

Chapter V

Spatially-explicit Pest Infestation in Bangladesh

This chapter devoted for spatially-explicit results of insect pest infestation for rice in Bangladesh. The spatial analysis of three major rice insect pests infestation status all over Bangladesh had been conducted. The secondary data help to analyze infestation rate for three major insect pests in different districts all over the Bangladesh.

5.1 Spatial Analysis Three Major Insects of Rice in 64 Districts of Bangladesh

Insect pests are severe constraints to rice production throughout the world (Dale, 1994). In Bangladesh, three insect pests are major in terms of economical loss over the last 15 years in rice crop. From the secondary data it had been found that the infestation of last ten years all over the Bangladesh remarkably changed by location specific. Analysis also showed that the percentage of infestation according to cultivable area of 64 districts ranged from 0-30%. According to the distribution of the percentage of infestation for ten years period, four classes of infestation level were defined which are:

0-8% = Very low infested area.

9-16% = Low infested area.

17-24% = Moderate infested area.

25-32% = High infested area.

The infestation showed with 30 different maps of Bangladesh with polygon shape file.

5.1.1 Stem borer (*Scirpophaga incertulas*) Infestation during the Year 1999-2008

Spatial distribution analysis of stem borer (*Scirpophaga incertulas*) infestation in Bangladesh during the year 1999 to 2008, it was observed that the average highly infested districts were 16. From the year 1999 to 2008 the standard deviation of highly infested districts number was 2.62 and the range of highly infested districts were 11-19. In the year 1999 the highly infested districts were smallest in number that was 11. Whereas in the year 2003 highly infested districts were highest in number that was 19 (Table 5.1). After analyzing first five years (1999-2003) it was observed that five districts are common which showed high infestations throughout these five years period. The names of these districts were Naogaon, Joypurhut (north-west region of Bangladesh); Chandpur, Chittagong (south-west region of Bangladesh), and Kishorgonj (north-east region of Bangladesh). So, these five districts should be considered as most intensive high-infested districts within this period (Figure 5.1 to 5.3).

From the year 2002 to 2004 we observed that nature of infestation had been changed totally. In the year 2004 the highly infested districts are 14 among which 8 districts are similar to the earlier year 2003 but only two districts similar to the year 2002. However, we found from the year 2004 to 2008 the high infestation zone had been changed. From 2004 to 2005, four districts are common for high infested districts. After that from the year 2005 to 2006, 5 districts are common for high infestations. From 2006 to 2007 only 3 districts were common for high infestations. And last of all from 2007 to 2008 again 3 districts were common for high infestations. After analyzing last five years infestations (2004 - 2008) it was noticed that no single

district is common for high infestation within this five years period. Again, the first five years tenure (1999 - 2003) high infested districts Naogaon infested highly in the year 2006, Joypurhat infested highly in the year 2004 and 2008, Chandpur in the year 2006, and Kishorgonj in the year 2006. So, by synthesizing the map from 1999 to 2008 it was observed that most highly infested districts within this ten years period were Joypurhat, (seven years frequency of infestation), Naogaon, Kishorgonj, Chandpur, (six years frequency of each), and lastly Chittagong (five years frequency of high infestation). The results of the synthesis also showed that the number of highly infested districts is decreasing after the year 2003 (Table 5.1).

In case of moderate infestation it was noticed that the infestation range was 17-36 districts and standard deviation was 5.34 where the average infested districts were 21. The highest number of moderate infestation was in the year 1999, which was 36, and the lowest was in the year 2003 that was 17 (Table 5.1). The moderate infestation also showed that from 1999 to 2003 it was decreasing in number of districts and after 2003 it was increasing and up-to 2008 the trend of moderate infestation almost same in number. From 1999 to 2003 only two districts were same of moderate infested. The name of those two districts was Sylhet (north-east of Bangladesh) and Cox's Bazar (south-east of Bangladesh). From 2003 to 2004 moderate infestation increased in number of districts from 17 to 21, but within this period six districts were similar in infestation. From 2004 to 2008 the moderate infestation occurred in various districts with heterogeneous way. After synthesis of moderate infestation it can be concluded that only two districts that were Sylhet moderately infested for seven years period and Cox's Bazar moderately infested for six years (Figure 5.1 to 5.3).

In case of low infestation it was observed that the infestation range was 13-21 districts, standard deviation was 2.3, and the average number of districts within this ten years period was 18. In the year 1999 the low infested district was smallest in number that was 13 and in the year 2003 the number was highest that was 21 (Table 5.4). The dispersion of low infested districts during 1999 to 2003 were significantly changes its location. From 1999 to 2002 only two districts were similar in infestation, which were Bandarban (South-east part of Bangladesh) and Bagerhat (southern part of the country). During 2003 to 2008 no similarity of same district for low infestation had been observed. Finally, it was observed during 1999 to 2008 low infested district Bagerhat (south of Bangladesh) was in highest frequency that was for nine years, except in the year 2007 it was under very low infested group. Then Khagrachari for six years and Rangamati, Bandarban and Vola for five years each. The first three districts situated in south-eastern side of Bangladesh known as hill tracts districts of Bangladesh, and Vola situated in south most portion of Bangladesh (Figure 5.1 to 5.3).

According to very low infested districts result showed that average infested districts were 8, standard deviation was 2.1, and the range of very low infested districts was 4-11. In the year 1999 the number of very low infested district was lowest that was 4 and in 2004 and 2006 the number of very low infested districts were highest that was 11 (Table 5.1). During 1999 to 2002 one district is common for very low infested group. The name of the district was Vola. Again during 2002 to 2008 only one district showed the high frequency of very low infestation for six years. The name of that district was Sathkhira (south-west of Bangladesh). In conclusion of very low infested group it was said that Sathkhira was in the highest frequency that was for

six years, Vola and Borguna were for five years each, and Rangamati and Bandarban for four years each, lastly Khagrachari showed three years of very low infestation (Figure 5.1 to 5.3).

Table 5.1 Spatial distribution of stem borer (*Scirpophaga incertulas*) infestation during ten years period (district number and percentage)

Year	Highly Infected Districts	Moderately Infected Districts	Low Infected Districts	Very Low Infected Districts
1999	11 (17.19%)	36 (56.25%)	13 (20.31%)	4 (6.25%)
2000	18 (28.13%)	23 (35.93%)	16 (25%)	7 (10.94%)
2001	18 (28.13%)	19 (29.69%)	19 (29.69%)	8 (12.5%)
2002	18 (28.13%)	19 (29.69%)	18 (28.13%)	9 (14.06%)
2003	19 (29.69%)	17 (26.56%)	21 (32.81%)	7 (10.94%)
2004	14 (21.88%)	21 (32.81%)	18 (28.13%)	11 (17.94%)
2005	18 (28.13%)	20 (31.25%)	18 (28.13%)	8 (12.5%)
2006	14 (21.88%)	20 (31.25%)	19 (29.69%)	11 (17.19%)
2007	16 (25%)	18 (28.13%)	20 (31.25%)	10 (15.63%)
2008	14 (21.88%)	21 (32.81%)	20 (31.25%)	9 (14.06%)
Average	16	21.4	18.2	8.4
S. D.	2.6	5.4	2.3	2.12
Range	11-19	17-36	13-21	4-11

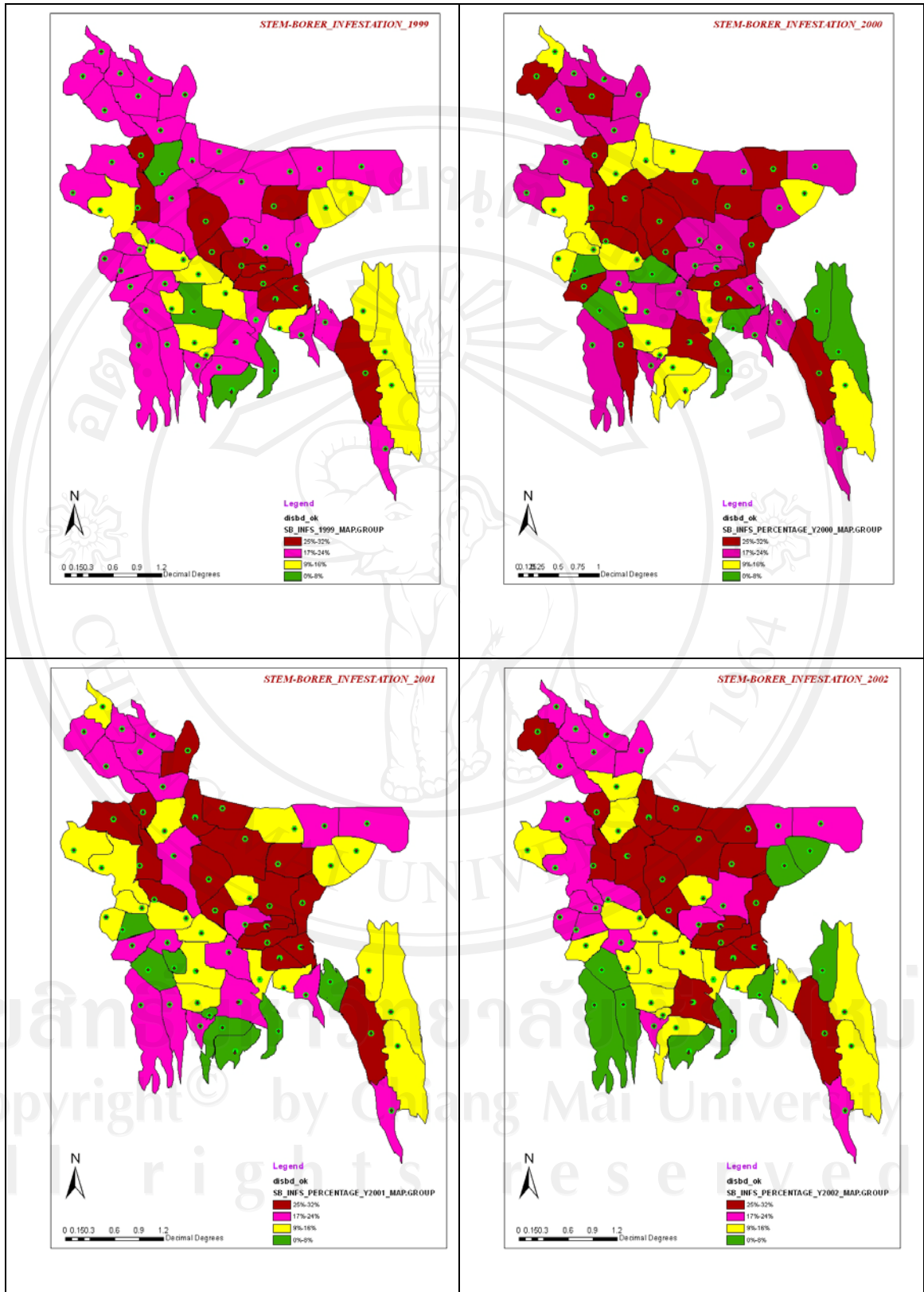


Figure 5.1 Map showing stem borer infestations during the year 1999- 2002

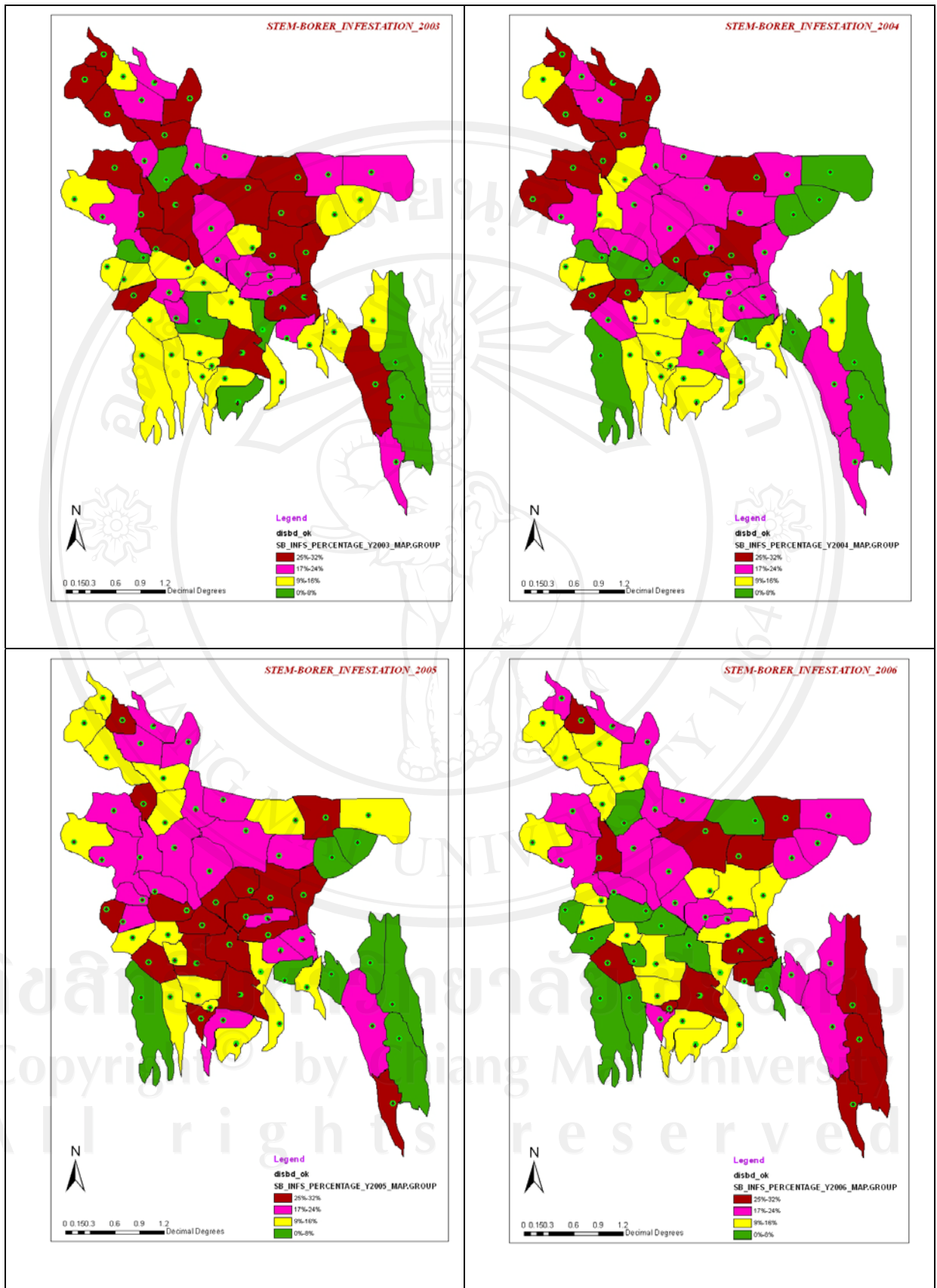


Figure 5.2 Map showing stem borer infestations during the year 2003- 2006

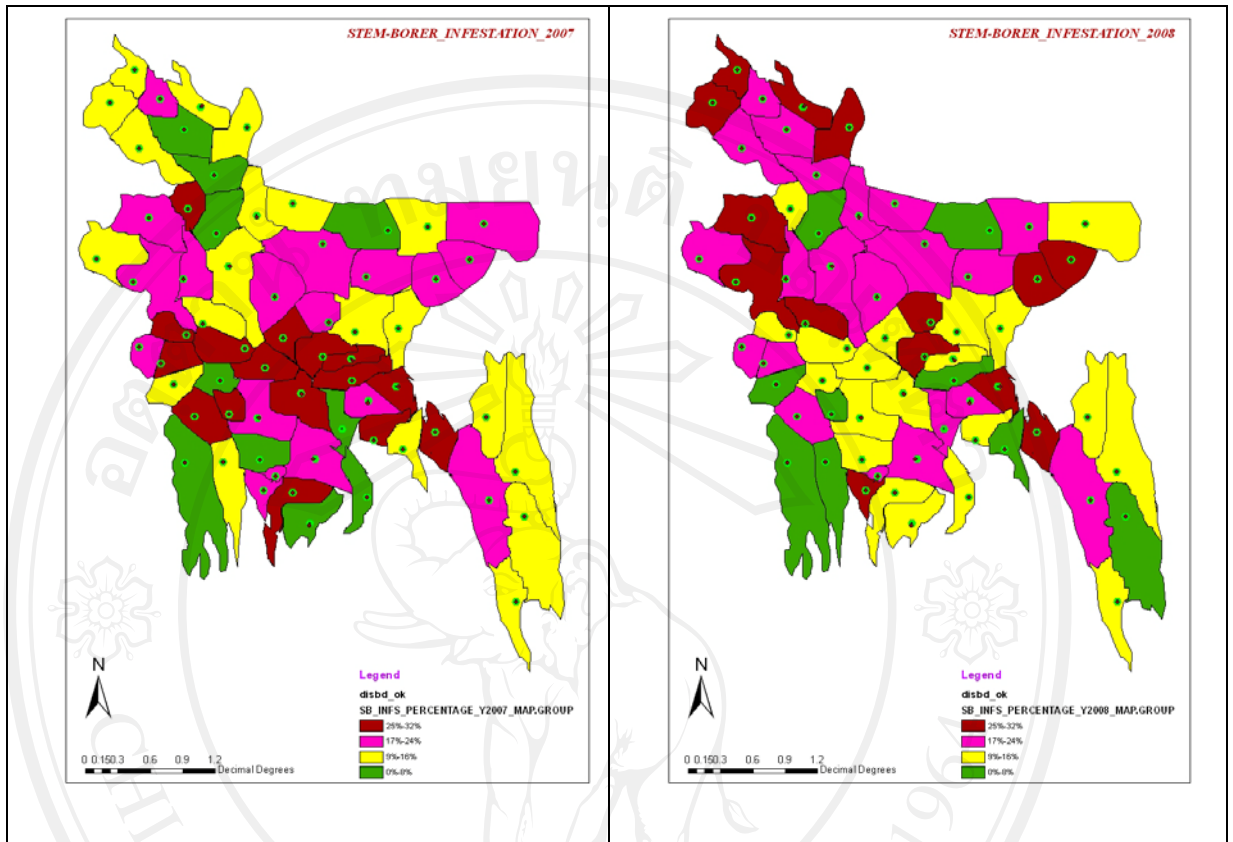


Figure 5.3 Map showing stem borer infestations during the year 2007- 2008

5.1.2 Brown Planthopper (*Nilaparvata lugens*) Infestation during the Year 1999-2008

Spatial distribution analysis of brown planthopper (*Nilaparvata lugens*) infestation in Bangladesh during the year 1999 to 2008 it was found that the average highly infested districts were 16. During 1999 to 2008 the standard deviation of highly infested districts number was 2.4 and the range was 13-21. In the year 2001 the infestation of highly infested districts frequency was lowest that was 13 and in the year 2007, was highest that was 21 in number (Table 5.2). From the year 1999 to 2003 frequency of highly infested districts significantly changes from one district to

another. During 1999 to 2003 within these five years period only one district showed the similarity of highly infestation. The name of the district was Kishoregonj (east of Bangladesh). During 2004 to 2008 no districts were in similar high frequency for these five years tenure. The spatial analysis for highly infested group for ten years period found that one district Kishoregonj for eight years under highly infested group, Chandpur and Chittagong for seven years highly infested districts, Tangail for six years, Natore (north-western portion of the country) for four years under highly infested group (Figure 5.4 to 5.6).

In case of moderate infestation it was observed that the highest frequency of districts in the year 2005 that was 23, lowest in the year 2000 and 2002 that was 17. The range of infested district was 17-23, standard deviation was 2.4 (Table 5.2). During 1999 to 2002 analysis showed that the district Naogaon (north-west portion of the country), and Barisal were for every years moderate infested position. During 2003 to 2008 it was noticed that the distribution of moderate infested districts changes in different location heterogeneously. After synthesis of ten years figure results showed that during 1999 to 2008 the district Sunamgonj had highest frequency that was for eight years. After that Nilphamari and Barisal for seven years, Dinajpur and Brahmanbaria for six years and at last Naogaon, Narsighdi, and Sylhet for four years each moderately infested. So, those districts can be considered as moderately infested for brown planthopper infestation (Figure 5.4 to 5.6).

In case of low infested area for brown planthopper it was observed that the average infested district for ten years period was 16, standard deviation of low infested district was 3 and the range was 14--23. The highest frequency of district in the year 2002 that was 23, and lowest in the year 2007 that was 14 (Table 5.2). From

the distribution of map during 1999 to 2003 it was found that only one district for 3 years frequency of infestation that was Moulovibazar (north-east of the country). From 2004 to 2008 the infestation distribution was heterogeneous. From ten years spatial analysis it was noticed that the most important low infested districts were Noakhali for seven years, Khulna, Lakshipur, Moulovibazar for five years each, Satkhira, Borguna and Patuakhali for four years each of low infestation (Figure 5.4 to 5.6).

For very low infestation result of analysis showed that the average infested district was 10, standard deviation was 2.0 and the range of infested district was 8-15. Among these statistics the highest frequency of district in the year 2000 that was 15, and lowest in the year 2003, that was 8 (Table 5.2). From the distribution of the year 1999 to 2003 it was found that Rangamati, Khagrachari, were for four years, and Vola was for three years of frequency. During the year 2004 - 2008 distribution changes heterogeneously from year to year. And finally it was observed that within this ten years tenure the most important districts were Rangamati and Khagrachari for six years, Bandarban for five years, and Vola for three years with very low infestation frequency (Figure 5.4 to 5.6).

Table 5.2 Spatial distribution of brown planthopper (*Nilaparvata lugens*) infestation during ten years period (district number and percentage)

Year	Highly Infected Districts	Moderately Infected Districts	Low Infected Districts	Very Low Infected Districts
1999	16 (25%)	22 (34.38%)	15 (23.44%)	11 (17.19%)
2000	17 (26.56%)	17 (26.56%)	15 (23.44%)	15 (23.44%)
2001	13 (20.31%)	22 (34.38%)	19 (29.69%)	10 (15.63%)
2002	14 (21.88%)	17 (26.56%)	23 (35.94%)	10 (15.63%)
2003	16 (25%)	19 (29.69%)	21 (32.81%)	8 (12.5%)
2004	15 (23.44%)	21 (32.81%)	16 (25%)	12 (18.75%)
2005	17 (26.56%)	23 (35.94%)	15 (23.44%)	9 (14.06%)
2006	19 (29.69%)	21 (32.81%)	15 (23.44%)	9 (14.06%)
2007	21 (32.81%)	19 (29.69%)	14 (21.88%)	10 (15.63%)
2008	18 (28.13%)	20 (31.25%)	16 (25%)	10 (15.63%)
Average	16.6	20.1	16.9	10.4
S. D.	2.4	2	3.0	2.0
Range	13-21	17-23	14-23	8-15

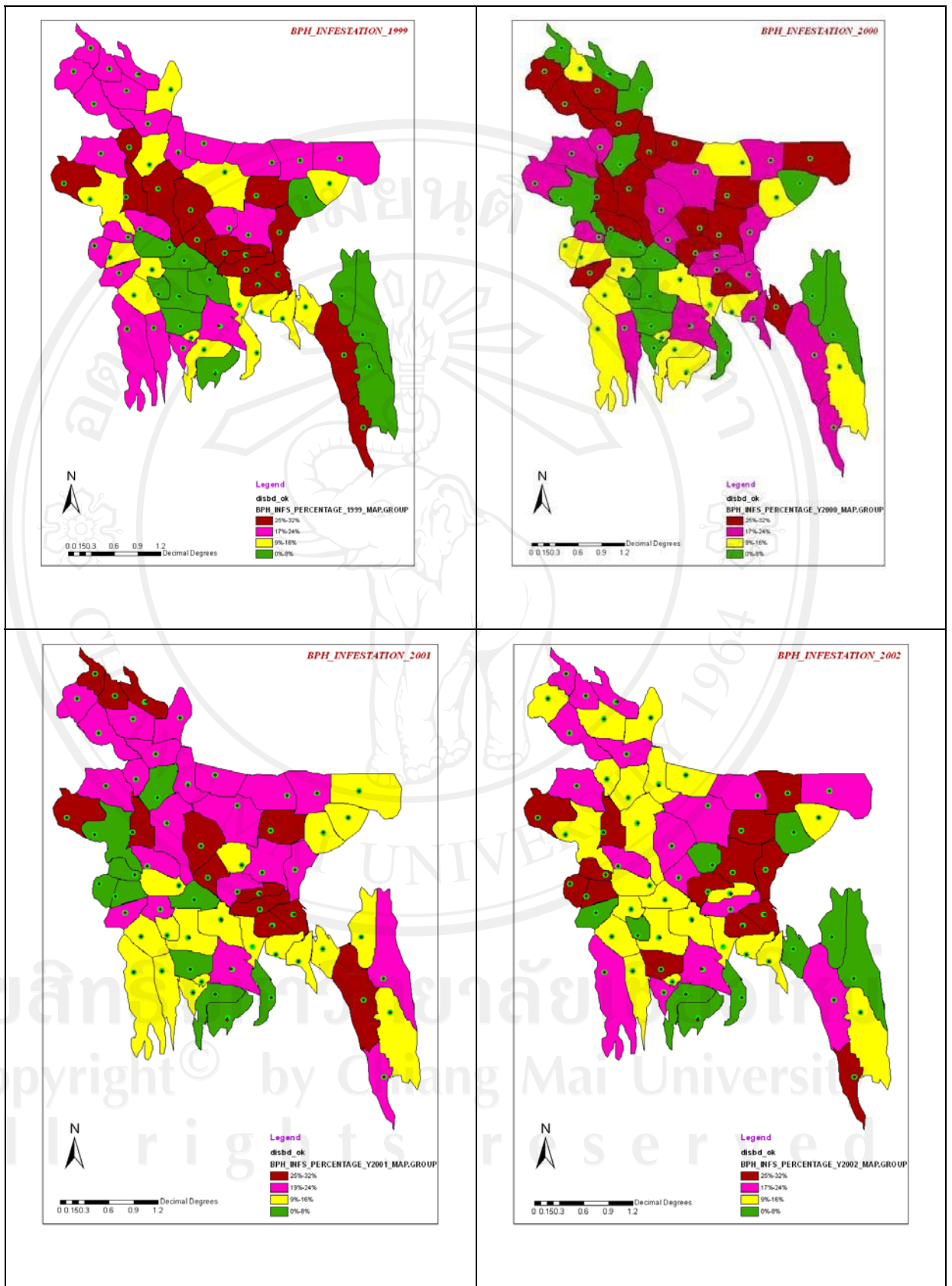


Figure 5.4 Map showing brown planthopper infestation during the year 1999-2002

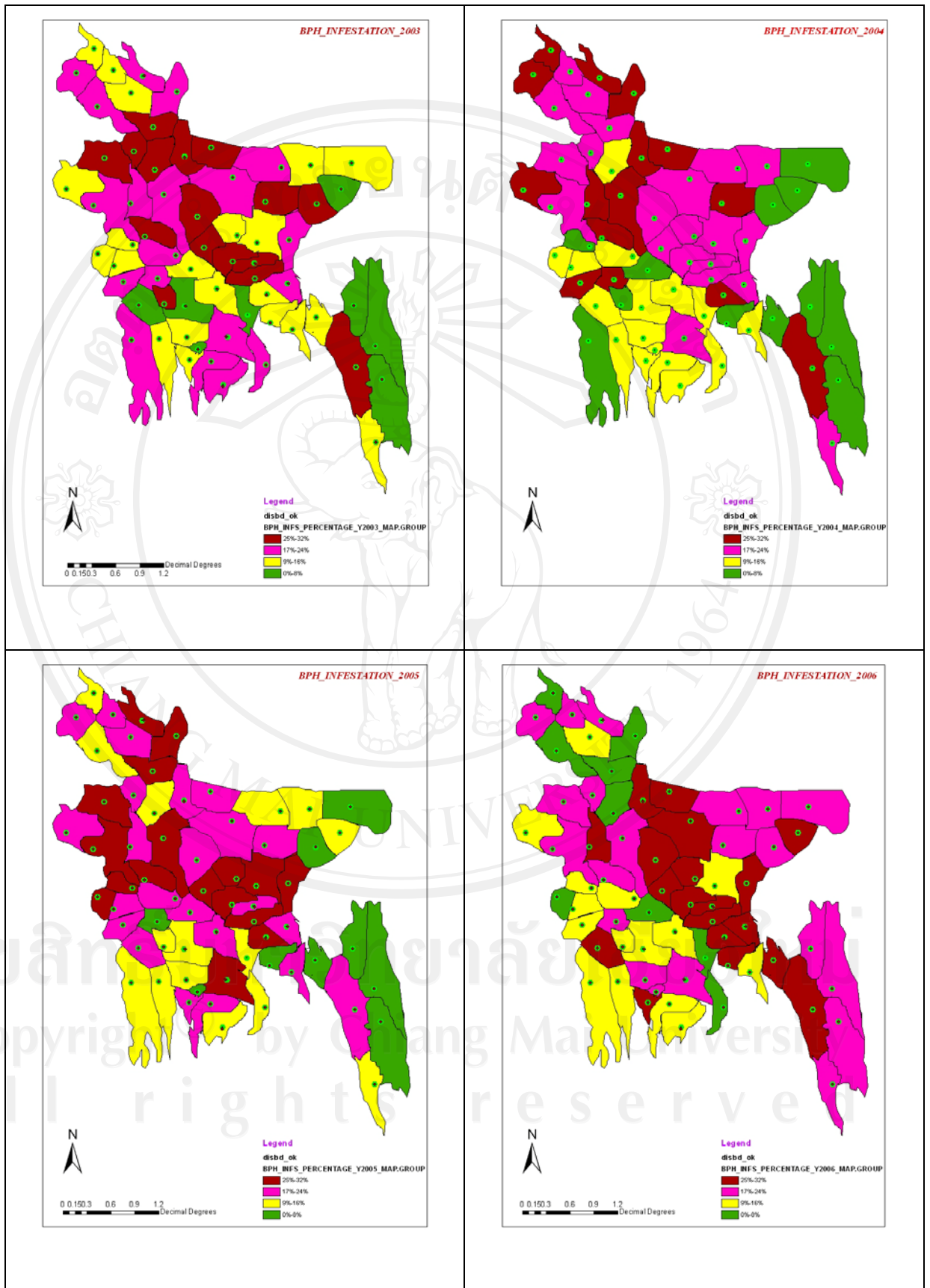


Figure 5.5 Map showing brown planthopper infestation during the year 2003-2006

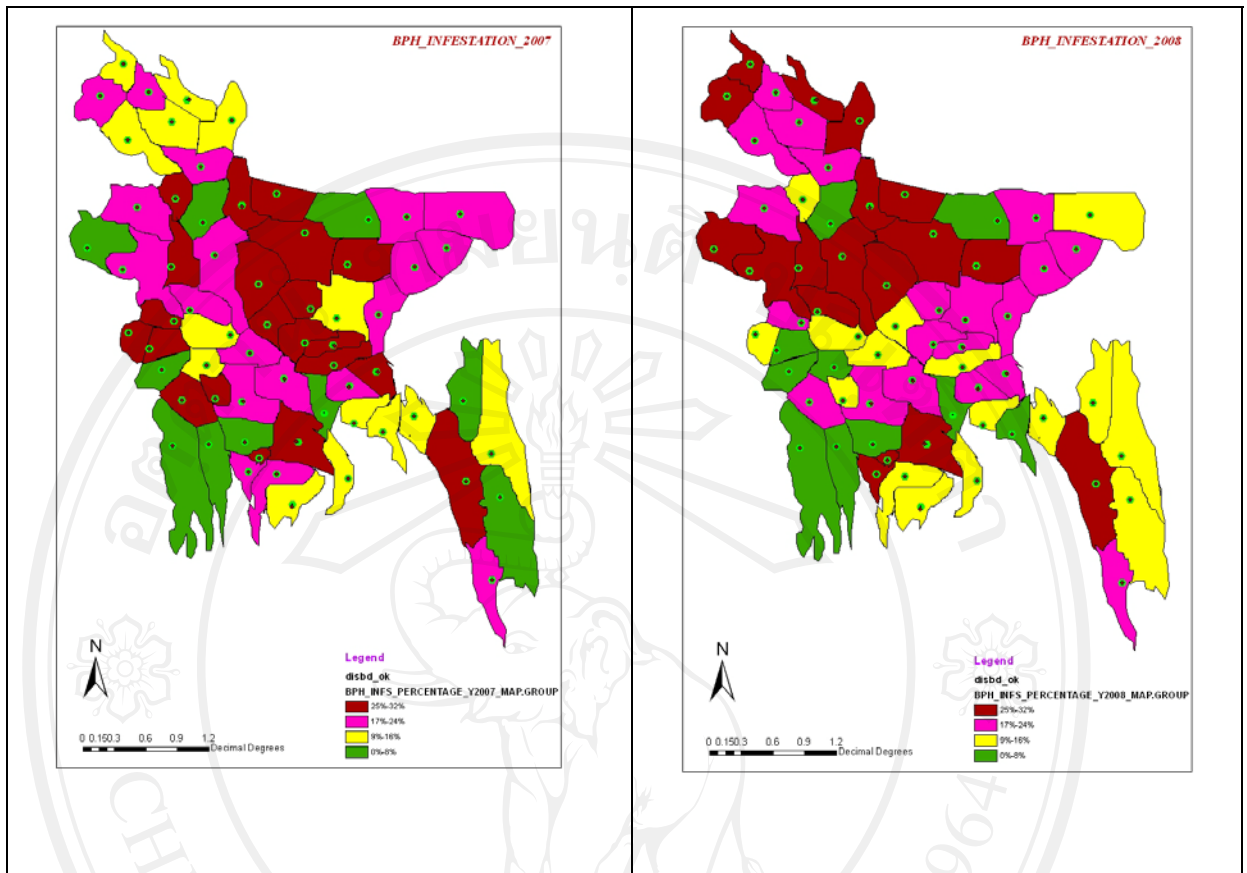


Figure 5.6 Map showing brown planthopper infestation during the year 2007-2008

5.1.3 Rice Hispa (*Dicladispa armigera*) Infestation during the Year 1999--2008

Spatial distribution analysis of rice hispa (*Dicladispa armigera*) infestation in

Bangladesh during 1999 to 2008, found that the average highly infested districts are

18.8. During 1999 to 2008 the standard deviation of highly infested districts number

was 2 and the range was 15--22 (Table 5.3). Synthesis of spatial distribution showed

that from the year 1999 to 2003 the highly infestation nature was not alike in earlier

discussed pest stem borer and brown planthopper. During 1999 to 2003 five districts

were consecutively highly infested which all were in north-eastern portion of the

country. The names of the districts are Sylhet, Sunamgonj, Moulvibazar, Habigonj,

and Kishorgonj. After 2003 things had been changed totally. These five districts are

no more highly infested group up-to the year 2008. The reason of this kind of low infestation might be the action of various agricultural organizations during this time in the infestation zone and government promotional activities for farmers who were successfully control rice hispa in natural way. So, rice hispa shifted its infestation zone from north-east to south west. During 2004 to 2008 the south-western districts showed the high infestation consecutively. It was observed that four districts of this portion of the country consecutively fall under highly infested group. The names of the districts were Sathkhira, Khulna, Jessore, and Bagerhat. Among these districts Khulna continuously for five years under highly infested group (2004--2008) (Figure 5.7 to 5.9).

In case of moderate infested group result showed that the average infested district was 20.2, standard deviation was 3 and the range of infested district was 14-24 (Table 5.3). During 1999 to 2002 it was found that two districts of the north border portion of the country consecutively under this group. The names of those districts were Thakurgaon and Dinajpur. From 2003 to 2008 synthesis showed that the distribution of moderate infestation was heterogeneous. However, similarity found again between the year 1999 and 2008. Seven districts of the north boundary portion were showed similarity of infestation of these two years period. Finally from 1999 to 2008 result showed that in moderate infested group Thakurgaon, Chittagong, and Cox's Bazar found for six years frequency, Dinajpur and Kurigram for five years, Sherpur for four years with moderately infested group (Figure 5.7 to 5.9).

In case of low infestation analysis showed that average infested district was 16.3, standard deviation was 2.9, and range of infested district was 13-23. The highest

number of low infested district was in 2006 that was 23 and lowest number of district was in the year 1999 that was 13 (Table 5.3). From the analysis of the year 1999 to 2002 it was observed only one district was consecutively showed every year for low infestation that was Bandarban. During 2003 to 2008 the infestation distributed heterogeneously among districts all over the country. Finally from 1999 to 2008 it was found that Khagrachari was highest number of frequency that was for six years, Bandarban and Rangamati were for four years each, and Gopalganj and Madaripur were for three years each frequency with low infestation (Figure 5.7 to 5.9).

In case of very low infestation, we observed that the average number of district was 8.7, standard deviation was 1.3, and the range of infested district was 6-10. The highest numbers of districts under very low infestation group were in 2000, 2005 and 2006 which was 10; lowest number of district was in the year 2008 that was 6 (Table 5.3). From the distribution of infested district it was also observed that during 1999 to 2003 two districts were consecutively infested under this group for three years at least. The names were Rangamati and Vola. Again, from 2003 to 2008 we found that infestation distributed heterogeneously among the districts. At the end during 1999 to 2008 analysis showed that the infestation for six years was in the district Rangamati, four years in the district Khagrachari, and three years in the district Vola (Figure 5.7 to 5.9).

Table 5.3 Spatial distribution of rice hispa (*Dicladispa armigera*) infestation during ten years period (districts number and percentage)

Year	Highly Infected Districts	Moderately Infected Districts	Low Infected Districts	Very Low Infected Districts
1999	20 (31.25%)	23 (35.94%)	13 (20.31%)	8 (12.5%)
2000	19 (29.69%)	19 (29.69%)	16 (25%)	10 (15.63%)
2001	20 (31.25%)	21 (32.81%)	15 (23.44%)	8 (12.5%)
2002	22 (34.38%)	18 (28.13%)	15 (23.44%)	9 (14.06%)
2003	21 (32.81%)	20 (31.25%)	14 (21.88%)	9 (14.06%)
2004	19 (29.69%)	23 (35.94%)	14 (21.88%)	8 (12.5%)
2005	18 (28.13%)	18 (28.13%)	18 (28.13%)	10 (15.63%)
2006	17 (25.56%)	14 (21.88%)	23 (35.94%)	10 (15.63%)
2007	15 (23.44%)	22 (34.38%)	18 (28.13%)	9 (14.06%)
2008	17 (25.56%)	24 (37.5%)	17 (25.56%)	6 (9.38%)
Average	18.8	20.2	16.3	8.7
S. D.	2	3	2.9	1.3
Range	15-22	14-24	13-23	6-10

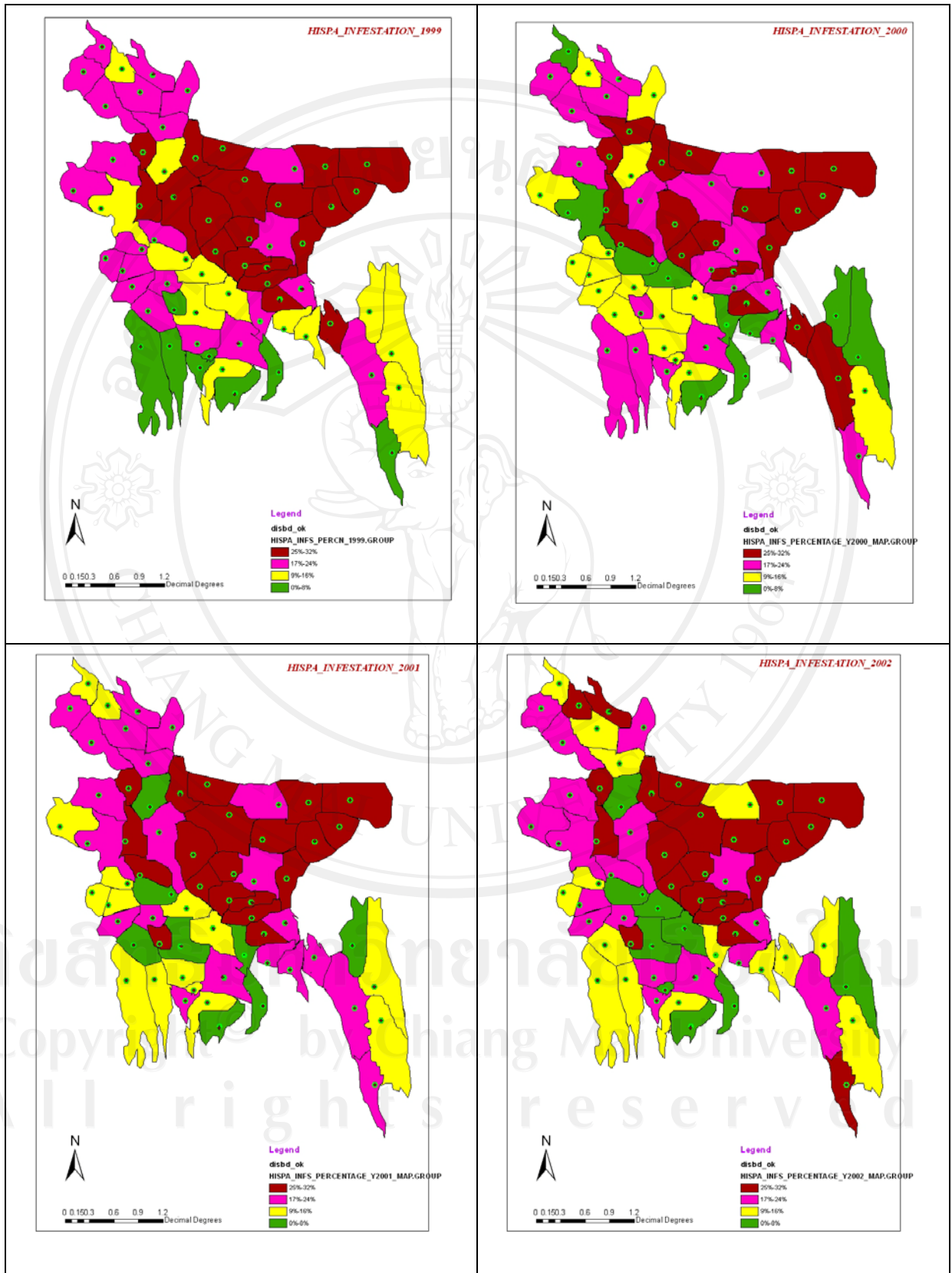


Figure 5.7 Map showing rice hispa infestations during the year 1999- 2002

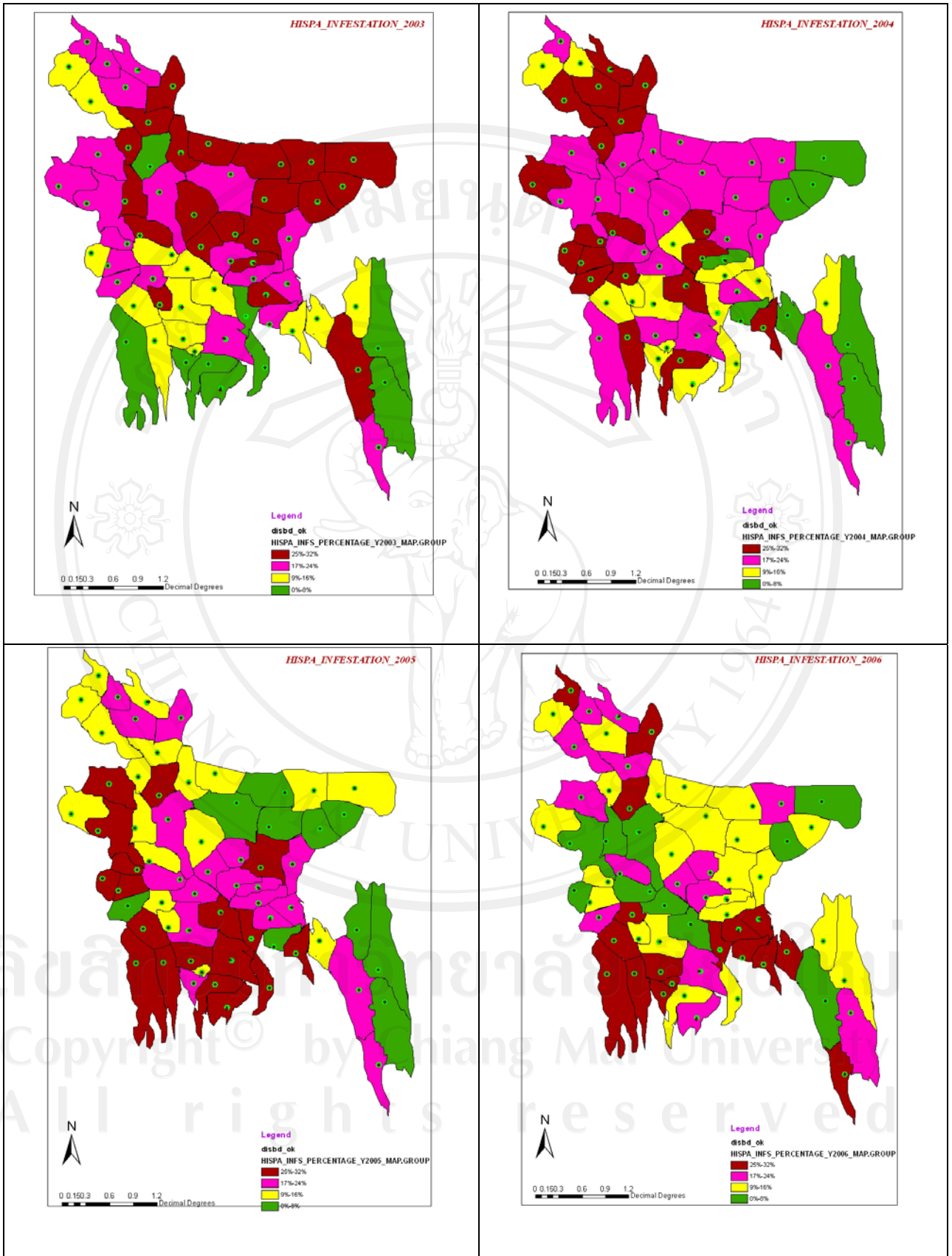


Figure 5.8 Map showing rice hispa infestations during the year 2003- 2006

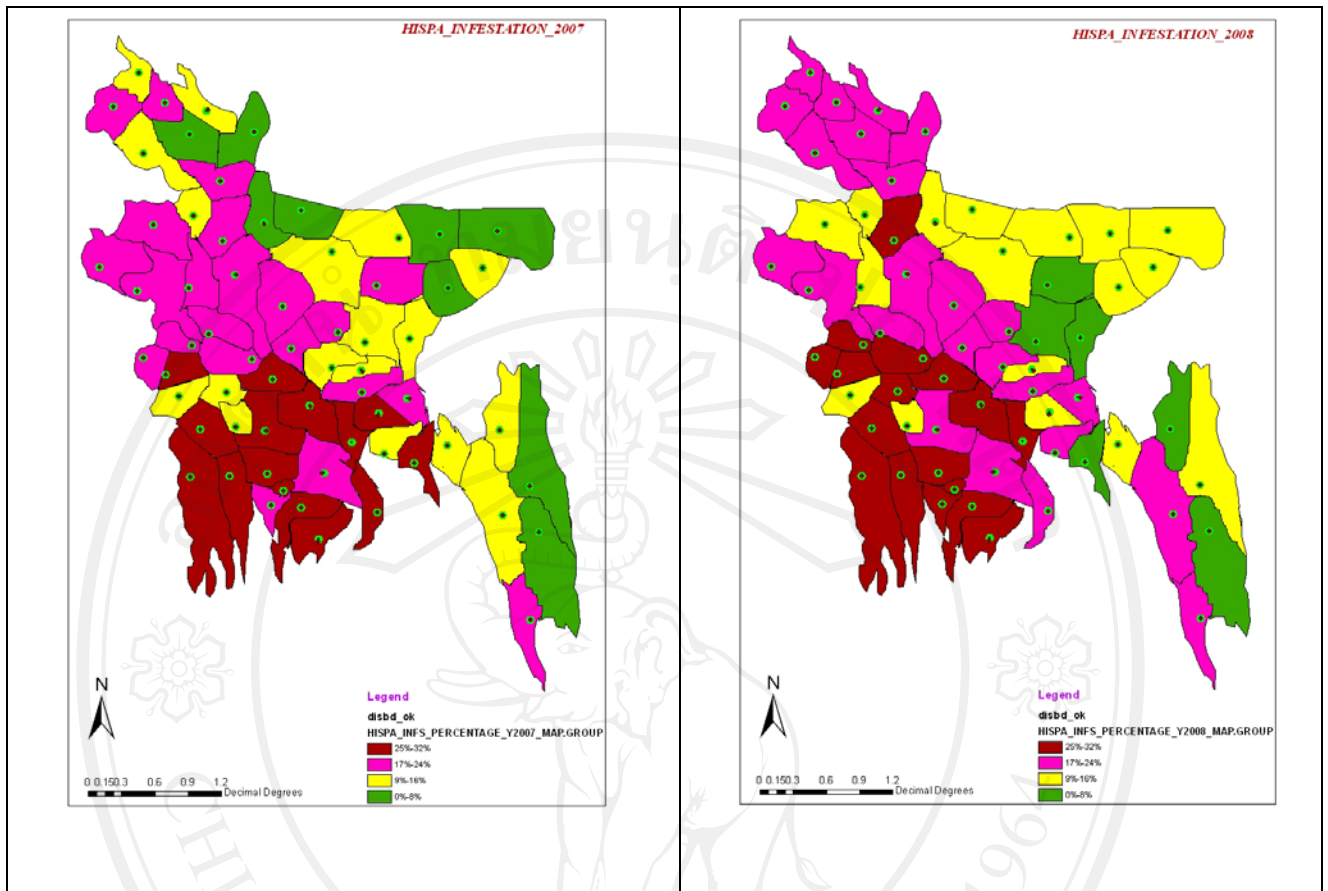
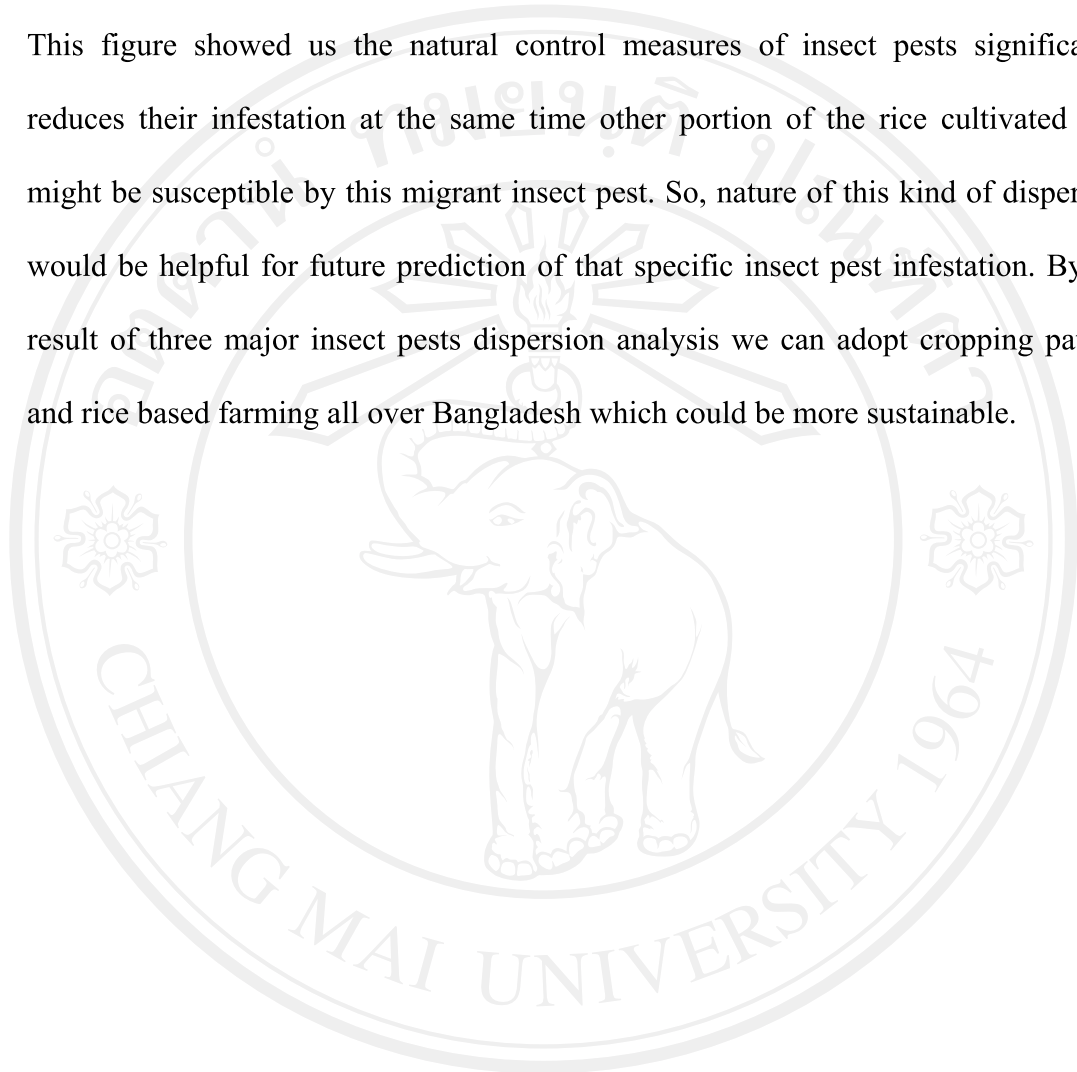


Figure 5.9 Map showing rice hispa infestations during the year 2007- 2008

5.2 Conclusion

Spatially-explicit results showed us for stem borer highly infested districts were Joypurhat, Naogaon, Kishorgonj, Chandpur, and Chittagong. Again the infestation range was decreasing after the year 2003. In case of brown planthopper analysis showed that the most susceptible districts are Kishorgonj, Chandpur, Chittagong, Tangail, and Natore. The range of brown planthopper infestation changes within this ten years tenure heterogeneously but hill tracts zone showed mostly low or very low infested area. For rice hispa it was observed that some special figure which was quite different than earlier two pests. From the year 1999 to 2003 this rice hispa were highly infested mainly in north-eastern part of the country. But after 2003 it

changes location quite significantly. From 2004 to 2008 mainly south-western part of the country infested highly and earlier location turn low or very low infested area. This figure showed us the natural control measures of insect pests significantly reduces their infestation at the same time other portion of the rice cultivated area might be susceptible by this migrant insect pest. So, nature of this kind of dispersion would be helpful for future prediction of that specific insect pest infestation. By the result of three major insect pests dispersion analysis we can adopt cropping pattern and rice based farming all over Bangladesh which could be more sustainable.



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