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RICE, SMALLHOLDER FARMS, AND CLIMATE CHANGE IN BANGLADESH: THALA OF POLICY OPTIONS

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ABSTRACT

Smallholder farmers in Bangladesh face some of the most unpredictable agricultural conditions on the planet. Annual flooding, cyclones and other natural hazards cause huge fluctuation in rice yields, the country's most important crop, are subject to huge fluctuations. Climate change is already happening in Bangladesh and the associated adversities are expected to increase the unpredictability of smallholder farming. This is pushing Bangladesh's smallholder farmers away from cereal cultivation or out of agriculture altogether. Eighty percent of Bangladesh's food is produced by smallholders, and this shift threatens the food security of the country. Increases in net production of rice as well as resilience of rice crops to the effects of climate change have thus become urgent and pivotal issues and challenging for the continued progress towards Bangladesh's goal of food self-sufficiency.

In the above backdrop, this article aims, firstly, to proffer a critical overview of rice production, small holder farms and agriculture in Bangladesh in the context of climate change; and secondly, to furnish selected policy suggestions towards greater climatic and social resilience of agriculture and rice production. The study makes several suggestions to policy makers for improving and expanding agricultural extension services, including (a) the provision of salt-resistant rice varieties to coastal areas, and (b) improvement of extension services with a focus on smallholder and women farmers - which may be relevant not only for Bangladesh, but also for similar territories in South Asia.

Keywords: Agriculture, climate change, farmers, rice, smallholders.

SETTING THE SCENE

Global population increase and rising incomes in hitherto poor countries, as some recent studies unequivocally suggest, will lead to increased food demand in the coming years. According to the FAO (2012), for example, the global demand for food is expected to increase by 60 percent by 2050. Given the challenges of climate change, natural resource constraints and competing demands, considerable challenges face agriculture and food systems worldwide (*World Bank*, 2009). These obstacles are especially relevant and pertinent to Bangladesh, which is one of the most densely populated nations in the world and is located in the low-lying, natural hazard-prone Ganges river delta.

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Bangladesh experienced famine in 1974 after the widespread destruction of infrastructure during the civil war with Pakistan in 1971, coupled with consecutive natural disasters that led to substantial reduction in rice production. Since that experience, the primary goal of food policy in Bangladesh has been achieving self-sufficiency in rice production and stabilization in rice prices as well as ensuring food security for all the households (*Dorosh et al.,* 2004; *Dorosh et al.,* 2006).

Food production in Bangladesh has increased significantly in past decades, in part due to agricultural intensification aided by the Green Revolution technology introduced in the 1980s (*Dorosh,* 2012). The country passed a major milestone in its efforts to achieve food security at the end of the 1990s, when for the first time in its history, food grain production exceeded target requirements (based on 454 gm/person/day) (*Hossain et al.*, 2005).

In a subsistence-oriented agrarian economy such as Bangladesh, domestic food production has an important role in the pursuit for both food security and developing economy. Smallholder farming is essentially meeting the nutritional requirements of the country and ensuring food security in the coming decades (*Dorosh et al*., 2002). However, in recent years Bangladesh has experienced various natural and market phenomena that have discouraged small farmers. For example, increasing input cost for fertilizers, pesticides, price of electricity and diesel has frustrated farmers and made farming increasingly less profitable (*Hossain et al.,* 2005).

Climate change, population density, and land pressures also pose significant and increasing threats to sustaining the yields. The country faces rising sea levels in the south, more annual flooding in the central region because of stronger monsoons, drought in the northwest and inadequate water for rice production, due to a shorter monsoon season, in the east. Decreased productivity due to these obstacles will affect smallholder farmers the most, possibly forcing them to switch to more lucrative cash crops from food grains or to leave agriculture altogether (*Dorosh et al.,* 2002).

The resulting rural-urban migration in Bangladesh is leading to over-crowded cities and mounting pressure on already strained civic infrastructure. Improvements in rural livelihoods could help to stem the flow. Because smallholder farms produce the vast majority of Bangladesh's food, the decision by farmers to leave agriculture could also have further detrimental effects on the food production and thus food security of the nation, especially the production of essential rice and wheat crops.

In attempting to meet the objective of food self-sufficiency, the Government of Bangladesh (GoB) has undertaken several policy initiatives, including open market sales of food grain to limit food grain price increases, targeting food distribution to poor households, providing emergency relief after natural disasters and procuring food grains to support producer prices and incomes (*Dorosh et al.,* 2002).

The severe variability of Bangladeshi agriculture due to geographic location and climatic conditions means that food self-sufficiency is unlikely to be a consistently attainable goal, and is made even more unrealistic by the prospects of climate change. Domestic food grain production is highly vulnerable to floods, droughts and major production shortfalls and periods of inadequate food availability that come with natural hazards (*World Bank,* 2009). Bridging the rice yield gap remains a priority of agricultural policies and justifiably so. Bangladesh lacks the foreign currency to be dependent on rice imports and rice cultivation provides the livelihood for millions of Bangladeshis (*Hossain*, 2005).

The problems of climate change and retaining smallholder farming must be tackled together in order to ensure the food security of Bangladesh. Neither can be ignored and the issues are interlinked. Although increasing, rice yields in Bangladesh are erratic and inconsistent. Climate change, which is already a reality in Bangladesh, poses threats to these yields now and in the future. Smallholder farmers, who produce the vast majority of the country's rice, are reliant on sufficient rice yields for their livelihoods.

Further increases in production of rice as well as improvements in climate resilience are thus necessary, if not to increase net production then to hedge against projected yield drops in climate change scenarios. Investments in a dynamic and responsive agricultural research and extension system are essential to bridge yield gaps and potentially accelerate export promotion. While the NGO sector in Bangladesh is well developed and the quality of informal institutions is improving, formal GoB development institutions remain somewhat weak (*World Bank*, 2009). Government agencies at all levels face overlapping functions, lack of communication and coordination, low skill levels and incentives and lack of responsiveness, exacerbated by an urban bias. Therefore, the combination of government and non-governmental efforts is needed to address the myriad obstacles to national food security.

AGRICULTURE IN BANGLADESH: AN OVERVIEW

Bangladesh has made significant progress in domestic food production since its independence in 1971. Through the 70's and early 80's, Bangladesh was a severely food deficit country and heavily dependent upon food aid, but the country's rice production has tripled over the past three decades (*Hossain,* 2005).

Bangladesh is a predominately an agrarian country with over 53% of its population engaged directly in agriculture (*Sumelias et al*., 2011). Though agriculture accounts for only 21% of the national GDP, agricultural production has an important bearing on employment generation, food security and poverty alleviation, and is thus critical for development of the rest of the economy (*World Bank*, 2009). For these reasons, growth in the agricultural sector remains a development priority.

Seventy-one million Bangladeshis are involved in agriculture, and sixty-five million of those are smallholder farmers when rice production dominates about 70% of all cropped land in Bangladesh (*Ganesh-Kumar*, 2012). Other major items in the food basket of Bangladesh are wheat, pulses, potato, vegetables and fish. Rice and wheat alone contribute to 74 percent and 57 percent of the total per capita calorie and protein intake respectively (*BBS Data*, 2011).

Bangladesh does not export any food items in significant amounts except for shrimp. The country is heavily dependent on imports of almost all food items to meet the demand from growing population. Bangladesh also receives substantial amount of wheat from outside the country, mostly in the form of food aid. Wheat imports increased consistently over time despite the rapid growth in domestic production and the reduction in food aid in recent years (*Ganesh-Kumar,* 2012).

Although trade liberalization faced substantial opposition, Bangladesh has undergone major reforms in trade policy including liberalizing private sector trade in rice and wheat during the 90's (*World Bank*,2009). As a result, domestic output prices of rice (the main agricultural product in terms of value) and wheat have been near border prices in most years since the early 1990s. Bangladesh has reaped major benefits from trade liberalization in terms of food security as private sector imports have helped stabilize markets after major production shortfalls. Keeping domestic prices of most agricultural commodities near border prices has also resulted in overall efficiency gains in the agricultural sector (*Dorosh,* 2012).

The outlook for future food security is uncertain. Agriculture in Bangladesh sits at the intersection of the greatest challenges facing the country. Ensuring food security, not to mention sufficiency, requires adaptation to climate change while dealing with the increasing scarcity of critical inputs like water, power and land and massive population growth. In 2012, the *Global Food Security Index* ranked Bangladesh 81st out of the 105 countries considered, the lowest ranking in South Asia.

Bangladeshi agriculture is also facing a rapidly shrinking land base. While the country's population is growing at the rate of 1.6 percent per year, demographic pressures and increased urbanization have caused cultivated area to decline at a rate of 1 percent per year. Because cropping intensity has approached its limit, growth will need to come from intensification of cereal production, diversification into high-value crop and non-crop activities, and value addition in the agro-processing sector, including storage, processing and marketing.

As mentioned, a massive population size compounds all of the challenges Bangladesh's agriculture faces. The country's population density is five times that of any other 'mega' country (those with more than 100 million people), presenting unique challenges for an overwhelmingly agricultural society (*Streatfield and Karar,* 2008). Though fertility is decreasing, most projections assume that the population will top 200 million by 2050. *FAO*(2012) data shows that the prevalence of undernourishment in Bangladesh was in a declining trend up to 2008 but it has started rising again this year. A similar trend is occurring in food inadequacy as well; in 2010-2012, 26.8% of country suffered from food inadequacy (*FAO,* 2012).

Despite these current challenges, Bangladesh has made substantial progress towards food security and food self-sufficiency in past decades. Between 2000 and 2007, Bangladesh's agriculture sector has averaged an annual growth of around 3 percent, on par with, if not more than, some of its South Asian neighbors (*Ganesh-Kumar,* 2012). Bangladesh has tripled its annual rice production in the space of only three decades, its infant mortality rate has declined dramatically, and its GoB- and NGO-led homestead food production programs have been effective in tackling malnutrition by providing food rich in key vitamins and minerals. Facing such a tough environmental and socio-economic context, Bangladesh's agricultural growth is commendable, but there is much ground to be covered.

RICE IN BANGLADESH

Over the last thousand years rice has been the dominant crop in Bangladesh, and it currently accounts for 77% of agricultural land use. There are about 13 million farm families growing a variety of traditional, modern, and hybrid rice varieties. Over 11.7 million hectares of land in Bangladesh is dedicated to rice production. Rice provides about 70% of direct human calorie intake, making it the most important food crop in Bangladesh in terms of both production and consumption. (*IRRI,* 2005)

The country is said to have among the world's highest per capita consumption of rice (about 170 kg annually), and its food security and economy largely depend on good harvests year after year (*Islam,* 2005). Nearly 40% of the population lives below the food consumption-based poverty line, lacking sufficient resources to afford diet of 2,122 kcal per person per day, along with other basic necessities (BBS 2011).

There are several major rice-growing ecosystems in Bangladesh. These include the upland, direct-seeded pre-monsoon '*Aus*' season crop; the irrigated dry season '*Boro*' crop; the rain-fed lowland monsoon season '*Aman'* crop; and medium deepwater rice-growing in tidal saline and tidal non-saline areas. *Aman* season rice accounts for nearly 51% of total land area, followed by *Boro* and *Aus* season rice, which account for 40% and 9%, respectively (*BBS*, 2003; *Ganesh-Kumar,* 2012).

About 60% of the country's rice area is irrigated, and farmers commonly cultivate modern varieties with associated inputs like fertilizers and pesticides for better farm management and good yield. However, non-irrigated rice is also important to many farming families, particularly those who operate in unfavorable environments (*BBS,* 2011).Despite a tripling in domestic rice production over the last three decades, Bangladesh is not yet fully self-sufficient in cereal grains. The imports of rice remain stagnant at around 0.5 million tons per year, with substantial increase in imports predictable in years following poor harvests due to floods and droughts. Bangladesh imported over 2.0 million tons of rice during 1973-75, 1988-89, and 1998-99; all these years followed years of disastrous floods or droughts (*Ahmed,* 2007).

Still, per capita rice production has increased sharply during the last 15 years, and the food grain deficit has declined (*IFPRI,* 2012). The rice harvest of 2011/12 was the largest since independence, producing 33.7 million tons. On average, Bangladesh has become nearly self-sufficient in rice: between 1998-99 and 2007-08 the country imported an average of about 850,000 MT of rice per year, or less than 5 percent of total net availability (*Ahmed,* 2007).

Bangladesh successfully reduced real prices of rice during the 1970s and 1980s through increases in supply, largely brought about by the efficient use of green revolution technology: irrigation (private tube wells), improved seeds, and fertilizer. These remain key channels for increasing availability of food, reducing its price, raising rural incomes, and enhancing food security. Since 2008, Bangladesh's domestic rice prices have generally been less than import parity but far greater than export parity to the world market. As a result of this, there have been relatively large domestic price fluctuations. Without interventions in domestic markets, this price volatility will likely continue due to fluctuations in domestic rice harvests (*Ahmed,* 2007). As discussed below, these production and price fluctuations will impact vulnerable smallholder farmers the most. And as the discussion on the climate change above has shown, these production fluctuations may become more severe in years to come.

In this environment, private trade at import parity prices still provides an external price ceiling and can dramatically reduce the volume of stocks needed for price stability (*Dorosh,* 2012). Stable prices are conducive to the retention of smallholder farmers in the rice industry. A return to the stable and low prices of the 2002–06 period is not possible in the absence of subsidized exports by India, however, without domestic rice market interventions by the Bangladesh government (*Ahmed,* 2007; *Dorosh,* 2012).

Though Bangladesh produced record food grains last season, the report of *Global Agricultural Information Network* (2012) warns that rising yields are largely a result of increasing *Boro* cultivation, which is putting substantial pressures on Bangladesh's groundwater supply. Similarly, the USDA post in Bangladesh recently decreased its estimate for the *Aman* harvest in 2012/13 because of increased flash floods in the northern part of the country, highlighting the dependence of agriculture on fluctuating meteorological and climatic conditions.

CLIMATE CHANGE AND ITS IMPACT ON FOOD PRODUCTION

Climate change is no longer a theoretical concept. There is a global consensus among scientists, academics, professionals and strategists that the globe has already committed to a certain degree of change in climate system. Losses of production between 5% and 10% worldwide have been predicted by the 2080's in a number of different climate

scenarios (*Parry et al.,* 2004). Agriculture is highly sensitive to climate change, and Bangladesh is one of the most climate vulnerable countries in the world. The reasons for this vulnerability include a precarious geographic location, low-lying topography, and high population density. These factors have the potential to increase the hardships for the people of Bangladesh in future climate change scenarios.

The implications of climate change that will likely have the largest effect on Bangladesh rice production are increases in temperature, precipitation, and the frequency of cyclones. The National Water Management Plan of Bangladesh, prepared by the Water Resources Planning Organization, outlines a variety of other potential implications of climate change on the country. These include increased evapo-transpiration, higher irrigation needs in the winter, reduced trans-boundary flow, and slower accretion of coastal lands.

Based on the General Circulation Modeling, a recent study predicts that there will be a general increase in temperature fluctuation throughout Bangladesh in years to come (*Ahmed et al.*, 2009). Every crop has an optimal temperature range for their vegetative and reproductive growth and when temperature falls below the range or exceed the upper limit, crop production faces constraints. Changing climatic parameters shorten development stages and can reduce the yield of a given variety (*Basak,* 2012). *Islam and Morison* (1992) show that *Boro* season crops often suffer from cold at the seedling stage as well as the reproductive phase, particularly for early planting with short duration rice varieties. This effect will be magnified with increasingly cold winters. Similarly, *Peng et al.* (2004) have shown a clear correlation between increased night time temperature in summers due to global warming and decreased rice yields.

Total annual precipitation may also increase, as monsoon precipitation increases significantly and winter precipitation decreases (reference). Higher intensity monsoon seasons would stress already strained water systems and result in further severe floods in many parts of the country, leaving some crops inaccessible or waterlogged. The loss of rice to floods accounts for nearly three quarters of all lost agricultural output annually (*Paul*, 1993). The threat of extreme flooding became particularly obvious during 2007 when two monsoon floods led to significant losses in the *Aman* and *Aus* rice crops, estimated at 1.8 million tons from the *Aman* crop alone.

Climate change is also likely to bring more extreme natural events, including a potential failure of the monsoon in South Asia while IFPRI simulates an extended drought beginning in 2030 and continuing through 2035 (*Nelson,* 2010). Such a drought would have dire consequences on the food security of the nation. Some reports *(IPCC,* 2007; *CCP*, 2008) have also predicted that greenhouse warming will increase the frequency and/or intensity of tropical cyclones, affecting the southern rice- and grain- growing regions of the country.

According to the IPCC, rising sea levels will wipe out and salinize more cultivated land in Bangladesh than anywhere else in the world. By 2050, rice production is expected to drop almost 10 per cent and wheat production more than 30 per cent. That's a huge risk for a population that is poor and growing. The threats of climate change on food production are heightened by population growth, high food price in international market, land degradation, high input price, and lack of governance. Of course it is impossible to predict the exact effects of climate change, however, it is clear that Bangladesh needs to take immediate and pertinent action to adapt its food strategy to climate change.

CHALLENGES FOR SMALLHOLDER FARMERS

Of the majority of more than 200 million rice farmers who live in Asia as a whole, few cultivate more than two hectares and the same trend extends to Bangladesh (*IRRI*, 2011). Smallholder farming plays a key role in meeting the nutritional requirements of Bangladesh and ensuring food security in the coming decades. However, smallholder farmers are threatened by the productivity losses predicted in climate change scenarios as discussed above. In recent years, Bangladesh has experienced various market phenomena that have discouraged small farmers. For example, increasing input cost for fertilizers, pesticides, price of electricity and diesel has frustrated farmers (*Islam*, 2005). Prevailing market prices for rice have also been unfavorable. Many farmers are being pushed either towards cash crop production (which does not contribute to national food security) or out of agriculture altogether. About 46% of all rural households in Bangladesh own less than 0.2-0.3 ha for farming, while more than 65% of the farmers possess only 0.2 to 1.0 ha (*Begum,* 2002; *Rahman,* 2007). These small farmers work directly in the fields and rely on agriculture as their only means of living.

The vast majority of Bangladesh's farmers live below poverty line. They are unable to increase production easily, since they lack capital for the investment in modern technology. They are highly vulnerable to natural disasters and, while they tend to have large families, they are often unable to send their children to school and often lack sufficient food for the family unit (*Rahman* , 2007). Achieving the Millennium Development Goal (MDG) of halving poverty to 26.5 percent by 2015 will require a growth rate of at least 4.0 percent in agriculture and 7.0 percent in the non-farm sector *(World Bank,*

2009). However, economic and institutional realities, the country's geographical and demographic characteristics, and its vulnerability to natural disasters, make this a very challenging task.

Retaining poor farmers in the agricultural sector of Bangladesh is essential. Smallholder agriculture is the largest provider of food and raw materials at world level. Smallholder agriculture is productive and represents resilience when it comes to shocks of whatever type. Smallholder agriculture is also the largest provider of jobs in the world and it plays an indispensable role in the emancipation of marginalized social groups. Smallholders are able to maintain natural resources and improve the environment if favorable conditions are met.

When market conditions are favorable, smallholders respond positively, they innovate, organize joint market channels, engage in processing agricultural products and gain market power. When, however, markets are imperfect and total value added is distributed in a skewed way, smallholder agriculture will suffer a range of negative consequences that in the end may even cause a de-activation of agricultural production (*FAO,* 2012).

Of course, the more a country urbanizes and industrializes, the more it increases its rate of growth, but there is no way to deny that the survival of the urban people depends on the rural ones who produce the food and supply to the urban markets. That is why balancing the interest of both urban and rural people is necessary in governance.

CONCLUSION AND POLICY IMPLICATION

As shown in this article, the issues of rice yields, climate change, and smallholder farming are closely tied. Though increasing, rice yields in Bangladesh are erratic and inconsistent - profoundly affected by seasonal environmental hazards and changing international prices. Climate change, which is already a reality in Bangladesh, poises threats to these yields now and in the future. Smallholder farmers, who produce the vast majority of the country's rice, are reliant on sufficient rice yields for their livelihoods.

Through the contribution of agriculture to the national economy and employment may diminish further, it will remain in the visible future as the single largest contributor to income and employment generation and a vital element in the country's challenge to achieve self-sufficiency in food production reduce rural poverty and foster sustainable economic development (*Uddin,* 2009). The Government of Bangladesh has the responsibility to ensure that the necessary conditions exist to enable the country to meet these challenges, and for this purpose, a sound agricultural policy is essential. Specifically for this paper, ensuring sufficient yields in all rice growing regions is a laudable goal that can be approached by a) improving current yields, and b) building smallholder resilience in anticipation of the detrimental effects of climate change.

Agricultural extension services provisions (ESP) are fundamental in building farmers' knowledge and capacity for better crop yields and resource management. In 1996, the government enacted the New Agricultural Extension Policy (NAEP) in an effort to improve lacking agricultural support for the country's farmers. The NAEP had an express focus on providing these extension services to all "sizes and types" of farmers (*GoB, 1996*).

ESP in Bangladesh is generally less available for farmers in lower income categories and operating less land. In particular, GoB ESP's remains targeted at male farmers with larger land holdings and higher incomes. Over 41% of farmers in the large farm category (over 7.5 acres) receive ESP's despite cultivating only 16.4% of land and representing 0.3% of farmers. GoB delivery has also failed to take advantage of opportunities to work with farmer groups, which was an additional explicit goal of the NAEP draft in 1996. The Government thus needs to re-visit its ESP policy and refocus its efforts to support the smallholder farmers who need it the most. They are, after all, the ones who are effectively feeding the country.

ESP policy must be implemented with a focus on improving production and building resilience for climate change. A rights-based approach to extension, one that ensures that all categories of farmer (particularly women and farmers in smaller farm households and on lower incomes) are aware of their rights to service provision, is needed. In this way ESP's can enable agriculture to support poverty reduction and food security. This does not imply monopolistic service provision by the state; it implies a managed and coordinated range of service providers meeting the needs of farmers.

Ensuring sufficient yields in climate- and natural hazard-threatened growing regions can be aided by the development and adoption of select hybrid varieties of rice, specifically flood resistant salt-resistant strains. Flood-tolerant rice developed by the International Rice Research Institute (IRRI) helps a rice crop survive underwater for up to ten days. Given the intensity of flooding in Bangladesh, and the additional risk of extreme climate events anticipated due to climate change, submergence-tolerant rice is an important source of security for poor farmers. IRRI has also developed several

strains of salt-resistant rice that can be grown in the salinized soil of the coastal districts. The yields of the new varieties are not much higher than that of old types, but their advantage is the lower chance of losing crops because of saline water intrusion or drought, making them a worthwhile replacement for traditional varieties. This may help keep up harvests in some instances of severe weather, but will not be sufficient to meet growing demand in the country in the face of a wider range of climate impacts.

Of course, elevated pressure for food production may undermine or overlook the deleterious effects of using genetically modified (GM) materials and hybrid seeds that affects human health. Concepts of food safety and the use of GM technologies deserve due attention as far as the health of the consumers and environment are concerned. The GoB should give full attention and fund to development of these seeds and ensure the availability of these rice varieties to climate-threatened farmers through ESP. Ensuring the provision of quality ESP as well as flood- and salt-resistant rice varieties are crucial steps in sustaining the production, and thus livelihoods, of Bangladesh's rice farmers otherwise, it will really be difficult to retain the farmers in food grain production.

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