of the last seven days by the product of 7 and household size (de jure household members only).

According to "**Section 9.2.2: Regular non-food, non-durable goods expenditures of the past 7 days**" in the *Guide to Feed the Future Statistics*, information on regular, non-food, non-durable goods is meant to be collected using seven-day recall method. However, in BIHS, information on regular, non-food, non-durable goods were collected using one-month recall (Module P1). The method of deriving per capita daily expenditure for regular, non-food, non-durable goods is very similar to what has been described under Section 9.2.2 of the guide.

According to "**Section 9.2.3: Occasional non-food, non-durable goods expenditures of the past 1 month**", "**Section 9.2.4: Occasional non-food, non-durable goods of the past 3 months**" and "**Section 9.2.5: Occasional non-food, non-durable goods of the past 12 months**" of the *Guide to Feed the Future Statistics*, information on occasional, non-food, non-durable goods is to be collected using past 1-month recall, past 3-months recall, and past 12-months recall, respectively.

However, in BIHS, information was collected using 1-month recall (Module P1) for some of the items in the category of occasional, non-food, non-durable goods, and 12-months recall (Module P2) for others. In the *Guide to Feed the Future Statistics*, Step If of **Section 9.2.3** suggests dropping items related to health expenditure. However, health expenditure items were retained in our calculation of consumption expenditure from BIHS, but extreme outliers were capped. Legal fees were also retained in the consumption expenditure calculation from BIHS, although Step If of **Section 9.2.5** in the Guide to Feed the Future Statistics suggests dropping these items. However, other lumpy expenditure items and expenses related to rare events such as religious pilgrimage, marriage, birth of a new member and funerals were omitted as per Step If of **Section 9.2.5**. Other expenses that were dropped include insurance and expenditure on durable assets. Large expenditure values were flagged, verified and where necessary, capped at 3 standard deviations from the mean. Expenses for occasional, non-food, non-durable goods were all converted to daily per capita units.

Information on durable goods is in Module D of the BIHS questionnaire. The annual "rental price" of durable goods are derived by multiplying current value by the depreciation rate and average real interest rate (obtained from Module F of BIHS questionnaire). This method of calculation is very similar to the steps described under "**Section 9.2.6: Consumption expenditures on durable goods owned by the household**" of the *Guide to Feed the Future Statistics*. Consumption expenditure of durable goods were converted to daily per capita units.

Housing expenditures included rent (actual and imputed), as well as repairs and maintenance. These items were combined to form per capita daily housing expenditure as per Step 5 of "**Section 9.2.7: Consumption expenditures on housing**". All households in our sample provided an actual/imputed rent value, so there was no need to employ hedonic regression to impute values for households with missing rent information, as described in Step 8 of **Section 9.2.7**.

All food expenditures, regular non-food, non-durable expenditures, occasional non-food, non-durable expenditures, durable asset consumption expenditures and housing expenditures were combined and converted into daily per capita units for all $1.90 (2011 PPP) poverty threshold-related indicator calculations.

The prevalence of poverty at the national extreme threshold of poverty of Bangladesh was calculated using Bangladesh Household Income and Expenditure Survey (HIES) 2016 data. The sample was restricted to rural Barishal and rural Khulna divisions. Depth of poverty of the poor at the national extreme threshold and prevalence of near-poor at the national extreme threshold were also calculated from HIES 2016.

The prevalence of poverty at the national threshold of poverty of Bangladesh was also calculated using HIES 2016 data. The sample was restricted to rural Barishal and rural Khulna divisions. Depth of poverty at the national threshold and prevalence of near-poor at the national threshold were also calculated from HIES 2016.

In HIES, household expenditure includes household consumption and other spending by the household. Consumption expenditure of the household is the total value of goods and services explicitly consumed by the household during the reference period. Non-consumption expenditure items include income tax and other taxes, pension, social security contributions, related insurance premium, gifts, and other

transfers. Other items included in expenditure are additions to savings and investments. More details are available in the Final Household Income and Expenditure Survey 2016 Report, published by BBS.[154]

Data preparation

Data excluded from analysis:

Consumption expenditure calculation from BIHS 2018/2019

- All lumpy expenditures and life cycle events are excluded from consumption expenditure. Such expenses include: expense for pilgrimage, dowry/dower, caesarean section, land purchase, etc. The transfers of money to entities outside of the households (e.g., donations, insurance, taxes, or levies) or expenses on large purchases that occur infrequently, as Deaton and Zaidi (2002) have suggested, are excluded because they either do not contribute to the household's well-being or are considered "lumpy expenditures" that should not be included within the aggregate.

- Durable goods costs are excluded but use value of durable goods is included. For durable goods, data were collected in a manner that allows the calculation of use value per annum/month. The BIHS collected information for a list of durable items in the asset module of the questionnaire. This information included the following: the number of such items owned, the year of purchase, the price of purchase, and the estimate of the current value of the item. Since durable goods are typically expensive and used year after year, the purchase price or the current value is not added directly to the consumption aggregate. Instead, the consumption value of durable goods is estimated as a flow of services accrued to the household—that is, the use value of the durable good. The use value includes the value of durable goods used till date of the survey, and the opportunity cost of interest earnings. The calculation, however, excludes antiques and jewelry, which do not depreciate in value over time.

- The rental value of housing for households who rented the housing units was used as the housing expenditure. For owner-occupied households or employer-provided households, the expected rental values were used as housing expenditure. In all such cases, the respondent reported the expected value of the rent by estimating their housing cost based on the cost of housing for similar dwelling units in the neighborhood.

Consumption expenditure calculation from HIES 2016

- HIES is a secondary source dataset. IFPRI does not have access to details regarding the calculation of consumption expenditure from HIES. For more details on calculating the consumption expenditure from HIES, please refer to Ahmed et al. (2017).[155]

Imputations:

Consumption expenditure calculation from BIHS 2018/2019

[154] BBS (2017)
[155] Ahmed et al. (2017)

- For items with missing prices, prices were imputed from the next available level of disaggregation. If household level price was not available, then price was imputed from the village-level, or from the union-level, or from the upazila-level, or from the district-level, or from the division/strata-level, depending on the market from which the price of the items that have missing value were identified. This imputation was done for only a few food items that were missing the price at the household level.

- The data were inspected for outliers so that expenditure measures were not distorted. Generally, 3 standard deviations (Z value) were calculated for continuous variables to test whether the distribution is normal or skewed. Other standard measures for data validity and reliability process were also followed.

Consumption expenditure calculation from HIES 2016

- The HIES is a secondary source dataset. IFPRI does not have access to details regarding the calculation of the consumption expenditure from HIES. Please see Ahmed et al. (2017) for more details.

Prices:

Consumption expenditure calculation from BIHS 2018/2019

- Market surveys were performed to collect village-level prices along with the collection of household prices based on the BIHS questionnaire.

- There is little temporal and spatial price variation in the Feed the Future data. Since the BIHS data were collected over three months within a single season, there is minimal variation of price over time. Furthermore, markets are integrated in the 20 districts of the Feed the Future ZOI, with prices remaining relatively constant. Thus, there is little spatial variation in prices as well.

Consumption expenditure calculation from HIES 2016

- The HIES is a secondary source dataset. IFPRI does not have access to details regarding the calculation of consumption expenditure from HIES. Please see Ahmed et al. (2017) for more details.

Other adjustments:

Weights

Consumption expenditure calculation from BIHS 2018/2019

Based on the sampling procedure described previously, weights were calculated for the household-level based on the proportion of households in the survey to the number of actual households in each stratum of the sample. Population weights are generated by multiplying the household sampling weight by the number of household members present in each of the sampled households in the BIHS survey.

Consumption expenditure calculation from HIES 2010 & 2016

- HIES is a secondary source dataset. IFPRI does not have access to details regarding the calculation of consumption expenditure from HIES. Please see Ahmed et al. (2017) for more details.

Currency conversions using consumer price indices and purchasing power parity

In order to analyze the data, the consumption values and poverty thresholds had to be adjusted for inflation and converted between *Taka* and USD. The inflation adjustments were done using the Rural General Consumer Price Index (CPI), and the conversion between *Taka* and USD was done using the 2011 PPP.

Poverty thresholds

Prevalence of Poverty at $1.90 (2011 PPP) per person, per day

The local currency equivalent (LCE) of the PPP $1.90 per day poverty line was calculated as follows:

$$LCE_{2018/2019} = 1.90 \times PPP_{2011} \times \left[\frac{Survey\ Month\ and\ Year\ Price\ index_{2018/2019}}{2011\ Price\ Index}\right]$$

The $1.90 2011 PPP threshold is equivalent to 72.482 *taka*, per person, per day in 2018/2019 prices.

Prevalence of Poverty at National Poverty Threshold and at National Extreme Poverty Threshold

The national poverty threshold is the national upper poverty line, which is the summation of the food poverty line and the upper non-food allowance, as calculated by BBS using HIES. HIES 2016 was used, the most recent national survey conducted by the BBS, to assess the poverty status of rural Barishal and rural Khulna divisions (areas corresponding to majority of Phase 2 Feed the Future ZOI in Bangladesh) at the national poverty threshold for those regions.

According to BBS (2016), the poverty lines are estimated using the Cost of Basic Needs (CBN) method. This method is used to calculate the cost of obtaining a consumption bundle believed to be adequate for basic consumption needs. The CBN method is used to generate food and non-food poverty lines, which represent the minimum per capita expenditure that a person needs to be able to afford basic needs.

The food poverty line is based on the cost of consuming a bundle of eleven food items consisting of coarse rice, wheat, pulses, milk, oil, meat, fish, potatoes, vegetables, sugar and fruits that is needed to meet a minimum nutritional requirement of 2,122 kcal /day for one person. The cost of this food basket is both spatially and temporally updated using Törnqvist food price indexes. The non-food allowance is estimated by taking the median amount spend for non-food items by a reference group of households whose total per capita expenditure is close to the food poverty line.

The food poverty line plus the upper non-food allowance is equal to the upper poverty line, referred to as national poverty line in this report.

The food poverty line plus the lower non-food allowance is equal to the lower poverty line, referred to as national extreme poverty line in this report. Similarly to the poverty estimations at the national poverty threshold, poverty estimations at the national extreme poverty threshold are also calculated from HIES 2016 for rural Khulna and rural Barisal divisions.

According to the HIES 2016 Report, published by BBS, the upper and lower poverty lines are kept constant over time in real terms, so that proper comparisons of poverty rates can be made across time. The poverty lines for 2016 have been updated from the 2005 poverty lines using price indices constructed for each quarter.[156] Table A2.2 shows the lower and upper poverty lines for rural Barishal and rural Khulna divisions that were used to calculate poverty estimations from HIES 2016.

Table A2.2: National Extreme Poverty Threshold and National Poverty Threshold, in *Taka* per person, per month, of rural Barishal and rural Khulna divisions of Bangladesh, 2016

	National Extreme Threshold (Lower Poverty Line)	National Threshold (Upper Poverty Line)
2016		
Barishal (rural)	1,778	2,056
Khulna (rural)	1,677	2,019

Source: Household Income and Expenditure Survey, 2016.

For more details on national poverty lines, please see Appendix C of the HIES Final Report published by BBS.

A2.2b Wealth index

Asset-based wealth indices have increasingly been used as alternatives to income and consumption expenditure-based measures for several reasons, most notably because they are: (1) more stable measures of socioeconomic well-being, (2) able to better detect differences in equity, and (3) easier to collect and require shorter interviews. This appendix presents a short description of the methodology for calculating the wealth index. Additional details on how to prepare the data and perform the calculations for producing the wealth index are provided in the *Guide to Feed the Future Statistics*.[157]

The methodology for computing a wealth index using the Feed the Future ZOI Survey data is based on the approach developed by the DHS. The DHS approach to computing a wealth index assumes that wealth is an underlying unobservable variable and that a set of variables can identify the relative position of households in the underlying distribution of the wealth factor. The table below summarizes assets that were used to construct the wealth index for the Feed the Future Bangladesh ZOI Survey 2018/2019. Factor analysis was performed to assign weights to the assets. Each household was then assigned a wealth score equal to the sum of the weighted indicators. Wealth scores were standardized with a mean of zero and a standard deviation of one and then categorized into quintiles based on the distribution of the household population.

[156] BBS (2017)

[157] Zalisk et al. (2019)

Assets used to construct the wealth index

1. Domestic servants
2. Ownership of agricultural land and size of land
3. Number of people per sleeping room
4. House ownership
5. Water source
6. Toilet facility
   Main type of facility
   Whether the facility is shared with other households
7. Floor material
8. Roof material
9. Wall material
10. Cooking fuel
11. Farm animals (type and number):
    Cows
    Other cattle
    Goats
    Sheep
    Chicken or other poultry
    Fish
    Other
12. Household possessions:
    Electricity
    Radio
    Television
    Non-mobile telephone
    Computer
    Refrigerator
    Watch
    Mobile phone
    Bicycle
    Motorcycle or scooter
    Boat with a motor
13. Bank account

The "percentage of households below the comparative threshold for the poorest quintile of the asset-based comparative wealth index (CWI)" ZOI Survey indicator reflects the percentage of households in the ZOI that, based on asset ownership, fall below a fixed threshold that defines the poorest quintile (bottom 20 percent) in the comparative baseline wealth index that was used to create a cross-nationally, cross-temporally comparable asset-based wealth index, the CWI. Use of a fixed threshold across ZOIs is possible because the CWI is an index with threshold values that are relative to the baseline wealth index that is used for comparison. This means that the index scores and thresholds can be compared across ZOI Surveys and over time.

A2.3 Criteria for achieving adequacy for Women's Empowerment in Agriculture Indicators

The below table presents the Women's Empowerment in Agriculture five dimensions of empowerment, their corresponding empowerment indicators, the survey questions that are used to elicit the data required to establish adequacy or inadequacy for each empowerment indicator, their corresponding variables in the ZOI Survey dataset, and how adequacy criteria are defined for each empowerment indicator. For additional details refer to the Feed the Future Guide to Statistics.[158]

Domain	Indicator name	Survey questions	ZOI Survey (2018-2019) questions	ZOI Survey (2018-2019) variables	Adequacy criteria	Inadequacy criteria	Weight
Production	Indicator 1.1: Input in productive decisions	"When decisions are made regarding food crop farming, cash crop farming, livestock raising, and fishing or fishpond culture, who is it that normally takes the decision?"	Q.6202 (a, b, c, f)	v6202_01-v6202_03, v6202_06	For at least one activity: decides alone; OR participates and has input into some; or most or all decisions regarding the activity; OR does not make the decision NOR feels he or she could to a medium or high extent if wanted to	Participates but does not have input into some; or most or all decisions regarding the activity; OR does not make the decision NOR feels he or she could to a medium or high extent (93 "no decision made" coded as missing)	1/5
		"How much input did you have in making decisions about food crop farming, cash crop farming, livestock raising, and fishing or fishpond culture?"	Q.6203 (a, b, c, f)	v6202_01-v6202_03, v6202_06			
		"To what extent do you feel you can make your own decisions regarding these aspects of household life if you want(ed) to: food crop farming, cash crop farming, livestock raising, and fishing or fishpond culture if you wanted to?"	Q.6204 (a, b, c, f)	v6202_01-v6202_03, v6202_06			

[158] Zalisk et al. (2019)

Resources	Indicator 2.1: Ownership of assets	"Does anyone in your household currently have any [ITEM]?: agricultural land, large livestock, small livestock, chickens/ducks/turkeys/ pigeons, fishpond or fishing equipment, hand tools, non-mechanized farm equipment, mechanized farm equipment, non-farm business equipment, house, large consumer durable goods, small consumer durable goods, cell phone, other land or structures, and means of transportation?" "Do you own any of the item either by yourself or jointly with someone else?"	Q.6301a–Q.6301n Q.6303a–Q.6303n	v6301_01-v6301_15 v6303_01-v6303_15	Owns—alone or jointly—at least one large asset or two types of small assets (small assets are chickens/ducks/ turkeys/pigeons, hand tools, non-mechanized farm equipment, and small consumer durable goods)	Does not own any assets; OR owns only one type of small asset alone or jointly	2/15
	Indicator 2.2: Access	"Has anyone in your household taken any loans or borrowed cash/in-kind from	Q.6308a–Q.6308f	v6308_1-v6303_6	Can alone or jointly make at	Household has no credit; OR	1/15

Domain	Indicator name	Survey questions	ZOI Survey (2018-2019) questions	ZOI Survey (2018-2019) variables	Adequacy criteria	Inadequacy criteria	Weight
	to and decisions over credit	[SOURCE] in the past 12 months?: NGO, informal lender, formal lender, friends or relatives, group-based microfinance or lending (savings/credit group), informal credit/savings groups such as merry-go-rounds, tontines, funeral societies, etc." "Who made the decision to borrow from [SOURCE]?" "Who makes the decision about what to do with the money/item borrowed from [SOURCE]?"	Q.6309a–Q.6309f Q.6310a–Q.6310f	v6309_1-v6309_6 v6310_1-v6310_6	least one decision regarding at least one source of credit	household has credit but respondent did not participate in any decision about it	

Domain	Indicator name	Survey questions	ZOI Survey (2018-2019) questions	ZOI Survey (2018-2019) variables	Adequacy criteria	Inadequacy criteria	Weight
Income	Indicator 3: Control of use of income	"How much input did you have in decisions on the use of income generated from food crop farming, cash crop farming, livestock raising, non-farm economic activities, wage and salary employment, and fishing or fishpond culture?" "To what extent do you feel you can make your own personal decisions regarding these aspects of household life if you want(ed) to?: non-farm activities, own wage and salary employment, major household expenditures"	Q.6205a–Q.6205f Q.6204d, Q.6204e, Q.6204g	v6205_01-v6206_03, v6206_06 v6204_04, v6204_05, v6204_07	Has input into some; or most or all decisions on use of income for at least one productive/ economic activity; OR feels can make decisions to medium or high extent if respondent wanted for at least one income or expenditure decision—excludes minor household expenditures	Participates in activity but has no input in decisions about income, OR feels she or he has no or very little input into the decision regarding income from non-farm activities, wage and salary employment, or decisions regarding major household expenditures even if she or he wanted to	1/5
Leadership	Indicator 4.1: Membership in economic or social group	"Are you an active member of an agricultural/livestock/fisheries producers' group, waters users' group, forest users' group, credit/microfinance group, mutual help/insurance group, trade and business association, trade and business association, civic groups, local government, religious group, other women's/men's group, or any other formal or informal organization?"	Q.6405a–Q.6405k	v6405_01-v6405_11	Is an active member of at least one group	Is not an active member of at least one group	1/5

Domain	Indicator name	Survey questions	ZOI Survey (2018-2019) questions	ZOI Survey (2018-2019) variables	Adequacy criteria	Inadequacy criteria	Weight
Time	Indicator 5.1: Workload	The survey collected information on respondents' time allocation for a 24-hour period. Information was collected for primary activities and reported in 15-minute intervals.	Q.6601	v6601p_15_[hour], v6601p_30_[hour], v6601p_45_[hour], v6601p_60_[hour] where [hour] is a value 1–24	Works less than or equal to 10.5 hours in 24-hour period	Works more than 10.5 hours in 24-hour period	1/5

APPENDIX 3. DATA QUALITY

This appendix presents information that reflects the quality of data collected in the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019. Data-driven decisions call for high-quality data collection. High quality data was ensured in the ZOI baseline survey through field monitoring, data post-processing, and data analysis. The questionnaire was revised based on feedback and pre-tested in the field to ensure that the survey questionnaire was error-free and to serve as an end-to-end rehearsal of all content and survey procedures. During field-level data collection, survey supervisors routinely oversaw interviews conducted by enumerators, and verified that enumerators completed all questionnaires on a daily basis. If the supervisors detected inconsistencies in responses in completed questionnaires, they visited the related respondents to identify the reasons and correct the responses as needed. In addition, the supervisors made random checks of about 10 percent of the completed questionnaires by revisiting the sample households. The Bangladesh ZOI Survey used the CSPro software for data entry and conducting data quality checks, including completion checks, structure checks, and consistency checks.

Similarly, continuous data monitoring in the field is fundamental to the quality of data collection. In addition to using the data collection and monitoring approach described in the Feed the Future ZOI Survey Toolkit field manuals,[159] the Bangladesh ZOI survey in-country data manager ran field check tables that provided a management system for checking data quality. These tables cross-checked certain quality control indicators by field teams and individual interviewers to detect potential areas in which correction and remedial action were required. Any issues that were attributed to non-sampling error (that is, field-based error) were communicated as feedback to the field teams.

In the post-processing stage, secondary editing procedures were implemented according to the Feed the Future ZOI Survey Data Processing Manual to ensure the data were clean and of the highest quality. During the analysis phase, any inconsistencies or issues identified by data analysts were communicated to the data processing manager for troubleshooting and resolution.

The remainder of this appendix focuses on final field check tables. These results are a reflection of the quality of fieldwork for the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019.

Table FC-1 presents the household completion rate. During the Feed the Future Bangladesh ZOI baseline survey 2018/2019, the teams were formed containing one supervisor for two teams of two interviewers. In total, 24 survey teams were deployed to collect data for the Feed the Future Bangladesh ZOI baseline survey 2018/2019.

The overall household response rate was 100.0 percent, which is greater than the target of 95.0 percent for the household response rate.

[159] USAID (2018)

Table FC-1: Household Completion Rate

Percent distribution of sampled households by result of household interview and household response rate by interviewer team, Feed the Future Bangladesh ZOI baseline survey 2018/2019

Team	Result of household interview								Total number	Total percentage	Household response rate (%) [a]
	Completed (1)	Not at home (2)	Extended absence (3)	Refused (5)	Dwelling vacant (6)	Not a dwelling (7)	Ill or impaired (10)	Other (96)			
Team 1	82	0	0	0	0	0	0	0	82	100.0	100.0
Team 2	121	0	0	0	0	0	0	0	121	100.0	100.0
Team 3	123	0	0	0	0	0	0	0	123	100.0	100.0
Team 4	103	0	0	0	0	0	0	0	103	100.0	100.0
Team 5	120	0	0	0	0	0	0	0	120	100.0	100.0
Team 6	61	0	0	0	0	0	0	0	61	100.0	100.0
Team 7	100	0	0	0	0	0	0	0	100	100.0	100.0
Team 8	121	0	0	0	0	0	0	0	121	100.0	100.0
Team 9	120	0	0	0	0	0	0	0	120	100.0	100.0
Team 10	120	0	0	0	0	0	0	0	120	100.0	100.0
Team 11	80	0	0	0	0	0	0	0	80	100.0	100.0
Team 12	102	0	0	0	0	0	0	0	102	100.0	100.0
Team 13	121	0	0	0	0	0	0	0	121	100.0	100.0
Team 14	100	0	0	0	0	0	0	0	100	100.0	100.0
Team 15	101	0	0	0	0	0	0	0	101	100.0	100.0
Team 16	104	0	0	0	0	0	0	0	104	100.0	100.0
Team 17	100	0	0	0	0	0	0	0	100	100.0	100.0
Team 18	80	0	0	0	0	0	0	0	80	100.0	100.0
Team 19	101	0	0	0	0	0	0	0	101	100.0	100.0
Team 20	123	0	0	0	0	0	0	0	123	100.0	100.0
Team 21	60	0	0	0	0	0	0	0	60	100.0	100.0
Team 22	202	0	0	0	0	0	0	0	202	100.0	100.0
Team 23	100	0	0	0	0	0	0	0	100	100.0	100.0
Team 24	80	0	0	0	0	0	0	0	80	100.0	100.0
All teams	2525	0	0	0	0	0	0	0	2525	100.0	100.0

[a] Household response rate=(1)/[(1)+(2)+(3)+(5)+(10)]x100. The target is 95 percent for the household response rate.

Table FC-2 presents information about the presence of primary adult decisionmakers in households with a completed roster.

Across all 24 survey teams, virtually all surveyed households had at least one primary adult decisionmaker. More households had a primary adult female decisionmaker (99.8 percent) than a primary adult male decisionmaker (88.2 percent).

Table FC-2: Primary Male and Female Decisionmakers

Number of households with a completed roster and, among those households, the percentage with at least one male member 18 years of age or older, the percentage with a male decisionmaker, the percentage with at least one female member 18 years of age or older, the percentage with a female decisionmaker, and the percentage of households with at least one decisionmaker, by interviewer team, Feed the Future Bangladesh ZOI baseline survey 2018/2019

		Male		Female		
Team	HH with Module 1 completed (N)	HH with at least one male member 18+ (%)	HH with primary adult male decisionmaker (%)	HH with at least one female member 18+ (%)	HH with primary adult female decisionmaker (%)	HH with at least one primary adult decisionmaker (%)
Team 1	82	92.7	92.7	100.0	100.0	100.0
Team 2	121	87.6	85.1	100.0	100.0	100.0
Team 3	123	87.0	87.0	100.0	100.0	100.0
Team 4	103	90.3	90.3	100.0	100.0	100.0
Team 5	120	89.2	89.2	99.2	99.2	100.0
Team 6	61	88.5	88.5	100.0	100.0	100.0
Team 7	100	94.0	94.0	100.0	100.0	100.0
Team 8	121	84.3	84.3	100.0	100.0	100.0
Team 9	120	84.2	84.2	100.0	100.0	100.0
Team 10	120	85.0	85.0	99.2	99.2	99.2
Team 11	80	87.5	87.5	100.0	100.0	100.0
Team 12	102	90.2	88.2	100.0	100.0	100.0
Team 13	121	92.6	92.6	100.0	100.0	100.0
Team 14	100	93.0	93.0	100.0	100.0	100.0
Team 15	101	97.0	97.0	99.0	99.0	100.0
Team 16	104	88.5	88.5	100.0	100.0	100.0
Team 17	100	91.0	91.0	100.0	100.0	100.0
Team 18	80	88.8	88.8	100.0	100.0	100.0
Team 19	101	83.2	83.2	98.0	98.0	100.0
Team 20	123	91.9	91.9	100.0	100.0	100.0
Team 21	60	83.3	83.3	100.0	100.0	100.0
Team 22	202	85.6	85.6	99.5	99.5	100.0
Team 23	100	84.0	84.0	100.0	100.0	100.0
Team 24	80	86.3	85.0	100.0	100.0	100.0
All teams	2525	88.5	88.2	99.8	99.8	100.0

HH=household
Note: The target is [100% - expected prevalence of child-only households].

Table FC-3 assesses age heaping in the household roster. Age heaping can be a common occurrence in surveys; however, a high rate of age heaping can introduce serious bias to the survey results and may

indicate less careful interviewing. One-third (33.3 percent) of household members in five-year age groups had their ages recorded as ending in 5 or 0. Although this is slightly above the 30 percent target for all age ranges, this may be acceptable.

Table FC-3: Age Heaping in the Household Roster

Percentage of household members in 5-year age groups with ages recorded as ending in 5 or 0 by interviewer team, Feed the Future Bangladesh ZOI baseline survey 2018/2019

	Ages of household members											
Team	Ages 3-7 recorded as 5 (%)	Ages 8-12 recorded as 10 (%)	Ages 13-17 recorded as 15 (%)	Ages 18-22 recorded as 20 (%)	Ages 23-27 recorded as 25 (%)	Ages 28-32 recorded as 30 (%)	Ages 33-37 recorded as 35 (%)	Ages 38-42 recorded as 40 (%)	Ages 43-47 recorded as 45 (%)	Ages 48-52 recorded as 50 (%)	All ages ending in 5 or 0 (%)	Number of household members
Team 1	20.7	25.6	8.7	21.1	20.7	25.0	41.9	54.5	47.4	44.0	35.2	327
Team 2	31.0	21.8	25.6	19.0	15.0	34.1	29.7	29.7	47.6	25.9	30.2	444
Team 3	23.3	26.8	23.1	30.0	16.2	47.1	50.0	43.3	61.5	53.6	39.8	450
Team 4	11.4	18.8	27.3	21.6	18.5	33.3	17.9	15.4	24.1	30.4	26.4	409
Team 5	28.0	16.3	31.8	27.8	18.2	27.3	63.6	37.5	55.6	44.4	37.8	460
Team 6	15.4	13.0	26.1	23.8	23.8	33.3	61.5	38.5	27.3	57.1	37.2	250
Team 7	25.9	31.3	33.3	29.0	20.0	28.1	43.5	37.9	75.0	43.8	39.5	382
Team 8	18.4	27.3	17.0	24.4	23.7	34.1	40.5	47.1	23.5	25.0	31.1	466
Team 9	21.1	19.4	27.1	28.3	25.0	27.3	39.4	33.3	32.1	33.3	31.2	529
Team 10	15.6	21.9	21.6	34.3	19.2	41.9	37.8	55.6	73.9	46.2	38.6	492
Team 11	18.9	23.3	17.9	37.1	18.5	31.6	30.4	53.3	36.4	20.0	31.3	342
Team 12	20.5	16.3	29.4	18.2	30.0	38.9	58.3	55.0	36.8	58.3	39.1	394
Team 13	22.9	35.8	23.9	29.6	17.0	36.1	41.4	42.9	40.0	32.3	36.4	503
Team 14	29.6	22.5	30.0	29.0	29.2	33.3	60.7	38.7	50.0	43.5	41.1	409
Team 15	17.0	18.5	18.2	40.7	10.7	39.5	48.6	37.1	40.0	50.0	32.8	436
Team 16	13.3	21.7	22.0	9.8	25.6	40.6	34.6	42.9	50.0	33.3	33.2	382
Team 17	14.0	23.8	22.2	19.4	14.3	25.8	26.7	21.4	25.8	24.0	22.7	410
Team 18	17.6	15.8	31.4	36.4	26.1	44.8	40.9	36.8	41.2	58.3	36.8	329
Team 19	22.2	28.1	14.8	25.0	19.4	24.2	20.8	43.5	33.3	29.2	27.0	441
Team 20	12.1	18.4	30.0	19.1	14.0	52.8	23.3	32.3	41.2	46.4	31.6	471
Team 21	16.1	28.2	30.0	21.1	27.8	58.8	70.6	45.0	52.9	10.0	38.2	275
Team 22	17.9	23.5	21.3	22.5	15.6	31.9	46.9	34.6	37.2	27.3	31.9	774
Team 23	22.4	17.3	20.0	26.5	32.4	32.3	36.4	23.8	23.1	47.6	30.1	422
Team 24	19.5	10.0	25.0	15.6	22.6	25.7	46.2	40.0	23.1	21.4	24.4	389
All teams	19.9	22.0	23.8	25.1	20.7	35.0	41.1	38.5	41.3	37.9	33.3	10,186

Note: The target for all age ranges is 30 percent.

Table FC-4 presents the mean number of eligible women of reproductive age per household. The number of eligible women and the total number of completed households are used to compute the mean number of eligible women per household. On average, there is 1.1 eligible women of 15-49 years of age present per household for the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019. The target mean number of eligible women per household of 1.15 was obtained from the BBS 2011 Population and Housing Census data, which are the latest available census data in Bangladesh.

Table FC-4: Eligible Women per Household

Mean number of eligible women 15-49 years of age per household, Feed the Future Bangladesh ZOI baseline survey 2018/2019

Team	Completed household (N)	Eligible women in completed household (N)	Mean number of eligible women per household
Team 1	82	90	1.1
Team 2	121	126	1.0
Team 3	123	132	1.1
Team 4	103	118	1.1
Team 5	120	138	1.2
Team 6	61	71	1.2
Team 7	100	105	1.1
Team 8	121	141	1.2
Team 9	120	138	1.2
Team 10	120	138	1.2
Team 11	80	99	1.2
Team 12	102	107	1.0
Team 13	121	136	1.1
Team 14	100	111	1.1
Team 15	101	115	1.1
Team 16	104	120	1.2
Team 17	100	116	1.2
Team 18	80	91	1.1
Team 19	101	109	1.1
Team 20	123	131	1.1
Team 21	60	75	1.3
Team 22	202	218	1.1
Team 23	100	118	1.2
Team 24	80	107	1.3
All teams	2,525	2,850	1.1

Note: The target is 1.15 number of eligible women per household.

Table FC-5 presents the mean number of eligible children under 6 years of age per household.

On average, each household had 0.5 eligible children younger than 6 years of age. The target number for eligible children younger than *six* years of age from the population census data could not be obtained; however, the available 2011 population census data indicate that the target number for eligible children younger than 5 years of age is 0.4 eligible children per household.

Table FC-5: Eligible Children per Household

Mean number of eligible children younger than 6 years of age per household, Feed the Future Bangladesh ZOI baseline survey 2018/2019

Team	Completed household (N)	Eligible children in household (N)	Mean number of eligible children per household
Team 1	82	34	0.4
Team 2	121	55	0.5
Team 3	123	53	0.4
Team 4	103	40	0.4
Team 5	120	65	0.5
Team 6	61	36	0.6
Team 7	100	39	0.4
Team 8	121	56	0.5
Team 9	120	76	0.6
Team 10	120	66	0.6
Team 11	80	45	0.6
Team 12	102	46	0.5
Team 13	121	57	0.5
Team 14	100	41	0.4
Team 15	101	63	0.6
Team 16	104	35	0.3
Team 17	100	47	0.5
Team 18	80	44	0.6
Team 19	101	63	0.6
Team 20	123	47	0.4
Team 21	60	36	0.6
Team 22	202	92	0.5
Team 23	100	65	0.7
Team 24	80	59	0.7
All teams	2,525	1260	0.5

Note: The target is 0. number of eligible children per household.

* The number represents children younger than five years of age as data for children younger than six years of age were not available from the BBS 2011 population census data and could not be estimated for baseline.

Table FC-6 presents the eligibility and response rate of primary adult female decisionmakers.

All 2,524 eligible primary adult female decisionmakers who were interviewed during the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019 responded to the WEAI module. The overall response rate of 100.0 percent is above the target response rate of 95 percent.

Table FC-6: Module 6 (Women) Women's Empowerment in Agriculture Module, Eligibility and Response Rate

Percent distribution of eligible women (primary adult female decisionmaker) by result of individual outcome, by interviewer team, Feed the Future Bangladesh ZOI baseline survey 2018/2019

Team	Result of module		Total (%)	Number of women	Response rate[a]
	Completed (code 1)	Respondent not at home (code 4)			
Team 1	82	0	100.0	82	100.0
Team 2	121	0	100.0	121	100.0
Team 3	123	0	100.0	123	100.0
Team 4	103	0	100.0	103	100.0
Team 5	120	0	100.0	120	100.0
Team 6	61	0	100.0	61	100.0
Team 7	100	0	100.0	100	100.0
Team 8	121	0	100.0	121	100.0
Team 9	120	0	100.0	120	100.0
Team 10	120	0	100.0	120	100.0
Team 11	80	0	100.0	80	100.0
Team 12	102	0	100.0	102	100.0
Team 13	121	0	100.0	121	100.0
Team 14	100	0	100.0	100	100.0
Team 15	101	0	100.0	101	100.0
Team 16	104	0	100.0	104	100.0
Team 17	100	0	100.0	100	100.0
Team 18	80	0	100.0	80	100.0
Team 19	100	0	100.0	100	100.0
Team 20	123	0	100.0	123	100.0
Team 21	60	0	100.0	60	100.0
Team 22	202	0	100.0	202	100.0
Team 23	100	0	100.0	100	100.0
Team 24	80	0	100.0	80	100.0
All teams	2,524	0	100.0	2,524	100.0

[a] The response rate is the percentage of households completed divided by the number with response codes 1 and 5. The target response rate is 95 percent.

Table FC-7 presents the eligibility and response rate of primary adult male decisionmakers. Among the eligible 2,227 primary adult male decisionmakers interviewed as part of the Feed the Future Bangladesh ZOI Baseline Survey 2018/2019, 2,242 respondents completed the WEAI module. The overall response rate was 99.7 percent, which is above the target response rate of 95 percent.

Table FC-7: Module 6 (Men) Women's Empowerment in Agriculture Module, Eligibility and Response Rate

Percent distribution of eligible men (primary adult male decisionmaker) by result of individual outcome, by interviewer team, Feed the Future Bangladesh ZOI baseline survey 2018/2019

Team	Result of module			Total (%)	Number of men	Response rate[a]
	Completed (code 1)	Respondent not at home (code 4)	Refused (code 5)			
Team 1	76	0	0	100.0	76	100.0
Team 2	103	2	1	100.0	106	99.0
Team 3	107	0	0	100.0	107	100.0
Team 4	88	4	1	100.0	93	98.9
Team 5	106	0	1	100.0	107	99.1
Team 6	54	0	0	100.0	54	100.0
Team 7	94	0	0	100.0	94	100.0
Team 8	101	0	1	100.0	102	99.0
Team 9	101	0	0	100.0	101	100.0
Team 10	102	0	0	100.0	102	100.0
Team 11	70	0	0	100.0	70	100.0
Team 12	90	0	0	100.0	90	100.0
Team 13	115	0	0	100.0	115	100.0
Team 14	93	2	0	100.0	95	100.0
Team 15	97	0	1	100.0	98	99.0
Team 16	92	0	0	100.0	92	100.0
Team 17	91	0	0	100.0	91	100.0
Team 18	71	0	1	100.0	72	98.6
Team 19	84	0	1	100.0	85	98.8
Team 20	114	0	0	100.0	114	100.0
Team 21	50	0	0	100.0	50	100.0
Team 22	174	0	0	100.0	174	100.0
Team 23	84	0	0	100.0	84	100.0
Team 24	70	0	0	100.0	70	100.0
All teams	2,227	8	7	100.0	2,242	99.7

[a] The response rate is the percentage of households completed divided by the number with response codes 1 and 5. The target response rate is 95 percent.