

A Review of Rice Production Risk in Agriculture of Bangladesh: Perspective Pest and Diseases

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ABSTRACT

Diseases and pests are the main barriers to rice production in agriculture. The primary cause of rice production loss in agriculture is diseases and pests in Bangladesh. Therefore, the objectives of this study are to identify the different sort of pest and diseases of rice and their effects on rice production loss in agriculture of Bangladesh. The review study also provides some policy to reduce pest and diseases attack in rice production of Bangladesh. For this purpose, secondary data were used which have been collected from various report, journal, article and internet sources. This study used qualitative synthesis to analyze data. The study found some pest or insects which are attacking rice output in agriculture of Bangladesh. These insects are rice leaf folder, rice meal moth, rice bug, green leaf hopper, brown plant hopper, rice gall midge, saw-toothed grain beetle, lesser grain beetle, yellow stem borer, rice weevil, angoumois grain moth, white backed plant hopper, and red flour beetle. Additionally, this study found some diseases which are attacking rice output in agriculture of Bangladesh. These diseases are fungal diseases, bacterial disease, nematode disease, virus diseases and micoplasma disease. As a result, rice output is down in many agriculture fields in Bangladesh. This study makes some recommendations for managing sustainable rice production while addressing pest and disease issues: varietal modifications in the cultivation of rice, precautions in the production of rice, an effective forecasting system, to properly identify rice illnesses, farmers and extension agents need to get effective training and assistance, monitoring rice fields on a regular basis and using epidemiological study.

1. Introduction

Rice is the main staple food and source of nutrition for the people of Bangladesh. About two-thirds of the country's total calorie supply, nearly 48% rural people's employment, and roughly 50% of the average person's protein intakes are sourced from it. Additionally, the rice sector generates one-sixth of the country's income and one-half of the agricultural GDP in Bangladesh (Anonymous, 2011). However, production of rice is severely challenged by attacks of pests and various

types of diseases. Pests refer to a group of living organisms when cause injury or disturbance to persons, animals, crops, or property. These species include insects, weeds, nematodes, mites, rats, and birds, to name a few. Pest and diseases results in loss of yields and these losses vary from across crops. A report published by the Ministry of Agriculture (MOA, 2002) revealed that pests caused an annual yield loss of vegetables by 25%, pulse by 25%, sugarcane by 20%, rice by 16%, jute by 15% and wheat by 11%.

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In Bangladesh, rice blast diseases were noted during the Boro season (November to May: irrigated ecology) and Transplanted Aman (July to December: rainfed ecosystem). The Bangladeshi government is leading the charge for the expansion of the Aus coverage. It indicates that rice is farmed year-round with great care. As a result, various pests and diseases are becoming more common in the popular kinds. For greater adaptation, even pests are given the chance to change their race. According to Biswas (2017), 267 different races of rice blast have already been found in environment. As a result, diseases pressure is on the rise and could have disastrous effects in the near future. Not only in Bangladesh, but also the other 85 nations where rice is farmed, is affected by this situation. As a result, rice pests continue to exist everywhere. Therefore, rice blast is viewed as a major and ongoing issue in many countries that farm rice. This is why we need to know the different sorts of pest and diseases of rice production in Bangladesh and we need to know that how to reduce pest and diseases attack in rice

production of Bangladesh. Therefore, the objectives of this study are to identify the various kinds of pest and diseases of rice, to assess the rice yield loss due to pest and diseases in rice production of Bangladesh, and to provide some policy to reduce pest and diseases attack in rice production of Bangladesh.

2. Methodology

The primary information source for this study is secondary data. Data for this study came from a wide range of reports, journals, articles and internet sources. For this study, 47 scholarly articles and reviews were chosen and selected. The collecting data were shown using tables and figures. Qualitative synthesis was used in the analysis of the collecting data for this study. Although it has a number of drawbacks, including the inability to change methods, questions, measurements, or data collection, its advantages stem from its ability to improve data comprehension and its applicability to historical research. The analytical framework of this study is shown in Figure 1.

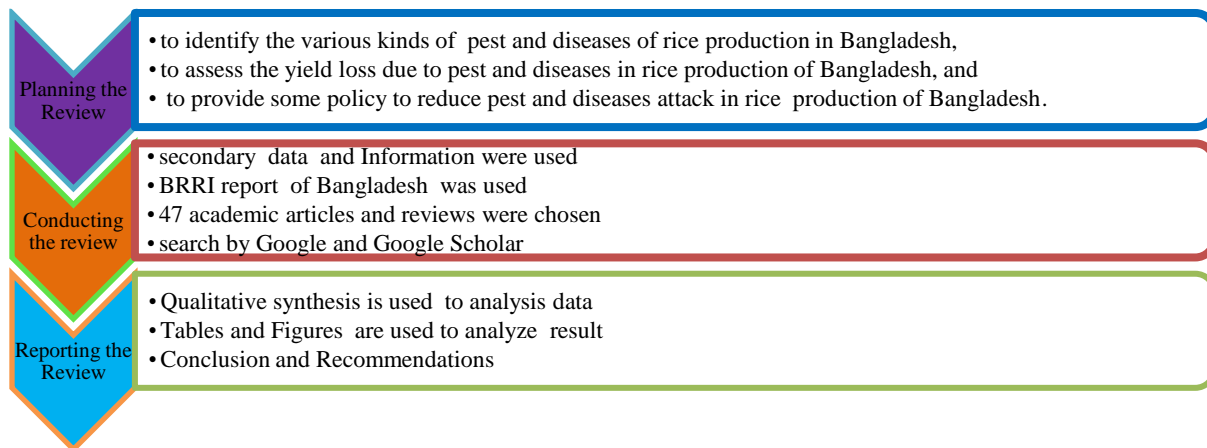


Figure 1. Analytical Framework of the Study

3.1 Pest of Rice in Agriculture of Bangladesh

In Bangladesh, rice plants are regularly attacked by a variety of pests. Insects pose a serious threat to rice production. The brown plant hopper (*Nilaparvatalugens*), rice stem borer (*Sciropophaga spp.*), green leaf hopper (*Nephotettix spp.*), white-backed plant hopper (*Sogatellafurcifera*), rice gall midge (*Orseoliaoryzae*), rice hispa (*Dicladispaarmigera*), and rice leaf folder (*Cnaphalocrocismedinalis*) are a few of the common insect pests that affect rice production in Bangladesh (Nasiruddin and Roy, 2012, Alam, 2013,

Fatemaet *al.*, 1999, Alamet *al.* 1981, Kamal *et al.*, 1993, Anonymous, 1997, 2000, 2001, 2007, 2009). There are major diseases of rice: stem rot, bacterial leaf blight, sheath blight, leaf blast, and sheath blast. There is a major weed invasion in Aus rice. Rats may also prey on aman rice during harvest, drastically reducing the crop's yield. In contrast, Boro is the ideal season for rice cultivation since it has reduced pest infestation and produces the largest yield when irrigation is used. Table 1 and Figure 2 show some of the most significant insects and pests of rice crops in Bangladesh:

Table 1. Some of the main mite, insect and pests that affect Bangladesh's rice (*Oryza sativa*) crops

English name of pest	Scientific name	Plant parts affected	Status
Rice leaf folder	<i>Cnaphalocrocismedinalis</i> (Guen.)	Leaf	High
Rice meal moth	<i>Corcyra cephalonica</i> (Stainton)	Rice, paddy	High
Rice bug	<i>Leptocrisa acuta</i> (Thunberg)	Grain	High
Rice leaf folder	<i>Marasmia exigua</i> (Butler)	Leaf	High
Rice leaf folder	<i>Marasmia patnalis</i> Bradley	Leaf	High
Green leaf hopper	<i>Nephotettix cincticeps</i> (Uhler)	Leaf	High
Green leaf hopper	<i>Nephotettix nigropictus</i> (Stal)	Leaf	High
Green leaf hopper	<i>Nephotettix virescens</i> (Distant)	Leaf	High
Brown plant hopper	<i>Nilaparvata lugens</i> (Stal)	Stem	High
Rice gall midge	<i>Orseolia oryzae</i> (WoodMason)	Leaf sheath, tiller	High
Saw-toothed grain beetle	<i>Oryzaephilus surinamensis</i> (Linnaeus)	Rice, flour	High
Lesser grain beetle	<i>Rhyzopertha dominica</i> (Fabricius)	Paddy	High
Yellow stem borer	<i>Scirpophaga incertulas</i> (Walker)	Tiller, panicle	High
Rice weevil	<i>Sitophilus oryzae</i> (Linnaeus)	Rice, paddy	High
Angoumois grain moth	<i>Sitotrogacealella</i> (Olivier)	Rice, paddy	High
White backed plant hopper	<i>Sogatella furcifera</i> (Horvath)	stem	High
Red flour beetle	<i>Tribolium castaneum</i> (Herbst)	Rice, paddy, flour	High

Source: Islam and Catling (2012), Ahmed and Amin (2007), Alamet *et al.* (1964), Anonymous, (1993), Anonymous(1977), Islam and Catling(2004),Islam *et al.* (2003), Islam *et al.* (2009), Rahman and Hossain (1985), Alam (1971),Alamet *et al.* (1964)



(a) Rice leaf folder



(b) Rice Bag



(c) Brown Plant hopper



(d) White backed plant hopper



(e) Red flour beetle



(f) Saw-toothed grain beetle

Figure 2. (a, b, c, d, e, f) Some Major pest of rice crop in Bangladesh

3.2 Rice Production Damage due to Pest in Bangladesh

Over 90% of the world's rice is produced in Asia, where yield losses from various insect pests average at about 20% (Pathak and Khan, 1994). There must be a proportional increase in rice production for every reduction in pest damage. A number of crop-loss assessment trials against major insect pests were carried out in the field by the Entomology Division of the BRRI between 1977 and 1979. The results showed an average yield loss of 13% in the boro season, 24% in the Aus season, and 18% in the transplanted Aman (T. Aman) season (Alamet *et al.*, 1981). However, as indicated by the estimated year and method in Table 2, the amount of loss incurred by pests varied.

Geographic location, rice variety, and pest species can all have a significant impact on yield loss. Table 2 displays the expected yield loss brought on by various rice insects and pests. Brown planthoppers (BPH) can cause the biggest yield loss in an outbreak area. The year affects how bad the pest epidemic is? Insects like rice hispa and brown planthopper can increase rice

production loss by 44% and 62%, respectively, in an outbreak situation which is shown in Table 2.

Table 2. Annual national rice yield loss scenario due to insects and pests in Bangladesh

Annual national rice yield loss by insect and pests in agriculture of Bangladesh		
Rice Yield Loss (%)	Reporting year	Used method for estimation
01.00	2020	Expert opinion on total production
08.10	1999	Survey estimation
04-14	2010	Literature review
18.00	1980	Crop loss assessment 1977-1979
08.67	1976	Insecticidal check method
06.00	1951	Insecticidal check method
Estimation of rice Yield loss from research data under different experimental situations in Bangladesh		
Name of Insect pest	Rice Yield Loss (%)	Year of Reporting
Rice hispa	8.5-32.85	2012

Leaf roller	4-11	1982-1986
Mealy bug	9-22	1982-1986
Rice hispa	20-39	1982-1986
Ear-cutting caterpillar	9.0	1982-1986
Rice hispa	11-62	1985
Brown planthopper (BPH)	20-44	1985
Major insects	22-26	1985
Stem borer	15.0	1985

Source: Kabiret *al.* (2020), Islam and Catling, (2012), Mondal (2010), Alamet *al.* (1981), Catlinget *al.* (1978), Alam, (1961), Bari *et al.* (2012),Karim, (1989),Anonymous (1985b)

3.3 Rice Diseases in Agriculture of Bangladesh

Bangladesh's primary cereal crop is rice, and it is crucial to periodically examine the illnesses affecting it in order to both monitor changes in disease occurrences and to create new techniques for reducing losses due to rice diseases. Twenty eight rice illnesses were documented in Bangladesh by 1973 (Miah, 1973; Talukdar, 1974).Anonymous (2016) which has divided into five categories of rice diseases such as fungal diseases, bacterial diseases, nematode diseases, virus diseases, and micoplasma diseases in Bangladesh (Table3).Here, the term major sickness refers to a disease that reduces rice yield economically, whereas the term minor refers to a disease that has less of an impact on the economy. According to the 2016 and 2018 reports, Bangladesh now has 32 rice illnesses detected, up from 24 in the 1987 report (Table 4). Out of 32 infections, the fungus is responsible for 22, nematodes for 6, bacteria for 3, and viruses and micoplasma for 1. There are 11 main diseases recognized as major, up from 10 in 1987 and 1993 (Shahjahan, 1993). Eight diseases remained serious issues between 1987 and 2016: bacterial leaf blight, bakanae, blast, brown spot, sheath blight, sheath rot, ufra, and tungro. In 1987, two illnesses that are now classified as minors are leaf scald and stem rot. On the other hand, three diseases that were rated as minor in 1987, bacterial leaf streak, false smut, and seedling blight are now rated as significant. According to a recent study on the possible effects of climate change on crop diseases in Bangladesh, major rice illnesses are still a problem, but their occurrence is expected to shift monthly under specific future temperature scenarios (Salam *et al.*, 2019). Now a days, there are 32 known rice diseases in Bangladesh, with blast, bacterial leaf

blight, sheath blight, and tungro being the most common (Nihadet *al.* 2021, Rashid *et al.*, 2021, Akteret *al.*, 2022, Aniket *al.*, 2022, Nihadet *al.*, 2022). Some photographs of rice diseases in Bangladesh are shown in Figure 3.

Table 3. Different rice diseases in agriculture of Bangladesh

Categories of rice Diseases	Name of rice diseases	Name of Causal Organism
Fungal diseases	Aggregated sheath spot	<i>Rhizoctoniaoryzaesativa</i>
	Bakanae	<i>Fusariummoniliforme</i>
	Blast	<i>Pyriculariaoryzae</i>
	Brown spot	<i>Bipolarisoryzae</i>
	Crown sheath rot	<i>Ophiobolussp</i>
	Damping off	<i>Achlyaprolifera</i>
	False smut	<i>Ustilagoideavirens</i>
	Grain red blotch	<i>Epicoccumpurpurescens</i>
	Grain spot	<i>Complex of fungi and bacteria</i>
	Kernel smut	<i>Tilletiabarcayana</i>
	Leaf scald	<i>Microdochiumoryzae</i>
	Leaf smut	<i>Entylomaoryzae</i>
	Leaf spot	<i>Curvularialunata</i>
	Minute leaf spot	<i>Nigrosporaoryzae</i>
	Narrow brown leaf spot	<i>Cercosporajanseana</i>
	Seedling blight	<i>Sclerotiumrolfsii</i>
	Sheath blight	<i>Rhizoctoniasolani</i>
	Sheath blotch	<i>Pyrenochaetaoryzae</i>
	Sheath rot	<i>Sarocladiumoryzae</i>
	Sheath spot	<i>Rhizoctoniaoryzae</i>
Bacterial disease	Stack burn	<i>Trichoconispadwickii</i>
	Stem rot	<i>Sclerotiumoryzae</i>
	Bacterial foot rot	<i>Erwiniachrysanthemipv. Chrysanthemi</i>
Bacterial disease	Bacterial leaf blight	<i>Xanthomonasoryzaepv. Oryzae</i>
	Bacterial leaf streak	<i>Xanthomonasoryzaepv. Oryzicola</i>
Nematode disease	Root knot	<i>Meloidogynegraminicola</i>
	Root lesion	<i>Pratylenchusspp</i>
	Root rot	<i>Hirschmaniellaoryzae</i>
	Ufra	<i>Ditylenchusangustus</i>
Virus Disease	White tip	<i>Aphelenchoidesbesseyi</i>
	Tungro	Vector: <i>Nephotettixvirescens</i>
Micoplasma disease	Yellow dwarf	Vector: <i>Nephotettixvirescens</i>

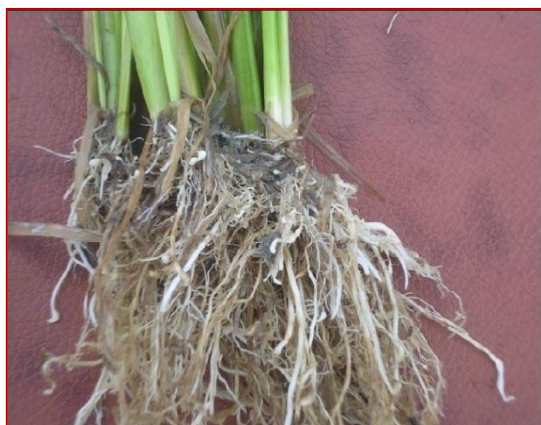
Source: Anonymous (2016)



(a) Aggregated sheath spot diseases of rice in Bangladesh
(Fungal disease)



(b) Bacterial foot rot diseases (bacterial disease)



(c) Root knot (Nematode disease)



(d) Root lesion (Nematode disease)



(e) Tungro (virus disease)



(f) Yellow dwarf (micoplasma disease)

Figure 3. (a, b, c, d, e, f) Photographs of rice diseases in Bangladesh

3.4 Rice Production Damage due to Diseases in Bangladesh

According to Shahjahan (1993), on a regional or national basis, there are few quantitative statistics on agricultural losses owing to illnesses in Bangladesh. The reports that are currently available are based on estimates because there don't seem to be enough methods for accurately assessing crop loss or for tracking the occurrence of pests and diseases throughout the country. The same author continues, stating that the following factors make it difficult to estimate losses brought on by diseases: It is unknown how much would be produced in the absence of diseases; only a small portion of the crop is affected by the loss, hence the loss in the entire crop must be projected; losses can happen in a single year or season, hence they must be averaged across a number of years; and losses may occur after artificially inoculating a crop at a particular time and receiving a high infection rate.

Table 4 shows the national average yield loss scenarios owing to rice illnesses and were compiled from various sources. The fact that diseases and insects caused 10 to 15% of the country's rice harvest to be lost is highly respected by experts (Miah and Shahjahan, 1987). The average yield loss in Bangladesh due to rice diseases is 9.9%, as reported by Khan (1991). But over the ten-year period from 1989–1990 to 1998–1999, the expected average losses due to illnesses were 3% in Boro, 5.9% in Aus, and 6% in Aman, with an average of 4.9% for

three seasons. This translated into an annual loss of 1.52 million tons (Islam and Catling, 2012). The data's sources, the farmer's perspectives, were greatly influenced by their worst yield memories, the authors added, so such figures should still be considered overestimated. High-ranking Department of Agricultural Extension (DAE) officials from 15 northern districts of Bangladesh participated in a brief phone survey conducted recently, and the results revealed a new scenario that explained less than 1% of yield loss in farmers' crops. That being said, this is an average annualized value. The yield loss could rise in years where disease epidemics are particularly bad. Similar outcomes have been obtained by Kabir *et al.* (2020). The main rice diseases in Bangladesh are blast, bacterial leaf blight, sheath blight, and most recently fake smut. In the farmers' field, yield loss under conditions of severe infection has been calculated as 65.4% and 56.9%, respectively, for blast disease in the irrigated and rainfed ecosystems (Hossain *et al.*, 2017) (Table 4). Shahjahan *et al.* (1994) reported a yield loss of 31% when the crop was afflicted by sheath rot disease at a critical stage. When 67 smut balls were observed in a panicle, which was deemed to be a severe outbreak situation for fake smut disease, yield loss of up to 87% was anticipated (Nessa *et al.*, 2015). Rayhan *et al.* (2019) has showed that blast diseases attacked on rice in different districts of Bangladesh which are shown in Table 5.

Table 4. Bangladesh's national rice yield loss as a result of rice diseases

National yield loss scenarios by rice diseases in Bangladesh			
Rice yield Loss (%)	Mode estimation	Year of reporting	
10-15	Highly regarded expert opinion	1987	
9.9	Survey estimation	1991	
4.9	Survey estimation	1999	
< 1.0	Phone survey	2019	
Estimating yield loss from Blast in Bangladeshi farmers' fields during different epidemics			
Yield Loss (%)	Feature of Variety and Location	Yield reduction area	Year of Reporting
65.4	Variety specific (Jhalak hybrid variety)	highest yield reduction in irrigated ecosystem	2017
56.9	Variety specific (BRRI dhan34)	highest yield reduction in rainfed ecosystem	2017
34.7	Location-specific, Among 30 agro-ecological zones (AEZs)	highest yield loss in AEZ 9	2017

Source: Miah and Shahjahan (1987), Khan (1991), Islam and Catling (2012), Hossain *et al.* (2017), Khatun *et al.* (2021)

Table 5. Rice diseases in different districts of Bangladesh

Name of districts	Name of Upazila	Available varieties	No. field visited	Diseases	Incidence (%)	Severity score	Year
Naogaon	Manda	Ziradhan, BRRI dhan63	8	Blast	20	5	2017-18 (Boro season)
Barishal	Mehendigaj	BRRI dhan74, BRRI dhan89	5	Blast	10	3	2017-18 (Boro season)
	Babuganj	BRRI dhan74	10	Blast	5	3	2017-18 (Boro season)
	Bakerganj	BRRI dhan89	12	Blast	5	1	2017-18 (Boro season)
	Hossainpur	BRRI dhan28	8	Blast	20	7	2017-18 (Boro season)
Kishoreganj	Mithamain	BRRI dhan29	10	Blast	20	5	2017-18 (Boro season)
	Pakundia	BRRI dhan28, BRRI dhan63	6	Blast	30	5	2017-18 (Boro season)
	Chandina	BRRI dhan28, BRRI dhan29	10	Blast	50	5	2017-18 (Boro season)
Cumilla	Burichang	BRRI dhan28, BRRI dhan29	9	Blast	30	3	2017-18 (Boro season)
	Gafargaon	BRRI dhan28, BRRI dhan81	7	Blast	30	5	2017-18 (Boro season)
Mymensingh	Bhaluka	BRRI dhan28, BRRI dhan63	10	Blast	20	3	2017-18 (Boro season)
	Muktagacha	BRRI dhan29, BRRI dhan81	15	Blast	60	5	2017-18 (Boro season)

Source: Rayhanulet *al.* (2019)

4. Conclusion and Recommendations

This study found some major insects and pests in rice production of Bangladesh such as rice leaf folder, rice meal moth, rice bug, green leaf hopper, brown plant hopper, rice gall midge, saw-toothed grain beetle, lesser grain beetle, yellow stem borer, rice weevil, angoumois grain moth, white backed plant hopper, red flour beetle. These insects and pests reduce the yield of rice in agriculture of Bangladesh. This study also found some diseases in rice production of Bangladesh such as fungal diseases (aggregated sheath spot, bakanae, blast, brown spot, crown sheath rot, damping off, false smut, grain red blotch, grain spot, kernel smut, leaf scald, leaf smut, leaf spot, minute leaf spot, narrow brown leaf spot, seedling blight, sheath blotch, sheath blight, sheath spot, stack burn, stem rot), bacterial disease (bacterial foot rot, bacterial leaf blight, bacterial leaf streak), nematode disease (root knot, root lesion, root rot, ufra, white tip), virus disease (tungro), and micoplasma disease (yellow dwarf). These diseases reduce the yield of rice in Bangladesh which is shown

by this study. Since pest and diseases effects on rice production of Bangladesh, this study suggested some strategies to manage rice production in Bangladesh. These strategies are varietal interventions in rice production, preventive measures in rice production, strong forecasting system, provide farmers and baseline extension agents with efficient instruction and guidance on how to correctly identify rice diseases, regularly monitoring of rice field and application of epidemiological study.

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