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CLIMATE CHANGE, GENDER, AND NUTRITION LINKAGES
Research Priorities for Bangladesh

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Climate change, coupled with high levels of poverty and population density, is a substantial threat to sustainable development in Bangladesh. Climate-related threats, such as flooding, inundation, salt-water intrusion, and changes in temperatures are increasing with climate change. Achieving the goals of Feed the Future and the Global Food Security Strategy requires careful consideration of the impact of relevant climate science on agricultural production, while at the same time considering other cross-cutting issues that influence agricultural growth, poverty alleviation, and resilience—especially gender and nutrition. This policy note summarizes assessments of these linkages in Bangladesh under the Gender, Climate Change, and Nutrition Integration Initiative (GCAN).

Changes in Climate

Between 1948 and 2011, the yearly mean temperature in Bangladesh rose by 0.64°C and temperatures in the premonsoon and monsoon seasons rose by 6 and 11 percent, respectively (Quadir et al. 2016). Varying by location and model, future trends based on results from four global circulation models suggest that both average temperatures and total rainfall will increase. Changes in the mean daily maximum temperature of the warmest month—one of the standard indicators of potential heat stress for agriculture—are projected to range from 1.9 to 4.7°C nationally, and from 2.0 to 4.9°C in the Feed the Future zone of influence (ZOI). Mean yearly rainfall changes are projected to range from 164mm to 352mm for Bangladesh, and from 90mm to 346mm for the ZOI (Figure 1).

Aggregated simulation results from four climate models project negative effects on yields for all major crops (Figure 2). Sugarcane and groundnut yields are projected to fall by 40 and 30 percent, respectively. Average yields of rice, wheat, and maize are also projected to fall, but comparatively less than those of sugarcane and groundnuts.

Bangladesh's Take on Climate-Smart Agriculture

Climate-Smart Agriculture (CSA) involves practices to increase productivity sustainably; enhance resilience through adaptation; reduce or remove greenhouse gas emissions through mitigation, where possible; and enhance the achievement of national food security and development goals. CSA is an umbrella term encompassing a multitude of location-specific solutions and approaches, and is recognized, albeit with limits, as a potential means of contributing to the achievement of the United Nations' Sustainable Development Goals. CSA is not prescriptive, but rather is an approach that addresses climatic risks at the intersection of productivity, resilience, and climate mitigation. As adverse impacts of climate change on agricultural production are becoming more evident, CSA practices are being promoted and adopted in several regions of Bangladesh, and several practices are listed in Bangladesh's nationally determined contribution document (Box 1).

Adoption of CSA is also being encouraged through the 2009 Bangladesh Climate Change Strategy and Action Plan (MOEF 2009). CSA practices in use in Bangladesh include alternate wetting and drying (AWD), row cropping, the adoption of stress-tolerant and high-yielding seed varieties, urea deep placement (UDP), and aquaculture/floating agriculture. AWD has been promoted and implemented in Bangladesh since 2004 by several nongovernmental organizations, as well as through the national agricultural research and extension program. AWD adoption has caused yields to rise and production costs to fall. Yields of farmers using AWD were 9 to 12 percent higher than those of farmers using conventional irrigation, and water savings ranged from 22 to 26 percent. Some of the constraints to adoption of AWD in Bangladesh include additional labor and costs associated with weeding, unreliable water and energy supply, and the inability to incur economic benefit from reduced use of irrigation due to the

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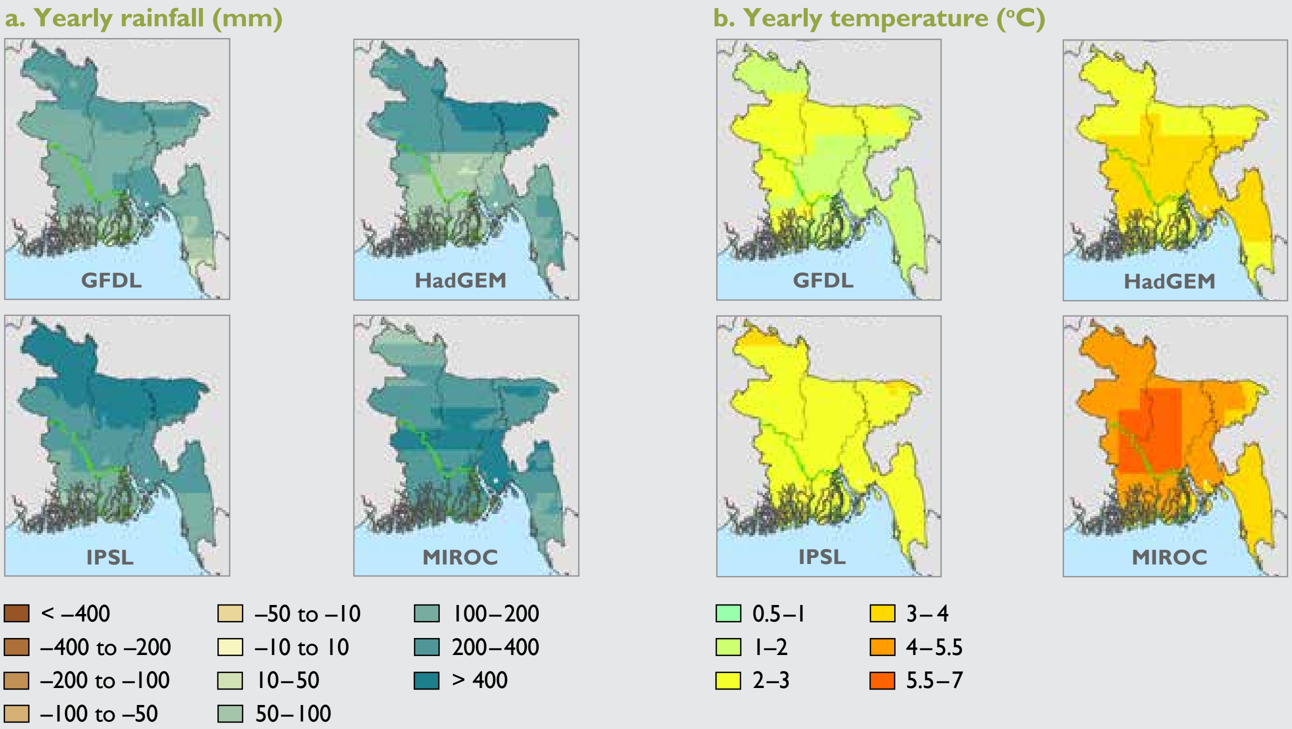
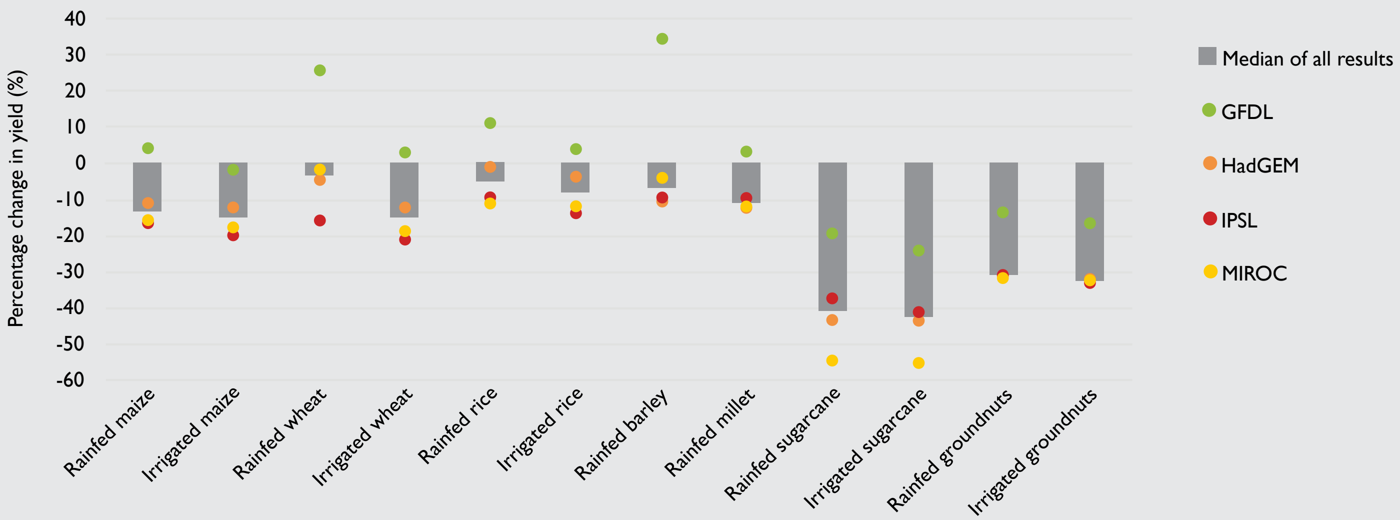
FIGURE 1. Predicted change in rainfall and temperature based on four climate models, 2000–2050



Source: Authors based on Müller and Robertson (2014).

Notes: GFDL = Geophysical Fluid Dynamics Laboratory; HadGEM = Hadley Centre Global Environmental Model; IPSL = L'Institut Pierre-Simon Laplace; MIROC = Model for Interdisciplinary Research on Climate. Simulations are based on Representative Concentration Pathway 8.5. The zone of influence is delineated by the green line.

FIGURE 2. Percentage change in yields due to climate change based on four climate models, 2000–2050



Source: Devised by authors based on Rosenzweig et al. (2014) using weights from MapSPAM harvested area (You et al. 2014).

Notes: GFDL = Geophysical Fluid Dynamics Laboratory; HadGEM = Hadley Centre Global Environmental Model; IPSL = L'Institut Pierre-Simon Laplace; and MIROC = Model for Interdisciplinary Research on Climate.

Box 1. Climate-Smart Agriculture in Bangladesh's nationally determined contribution document

The key activities on agriculture proposed in Bangladesh's (intended) nationally determined contribution document include (MOEF 2015):

1. scaling up rice cultivation using alternate wetting and drying irrigation where feasible,
2. increasing agricultural mechanization to reduce the number of draft cattle (and hence lower methane emissions),
3. continuing the plantation of coastal mangroves,
4. conducting reforestation and afforestation in reserved forests and plantation in the country's island areas, and
5. continuing social and homestead forestry.

fixed cost of service provision for pumps (Kürschner et al. 2010; Lampayan et al. 2015). In the future, it will also be advisable for farmers to shift to more optimal planting dates in response to rising temperatures. Both freshwater and coastal aquaculture are practiced in Bangladesh through production systems that include pond aquaculture, shrimp farming, fish culture using cages, and integrated fish farming (FAO 2005). Aquaculture enables vegetable-growing communities to adapt to adverse water-logged conditions through income generation and vegetable production/consumption.

The CGIAR Research Program on Climate Change, Agriculture and Food Security has been promoting CSA in Bangladesh though the climate-smart village approach. Technology options suggested for villages in southern Bangladesh include the Bangladesh Agricultural Research Institute's homestead vegetable model for saline and moist areas; the vertical "tower system" approach to vegetable production; the ring-setting approach to capturing fish on tidally flooded land; gher-system cultivation for mixed agriculture, whereby aquaculture ponds are dug into rice fields so that the surrounding banks can be used for vegetable cultivation; and backyard pond management for fish cultivation. Recommended varieties include saline-tolerant (dry-season) Boro rice; submergence-tolerant (irrigated) Aman rice; watermelons and other cucurbits (that is, plants belonging to the gourd family, such as pumpkins, squash, and cucumbers), which can be irrigated using nonsaline surface water; and zero/strip-tillage maize hybrids (Ali and Hossain 2016).

UDP is actively promoted in Bangladesh by the Department of Agricultural Extension with assistance from the International Fertilizer Development Center. This technique, which is used by more than 2.5 million farmers in Bangladesh (Mulligan 2016), has led to yield increases of 15 to 35 percent for rice and has reduced the cost of fertilizer use. The use of nitrogen fertilizer has fallen by 25 to 40 percent, and the market for urea briquettes has boosted rural employment (FAO 2010). In terms of greenhouse gases, emissions of both nitrous and nitric oxide were significantly lower with UDP use compared with conventional urea treatment. One drawback of UDP use, however, is the increased requirement for, and hence cost of, labor.

Gender and Social Inclusion

Gender differences in the capacity to manage climate risks, preferences of response options, and decisionmaking power mean that women and men are differentially affected by climate shocks and stressors. Moreover, the costs and benefits of measures intended to mitigate risk are also borne differently by men and women. Despite recent increases in women's participation in the agricultural labor force—from 20 percent during 1999–2000 to more than 33 percent during 2005–2006 (Sraboni et al. 2014)—agricultural services and programs commonly overlook women's contribution to agriculture, along with their distinct needs and preferences as clients and beneficiaries. Policies and programs intended to build resilience to changes in climate need to respond to both men's and women's roles, capacities, and preferences. This has important impacts not only for the women themselves, but also for household wellbeing—for example, in terms of nutrition. Women's empowerment in Bangladesh is positively associated with calorie availability and dietary diversity at the household level (Sraboni et al. 2014). Conversely, women's low status and gender gaps in access to healthcare and education are linked to chronic child malnutrition (Smith et al. 2003).

In Bangladesh, government policies on climate change have evolved to include the call for sectorwide gender integration (for example, in food security, social protection, disaster-management policy, and so on); for increasing women's access to the resources necessary for adaptation (such as land, water, technologies, insurance, financial services, and so on); and for strengthening women's participation in institutions (such as local disaster-management institutions, community risk assessments, water management, and capacity development) (MOEF 2013). These approaches are necessary to close the existing gender gap in resilience and leverage women's participation—but questions remain as to how best to apply these strategies in policy and programming.

Access to information is an important component of risk mitigation and adaptive capacity, but men and women do not have access to the same sources of information, and often need different kinds of agricultural, climate, and disaster-preparedness information. Quisumbing, Kumar, and Behrman (2017) found that women are more likely to get information on CSA practices from other neighbors and the radio, whereas virtually no women accessed traditional channels of agricultural information, such as private or public extension services or farmer field days. Furthermore, very few women accessed information from other family members, challenging the assumption that training one family member will result in dissemination of information to all household members. It is imperative to understand which channels are most effective in reaching men and women, whether in terms of CSA practices or disaster-risk preparedness. This same study found that access to information accounts for a large part of the gender gap in adoption of CSA practices. On the whole, women were less aware of CSA practices, but when they did have knowledge of these practices, the gap in adoption was small.

In 2011/12, Bangladesh scored the lowest among all Feed the Future countries on the women's empowerment in agriculture index (Table 1). After new programming designed to improve specific indicators was introduced, remarkable improvements were recorded in the largest gender gaps in 2015, including control over income use, speaking in public, and asset ownership (Table 2). Drawing on successful experiences in strengthening women's empowerment, resilience programming can advance by understanding women's particular perceptions, roles, and preferences regarding how to manage climate-related risks.

Bangladesh's Nutrition Profile

Bangladesh's nutrition profile indicates severe nutritional deficiencies (Table 3). There is also evidence of the double burden of malnutrition (the coexistence of undernutrition and micronutrient deficiencies, along with overweight and obesity) in individuals and households. Stunting in children under five years of age is remarkably high, with large gaps in prevalence across wealth quintiles and by urban (31 percent) and rural (38 percent) residence (Institute of Population Research and Training, Mitra and Associates, and ICF International 2016). Moreover, severe micronutrient deficiencies exist in children and women of reproductive age. Interventions should focus on the 1,000 day "window of opportunity" from pregnancy to a child's second birthday, emphasizing a combination of nutrition-specific and nutrition-sensitive approaches—that is, both the direct and underlying causes of undernutrition and poor food intake. On the one hand, this involves promoting exclusive breastfeeding and proper complementary feeding, while on the other, it focuses on water quality, sanitation, hygiene, improved infrastructure, and so on.

Dietary diversity in rural Bangladesh is low, and staple crops—predominantly rice—and oils/fats are most commonly consumed. Causes of low dietary diversity exist at different scales. At the macro-level, food prices are major determinants of dietary diversity (Thorne-Lyman et al. 2010), and rice prices are associated with underweight in children (Campbell et al. 2010). Consequently, it is important to consider the implications of climate change on the production and food prices of both rice and nonrice foods.

TABLE 1. Women's empowerment in agriculture, 2011/12

Indicator	Score/share
Women's empowerment in agriculture index score	0.66
Share of women with adequate empowerment	25%
Share of women with gender parity	39%
Average gap in empowerment score between men and women in households without gender parity	0.33

Source: Malapit et al. (2014).

TABLE 2. Changes in women's empowerment, 2011/12 and 2015

Indicator	Baseline 2011/12	Midline 2015
	Headcount	
Input into productive decisions	66	94
Ownership of assets	77	91
Access to and decisions on credit	54	67
Control over use of income	76	95
Group membership	42	53
Speaking in public	45	72

Source: Ahmed (2016).

TABLE 3. Bangladesh's nutrition profile

Indicator	National prevalence (%)	Rank	Zone of influence in 2015 (%)
Wasting in under five-year olds	14	117/130	16
Stunting in under five-year olds	36	107/132	32
Anemia in preschool-aged children	33	–	Not reported
Zinc deficiency in preschool-aged children	45	–	Not reported
Overweight and obesity in women ≥ 20 years	23	–	Not reported
Anemia in women of reproductive age	44	158/185	Not reported

Source: Data on national prevalence of wasting, stunting, and anemia in women of reproductive age are from IFPRI (2016); data on anemia and zinc deficiency in preschool-aged children are from Icddr,b–UNICEF–GAIN–IPHN (2013); data on overweight and obesity in women are from Ng et al. (2014); and data for the zone of influence are from Ahmed et al. (2016).

Another potential impact of climate change on nutrition relates to the weak capacity of existing infrastructure to withstand increased flooding, which increases the risks associated with stagnant water, such as diarrhea, cholera, and water-borne illness (Osmani et al. 2016). The risks associated with pests/insects and vector-borne diseases are also increased due to higher temperatures and changes in precipitation (Ali et al. 2014). Improving nutrition in Bangladesh under a changing climate requires that programmers and policy-makers use nutrition-specific and nutrition-sensitive approaches to improve the local infrastructure and strengthen local food systems. Strengthening food value chains from production all the way to food consumption and use is key to ensuring that food is available, affordable, and accessible to different groups within the population.

Suggested Research Priorities Moving Forward

Based on the threats and opportunities across the climate–gender–nutrition nexus in Bangladesh, the following short- and longer-term activities are suggested to strengthen insights, and to advance evidence-based programming that integrates these themes in Bangladesh. Three priority areas have been identified to fill research gaps:

1. *Analysis of agricultural risk management beyond financial instruments.* This area of inquiry would focus on how people are currently managing risk; the level of access to and efficacy of credit, group membership, onfarm diversification, land-use allocation, and landscape management for risk management; and how nonfarm employment opportunities help both to reduce risks and to move people out of poverty.
2. *Cropping patterns and women's empowerment.* Identifying the cropping patterns that achieve the triple objectives of improving nutrition, diversifying risk, and empowering women could potentially be useful for current and future programming, given that production diversification is a key focus under Feed the Future and is generally assumed to support climate change adaptation. This activity would identify how crop diversification could enhance women's empowerment, support adaptation to climate change, and improve nutritional outcomes.
3. *Mechanization, time use, and child health.* Various CSA technologies, such as conservation agriculture, require mechanized services to be successful. Such mechanization could potentially save women's time, unless they only focus on functions predominantly performed by men. This investigation would be designed to provide insights on how mechanization can support climate, women's empowerment, and nutrition outcomes.

Additional research gaps identified fall into the following categories:

1. How do gender differences in access to information affect climate change adaptation and nutritional outcomes under climate variability and change?
2. Why do different areas in Bangladesh exhibit stark differences in nutrition, incomes, and women's empowerment, and what levers for change could increase resilience to climatic and other shocks?
3. Are there linkages between climatic shocks, early marriage, women's empowerment, and nutritional outcomes, and— if so—what are entry points for change?

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