RESEARCH PROGRAM ON Agriculture for Nutrition and Health

CGIAR

LED BY IFPRI

Impact of sanitation and animal faeces on health and undernutrition

Wash Nutrition Forum, French Red Cross Office, Paris, France
27-29/11/2017

Aulo Gelli and Derek Headey, IFPRI.

Agenda

- Rationale (5m)
- Conceptual framework (5m)
- Review of what we know (10m)
- Evidence gaps (2m)
- SELEVER impact evaluation (5m)
- Conclusion (3m)

Rationale

- Scaling-up nutrition specific interventions will not meet global targets for improving nutrition outcomes (Bhutta et al., 2013)
- Other sectors are required and agriculture has strong potential due to the many ways it can influence underlying determinants of nutrition (Black et al., 2013)
- Livestock a key sector in nutrition-sensitive agriculture
  - High-quality protein and bioavailable micronutrients
  - Potential source of income and productive assets
  - But may also increase health risks through exposure to zoonotic diseases

"Livestock are everywhere… *and they don't use toilets*"

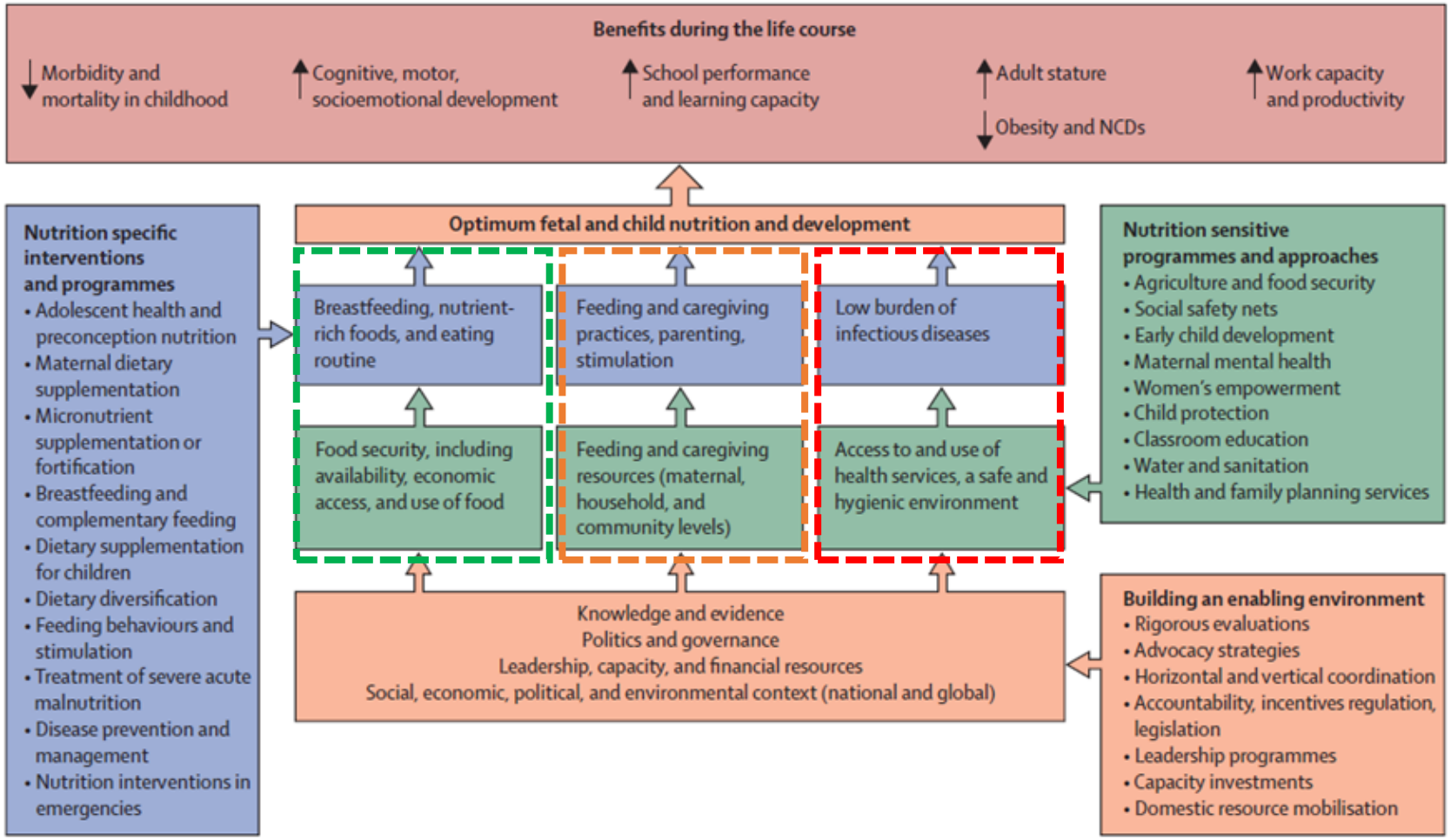
- Data from 46 countries (rural DHS)

	Cattle	Horses	Goats	Sheep	Chickens
MENA (N=2)	21%	20%	22%	24%	31%
Central Africa (N=5)	9%	0%	20%	7%	36%
Tropical W. Africa (N=8)	13%	2%	27%	17%	47%
Latin America (N=3)	19%	18%	21%	4%	53%
ECA (N=6)	54%	17%	11%	27%	58%
South & SE Asia (N=4)	46%	10%	32%	5%	57%
Sahel/Sahara (N=4)	58%	48%	57%	49%	59%
East/Southern Africa (N=10)	33%	9%	30%	9%	59%
Average	*31%*	*14%*	*28%*	*18%*	*52%*

Rationale

- WASH sector has focused little attention to livestock management and animal feces disposal
  - Elevated health risks for children, including diarrhea, environmental enteric dysfunction (EED) and respiratory infections
  - EED thought to reduce appetite, inhibit nutrient absorption, impair immune system function, associated with stunting
  - Scavenging poultry are a particular concern…

How can livestock interventions affect nutrition outcomes?



(Black et a., 2013)

WASH, livestock and nutrition pathways

- Observations of young children in Zimbabwe Peru and Bangladesh found that children directly ingested or mouthed poultry feces (Ngure et al., 2013, Marquis et al., 1990) or soils contaminated with poultry feces (Ngure et al., 2013, Morita et al., 2017)
- Animal feces may be a larger risk for EED than human feces because of the greater exposure of young children to animal feces (Mbuya and Humphrey, 2016)
- Systematic review found evidence that poultry and livestock exposure associated with diarrhea (Zambrano et al., 2014)
- Poultry ownership was positively associated with child HAZ in Ethiopia, but corralling poultry in the household dwelling overnight was negatively associated with HAZ (Headey and Hirvonen 2016)
- Having an animal corral within a child's sleeping room associated with elevated EED scores and doubled odds of child stunting in Bangladesh (George, Otia, Biswas, Perin, Lee, Ahmed, et al. 2015)

Livestock feces exposure: New observational study across 3 countries

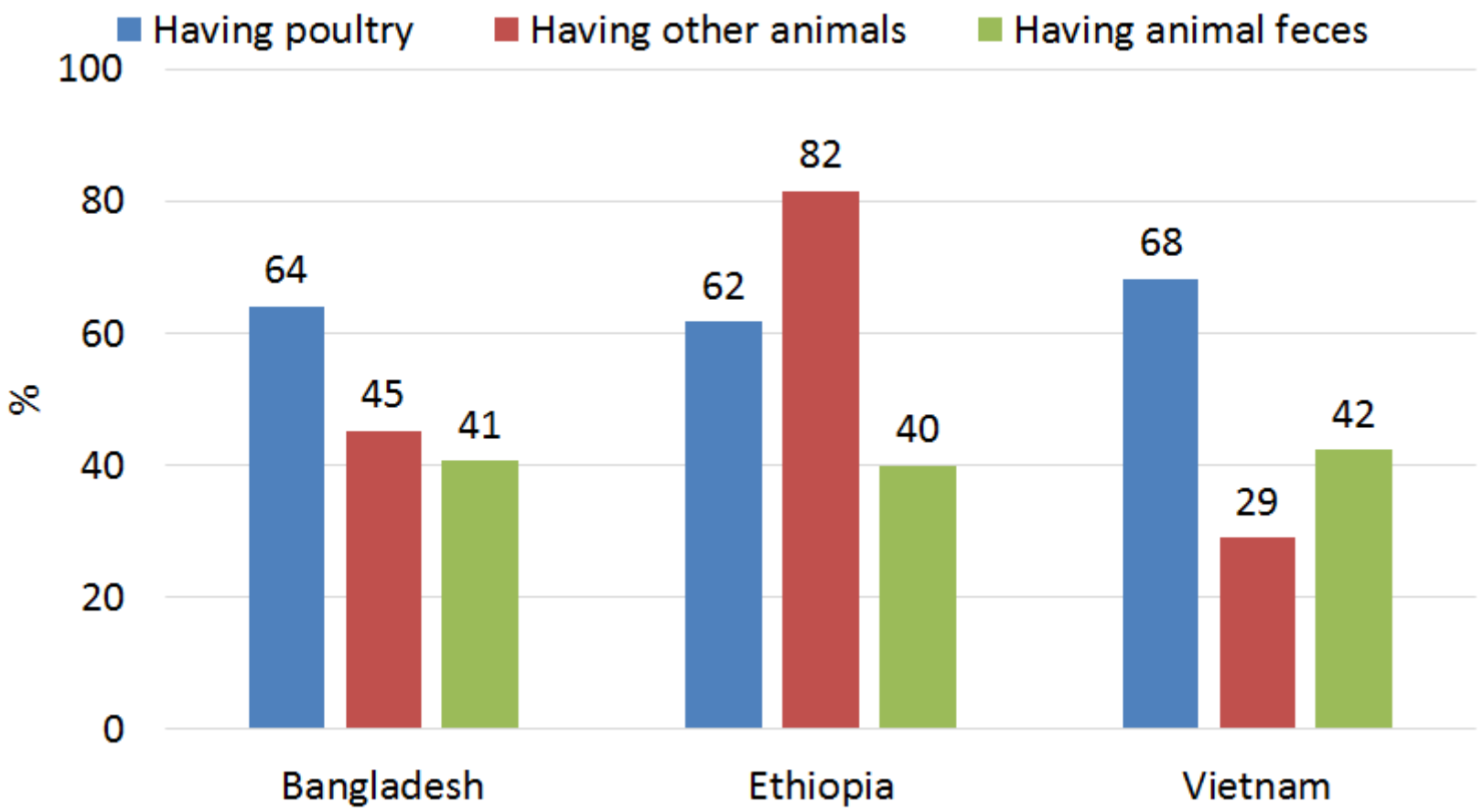
- (Headey et al., 2017) examined children's exposure to animal feces, factors associated with exposure to animal feces, and associations between exposure to animal feces and children's anthropometry and symptoms of morbidity
  - Used Alive & Thrive surveys in Bangladesh, Ethiopia & Vietnam in 2010 & 2014
  - Large samples, high quality anthropometric data, mother reports on morbidity
  - Detailed hygiene spot checks, as well as standard WASH indicators
  - Includes observation of animal feces in compound, cleanliness of mother, child, compound & house
  - Aggregated hygiene indicators into summary measures and focused on children 6-23.9 months

Hygiene-related outcomes

	Bangladesh (n= 2,214)	Ethiopia (n= 1,750)	Vietnam (n= 2,104)
Animal feces in compound (%)	40.61	37.8	41.7
Human feces in compound (%)	4.83	15.8	1.0
Improved toilet[3] (%)	28.7	N.A.	49.2
Any toilet[3] (%)	NA	82.7%	NA
Use of soap for hand cleaning (%)	43.9	60.5	95.7
Improved drinking water[4] (%)	66.7	54.2	86.9
Mother fully clean[1] (%)	72.7	34.4	69.0
Child fully clean[1] (%)	62.5	32.7	70.1
House fully clean[2]	24.9	15.8	20.1

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health
Led by IFPRI

Prevalence of animal feces around the house in Bangladesh, Ethiopia and Vietnam



Regression models explaining the presence of animal feces in compound

	Bangladesh	Ethiopia	Vietnam
Owns Poultry	1.61***	1.30*	2.71***
Owns cattle/ buffalo	1.27+	3.23**	1.65***
Owns Goat/ sheep	1.51**	1.03	0.85
Mother fully clean	0.60***	0.54***	0.49***
Child fully clean	0.62***	0.67**	0.71*
Improved toilet	0.94	0.79	0.59***
Improved drinking water	1.04	0.85	0.75
SES/wealth effects?	No	Positive	Negative
Mother's education effects?	None	Weakly negative	None

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Model for HAZ and WHZ among children 6-23.9 m

	Bangladesh		Ethiopia		Vietnam	
	Unadjusted	Adjusted[1]	Unadjusted	Adjusted	Unadjusted	Adjusted
HAZ						
Animal feces	-0.26***	-0.16*	-0.19*	-0.18*	-0.02	0.06
Mother's clean	0.37***	0.04	0.11	-0.06	0.16**	-0.02
Child's clean	0.43***	0.03	0.33***	0.10	0.27***	0.07
Hygienic toilet	0.40***	0.18***	0.1	0.12	0.25***	0.09
Hygienic water	0.42***	0.16+	-0.03	-0.01	0.28***	0.11
WHZ						
Animal feces	-0.12*	-0.06	-0.14*	-0.01	-0.24***	-0.09
Mother's clean	0.21***	0.05	0.16*	0.09	0.28***	0.02
Child's clean	0.18***	0.00	0.16**	0.12	0.36***	0.20***
Hygienic toilet	0.26***	0.16*	0.16*	0.11	0.14**	-0.08
Hygienic water	0.17**	0.08	-0.09	-0.13+	0.23***	0.02

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health
Led by IFPRI

Odds ratios for child morbidity symptoms among children 6-23.9 months

	Bangladesh		Ethiopia		Vietnam	
	Unadjusted	Adjusted[1]	Unadjusted	Adjusted[1]	Unadjusted	Adjusted[1]
Diarrhea						
Animal feces	1.45*	1.32+	1.13	1.03	1.62**	1.29
Fever						
Animal feces	1.20*	1.10	1.06	1.10	1.54***	1.15
Cough/cold						
Animal feces	1.02	0.95	0.99	1.09	1.41***	1.21+

- Very few covariates significant in adjusted models
- Exception is maternal cleanliness in Ethiopian survey

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

SELEVER impact evaluation

- Cluster randomized controlled trial design implemented in 120 rural villages within 60 communes in 3 regions of Burkina Faso
- Aimed at evaluating the impact of integrated poultry value chain package on the diets, health and nutritional status of women and children

SELEVER intervention package

- **Improved access to value chain services:** Vaccinations, financing and training on poultry flock management
- **Behaviour change communication (BCC) on nutrition**: Promotion of improved diets at key stages of the lifecycle
- **Community-level sensitization on women's economic empowerment and gender equity, including strengthening of women's groups:** Including training member of women's associations on enterprise development

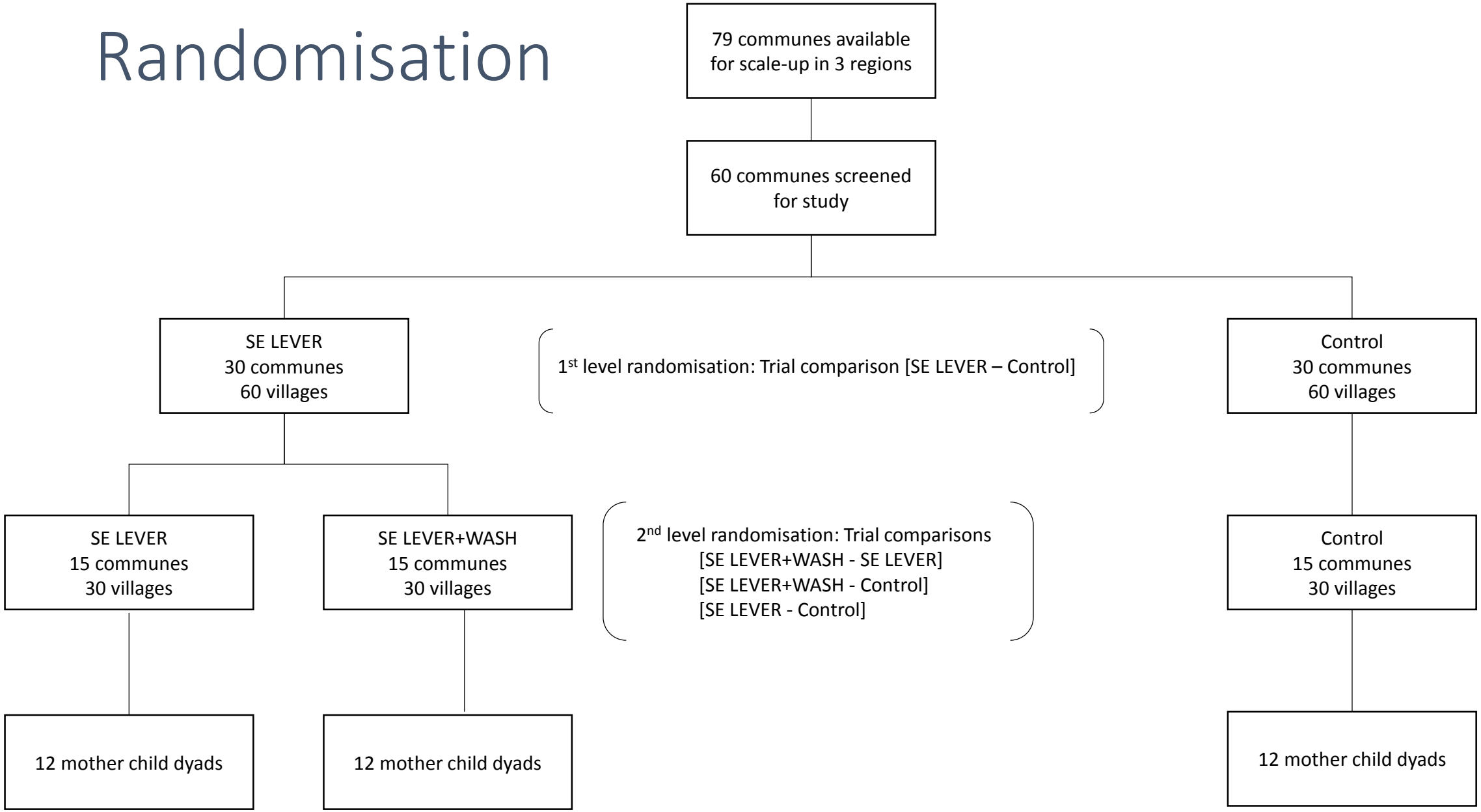
Formative research

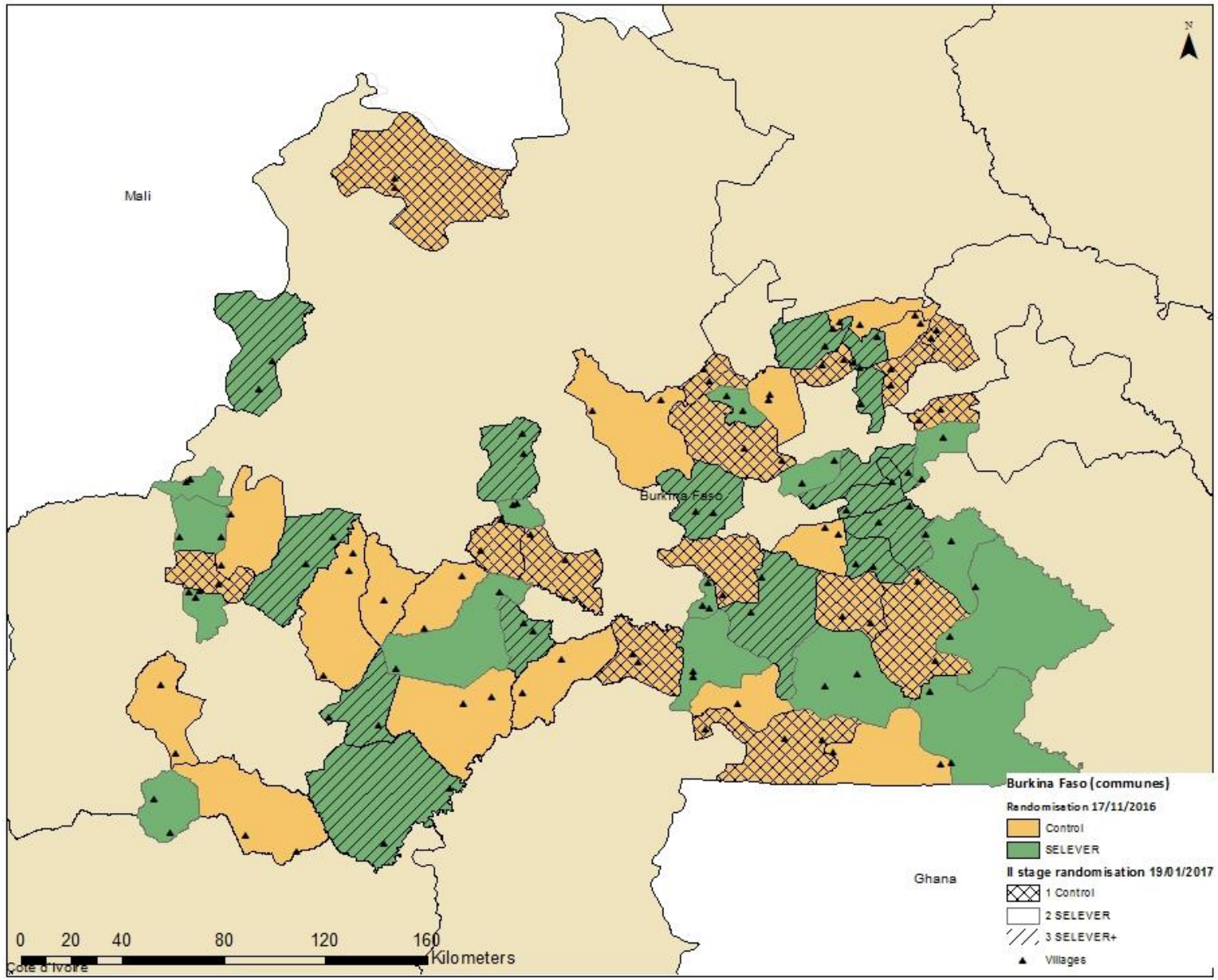
- Identify need for additional nutrition-sensitive WASH interventions and guide intervention design

Enhanced WASH component

- Information only
- Two main objectives:
  - Improving the WASH environment at community and household level (through CLTS)
  - Reducing children's exposure to poultry and livestock feces at household level (through specific hygiene-related messaging)

Randomisation



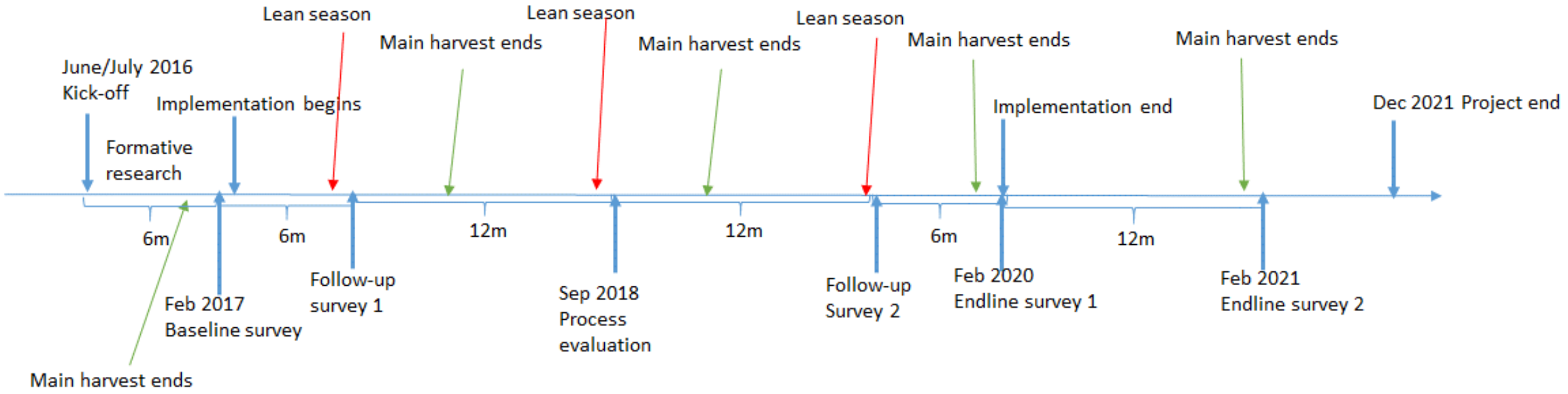


RESEARCH PROGRAM ON
Agriculture for Nutrition and Health
CGIAR
Led by IFPRI

Study outcomes

- Based on analysis of programme theory, the primary indicators for the study include:
  - Women's probability of adequacy (PA) for iron, zinc and vitamin A, and mean probability of adequacy (MPA) in micronutrients intake.
  - Children's (2-4 year olds) PA for iron, zinc and vitamin A and MPA in micronutrients intake.
  - Children's (6-24m) dietary diversity and other IYCF practices.
  - Household poultry production, sales and profits.
- Also assess a number of secondary outcomes and intermediate indicators along pathways

Study timeline



RESEARCH PROGRAM ON Agriculture for Nutrition and Health

CGIAR

Led by IFPRI

Baseline results

WASH environment descriptives	
Chicken feces in compound (%)	72
Human feces in compound (%)	15
Clean toilet (%)	26
Any toilet (%)	59
Use of soap for hand cleaning (%)	1
Treat drinking water (%)	11
Mother fully clean (%)	49
Child fully clean (%)	36
House fully clean	15

Regression model for presence of Feces (logit)	
Owns Poultry	0.39**
Owns cattle	0.21
Owns Goat/ sheep	0.19**
Own donkey	0.17**
Own porc	0.26*
Mother fully clean	0.03
Child fully clean	-0.52***
Treat drinking water	0.39**
Clean toilet	-0.65***
SES/wealth effects?	Yes
Mother's education effects?	No

Models for nutrition, infection and child development

	6-24m		24-48m	
	HAZ	WHZ	HAZ	WHZ
Malaria				
Age	-0.09***	-0.02***	0.002	0.002
Girl	0.2**	0.249***	0.016	-0.012
Chicken feces	0.01	0.04	-0.015	-0.087*
Child clean	0.12	-0.12*	0.175**	-0.103**
Treated water	-0.01	0.25**	0.114	0.055
Latrine clean	0.11	-0.02	0.064	0.065
Exp. quintile	0.01	0.07**	0.043**	0.049**
Mum completed primary	0.11	-0.12	0.21**	-0.145**

24-48m				
AGP	CRP	Hb	Anemia	Language
0.341***	5.477***	-0.603***	0.19***	-0.972*
-0.012***	-0.02	0.026**	-0.007**	0.525***
0.003	-0.127	0.137*	-0.042	0.246
0.077	1.628**	-0.184*	0.078**	-0.825**
-0.036	0.51	-0.05	0.011	-0.035
-0.15**	-0.745	-0.285**	0.079	0.787
0.009	1.728**	-0.102	0.038	-0.037
-0.008	0.002	0.034	-0.011	0.379**
0.045	0.262	0.112	-0.05	0.715

Very Preliminary, do not cite!

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health
Led by IFPRI

In summary…

- Emerging evidence suggests that important trade-offs exist in terms of the effectiveness of livestock interventions on child nutrition
  - Benefits in terms of animal source food consumption, income and diets may be offset by exposure to livestock feces and other contaminants
  - More research needed to clarify the mechanisms and identify the scale of the problem, including seasonality
- Plenty of scope to improve measurement: Hygiene spot checks; parental reports, morbidity symptoms …etc.
- Experimental research needed to identify:
  - Effects of livestock exposure on child nutrition and development
  - Obstacles to more nutrition-sensitive livestock rearing
  - Most effective means of overcoming these obstacles

Thank you!

RESEARCH PROGRAM ON Agriculture for Nutrition and Health

CGIAR

Led by IFPRI

WASH, diarrhea and nutrition

- Fecal contamination of the household environment is an important source of diarrheal pathogens (Curtis, Cairncross, and Yonli 2000; Marquis et al., 1990; Pickering et al. 2012)
- Strong evidence that poor WASH conditions contribute significantly to the burden of diarrheal morbidity and mortality (Esrey 1996; Checkley et al. 2004; Fink, Gunther, and Kenneth 2011; Mara et al. 2010; DFID 2013; Curtis and Cairncross 2003; Fewtrell et al. 2005; Aeillo et al. 2008; Ejemot et al. 2008; Cairncross et al. 2010)
- Evidence linking diarrhea to linear growth is less clear with several studies claiming that height is a more sensitive indicator of the health benefits of improved water and sanitation than diarrhea (Esrey 1996)

WASH, Acute Respiratory Infections, and Undernutrition

- Co-occurrence of respiratory and gastrointestinal infections has been reported in Bangladesh (Leung et al. 2015), Pakistan (Ashraf et al. 2013), and India and Nepal (Walker et al. 2013). Diarrhea was associated with increased risk of acute lower respiratory infections (ALRIs) in Indian and Nepali children (Walker et al. 2013) and in undernourished child populations in Ghana (Schmidt et al. 2009). The risk of comorbidities increased with the severity of the diarrhea (Walker et al. 2013). Recent diarrhea was also associated with increased risk of pneumonia in Pakistani children under five years old (Ashraf et al. 2013).