

Study on Impact of Land Fragmentation in Agriculture-A Case of Rajshahi District, Bangladesh

Md. Shafiqul Islam¹

Assistant Professor¹

Center for Sustainable Development, University of Liberal Arts, Bangladesh

Abstract: The study was conducted in Rajshahi district to get clear picture on the status of land fragmentation. Total 30 respondents were interviewed to know about the status of land fragmentation in Rajshahi, impacts of land fragmentation in agriculture, environment, economics and sustainable development. This study was conducted with the view to assess the impacts of land fragmentation in agriculture, land uses as well as on society, and in particular, challenges for the agricultural land. Several factors were recognized and it is happening due to alterations in physiographic and social-economic conditions and population growth. The land use pattern of Bangladesh is changing very rapidly due to unplanned human settlement and industrialization. Bangladesh is a small country but it supports a huge population, resulting in a very high density of population and very high intensity of land and resource use. The following factors are driving country's overall scenario of economic development and environment imbalance include: i) unexpected population growth; ii) human settlement; iii) increased number of nuclear family; and iv) scarcity of land for ever increasing demand of food. As a result, agricultural land is decreasing remarkably. Results showed that the land fragmentation of Rajshahi district is changing, especially the agricultural land is decreasing in an alarming rate and now it is becoming more and more vulnerable. The agricultural land of the study area is losing each and every year. The agricultural production also is decreasing due to lack of agricultural land, industrialization, decreasing soil fertility and making soils toxic by using chemicals. If this rate continues, the agricultural land will be totally exhausted within the next couple of years. Moreover the fragmentation of land is impacting sustainable development of the study area frequently. If the perceived problems could be solved by raising awareness among the people, go for vertical uses of land, motivate family to live in the extend family, adopting appropriate policy for human settlements and land use planning.

Keywords: Extend family; land fragmentation; nuclear family; vertical scope; sustainable development.

1. INTRODUCTION

Bangladesh is a small country lying between 20°34' and 26°38' N latitude and 88° 51' and 92° 41' E longitude. It has a total area of 147,570 square kilometers, where the population of the country is about 161,083,804. While nearly half of Bangladeshis are employed in the agriculture sector. Land is the important sources of man's food, shelter and clothes.

Now-a-days due to alteration in physiographic and social-economic conditions, climatic changes, adaptation and population growth, the land use pattern of Bangladesh is changing very rapidly. The country occupied huge population and showing very high intensity of land and resources utilization. Particularly in term of agriculture the land fragmentation issue is impacting very forcefully.

In each and every year the cropland is shrinking for human settlement and other human induced activities. It is estimated that the growing population pressure will use up 50 per cent of the country's cultivable land by 2025. Urbanization,

industrialization and acquisition of land by the government for different purposes have been causing negative impact on the life and conditions of the peasants as well as socio-economic scenario of the country. Huge areas of land were also devastated by the mighty rivers of Bangladesh. Moreover, land is fragmented every year in rural and urban areas due to growing population, breakdown of family and the law of heritage. According to UNDP & World Bank-WB study report, they calculated that due to fragmentation of 1.42 hectares into 10 holdings of 0.15 hectares each the effectiveness of net cropped area by about 1.5 per cent to a land owner. Moreover, per capita land that would support the basic needs of the population is fast decreasing.

Land use pattern of a country reflects its socio-economic stipulation. Land and resource use pattern also depends on family pattern and cultural heritage. Land use changes are concerning topics in perspective of socio-economic changes of a country; the pattern of its changes in Bangladesh is to meet the dynamic demand of the society that creates pressure on natural environment. As a result, various disharmonies occur in natural system. In fact, the land use change is the changes of men's activities on land which mostly occur in two ways: firstly, changes from one type to another and secondly, changes into a type *i.e.* either decreasing or increasing. Both types of changes take place in Bangladesh. Among the changing pattern the changes of agricultural land is remarkable in a land hungry country like Bangladesh. The total arable land of the country is not more than 0.782 crores ha and per capita land is only 0.0526 ha. Moreover, every year 1% of its arable land or 82900 ha of crop land and everyday 221 ha of arable land is losing in Bangladesh. Despite the remarkable achievement in controlling the high birth rate, the population continues to grow by 2 million people each year because of the large existing population base [1]. The country's population will be over around 190 million by 2030 when an extra 25% food grains will have to be produced but smaller area of cropland than is now available [2].

According to one projection, the country would have to grow an additional five to six millions tones of grains by 2020 in a land area two million ha less than today. In this perspective land use changing pattern is a challenge for agricultural land. The term land use has been defined differently from various perspectives by different scholars. It has seen as a product of interactions between a society's cultural background, skill and its physical needs in one hand, and the natural potential of land on the other [3]. Land use is also defined as men's activities on land, which are directly related to land. Vink [4] pointed out that the later is a subset of the former stating. Land use is characterized by the arrangements, activities and inputs by people to produce change or maintain a certain land cover type [5]. Land use defined in this way therefore establishes a direct link between the land cover and the actions of people in their environment [6]. Land cover is the observed biophysical cover on the earth's surface. In other words, land use equal to land cover plus land utilization [5]. Further, land use is the arrangements, activities and inputs that people undertake on a certain land cover type [7]. According to these definitions land use reflects human activities such as the use of the land like industrial zones, residential zones, and agricultural fields and so on. The major land use pattern of Rajshahi District has been categorized into the following classes: agricultural land, infrastructural land, orchard, water bodies, fallow land, char land, char agricultural land, and river area. Total land area of Rajshahi District is 577472.28 acres. Of this, agricultural land is 394486.32 acres, infrastructural land 117115.42 acres, orchard 11113.9 acres, fallow land 11070.78 acres, water bodies 19817.49 acres, char land 13281.8 acres, and river area 7547.65 acres. The land use pattern of the study area in 1977, 1990 and 2010 was shown in (table I)

Table I land use pattern

Land use pattern	Area in 1977 (in ha)	Area in 1990 (in ha)	Area in 2010 (in ha)	Changes area 1977-1990 (in ha)	Changes in % (1977-1990)	Changes area 1990-2010 (in ha)	Changes in % (1990-2010)	Changes area 1977-2010 (in ha)	Changes in % (1977-2010)
Agricultural	186056.74	177564.6	159913.48	8492.10	-4.65	17853.58	-9.95	26143.25	-14.05
Infrastructural	16161.36	26017.23	47617.58	9859.98	+60.98	21600.34	+83.02	31456.27	+194.63
Orchard	3781.95	3438.43	4499.55	343.34	-9.08	1061.13	+30.86	717.76	+18.97
Fallow land	8666.05	6613.66	4482.09	2052.40	-23.68	2131.58	-32.22	4183.98	-48.27
Water bodies	10235.95	10410.94	8428.13	134.61	-1.32	1982.81	-19.05	1807.81	-17.66
Char land	2071.20	4393.17	5377.25	2321.97	+112.1	984.07	+22.40	2901.19	+140.79
River area	6425.07	4951.13	3055.72	1392.97	-22.94	3369.34	-52.44	3369.34	-52.44

Source: Landsat MSS-1977, TM-1990 and TM-2010 image analysis.

The land use changing pattern of Rajshahi District described above revealed that the agricultural land is facing a greater challenge. Although the rate of decline is smaller than other types of changes, its vast amount is concerning more than other changes. The agricultural land of the study area has been decreased 14.05% during the past 33 years and at a rate of 0.46% per year which is shown in (table II).

Table II Change in land use

Year	Agricultural land (ha)	Duration	% Decreased	% Change s per year
1977	186056.74	-	-	-
1990	177564.61	1977-1990	4.57	-0.36
2010	159913.49	1990-2010	11.03	-0.55
		1977-2010	14.05	-0.46

Source: Satellite Images of Landsat 1977-MSS, 1990-TM and 2010-TM analysis.

Although the areas under agricultural land, water bodies, fallow land and rivers have been lessening, the infrastructural land and char land have been increasing steadily over the same period. This trend suggests that the agricultural land is converting into other type of land use, especially applicable for the infrastructural land [8]. The orchard area has been reduced during 1977-1990 but increased during 1990-2010. That means some new area (especially agricultural land) has been converted into orchards such as mangoes, litchi and plum (*Kul*) in the study area. In other words, it speaks that every year agricultural land is decreasing by the increasing areas of the infrastructure and orchards. These findings corroborate to those reported earlier [8] [9] [10].

The main objective is to find out the impacts of land fragmentation in term of agriculture at Rajshahi District. The other associates objectives are to i) determine the rate of land fragmentation; ii) determine the land use pattern; iii) determine the reasons behind land fragmentation iv) find out the impact of land fragmentation on sustainable development; v) find out the impact of land fragmentation on agriculture; vi) find out the other problems related to land fragmentation and; vi) recommend possible solutions to reduce land fragmentation

2. METHODOLOGY

The study was conducted over the period of one month started from February, 2013 and ended by March, 2013. The study was conducted in three phases. In the first phase, details information about the study areas were collected, In the second phase study site, study population and consultation and data collection were done. In the last phase validation, data management, data analysis and final report was made. The study was concentrated in 10 Upazillas(sub-districts) namely Bagha, Bagmara, Charghrat, Durgapur, Godagari, Mohanpur, Paba, Puthia, Tanore, Boalia from Rajshahi district to get real picture of the study areas (Annex 1). Total 30 participants (3 respondents under different age category and occupations group from each Upazila) were selected for interview regarding land fragmentation and impacts in agriculture. Both male and female were interviewed for this study. The respondents were selected from farmers, job holders and land lords. Data were collected through guided semi-structured questionnaire regarding reason for land fragmentation and impacts in agriculture. Both primary and secondary data were collected for this. After data collection it was checked for reliability and validity. Data were analysed using MS-Excell and presented in tabular and graphical form for ease perception.

3. RESULTS

3.1 Land fragmentation and its consequences

The rate of land fragmentation is increasing due to increase of nuclear family. The breakdown of family is the common factor in the study area. Mostly after getting marriage the son and son in law is becoming as the new nuclear family. So first of all there has been taken an interview of family fragmentation rate. The rate of family breakdown is directly linked

up with the land fragmentation. Fig.1 showed how frequently family is breaking down. At the same it was reflected the rate of land fragmentation in the study areas. This was just few case of sample.

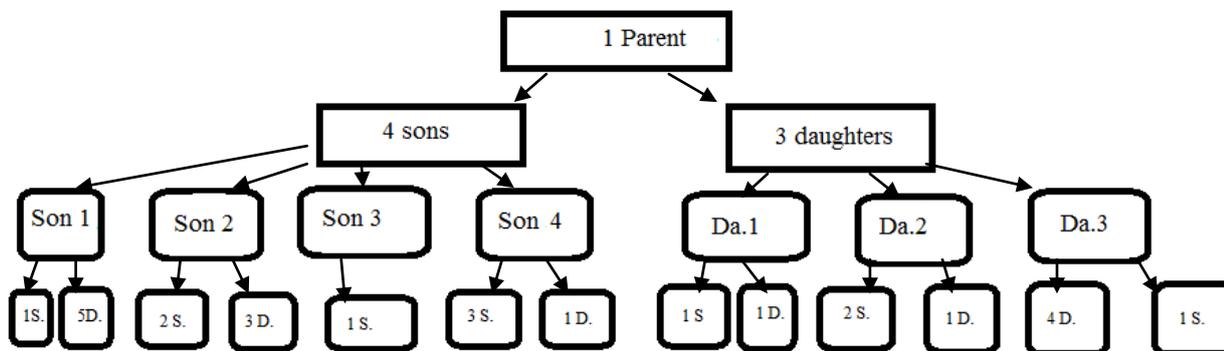


Figure-I

So, in this figure the time of fragmentation was four. 43.33% respondents were mentioned that 3 times land fragmentations have been occurred in their families during his/ her tenant (Table III). Here it was clear that by only time of fragmentation the population of the family increased rapidly. So the fragmentation of the land owned by this lineage to the descendants is natural here. On the study area the major fragmentation (60%) were found in the Farmers group.

Table III land fragmentation frequency

Frequency of land fragmentation	Farmers n=10		Landlords n=10		Service-holders n=10		All N=30	
	No	%	No	%	No	%	No	%
4	3	30	2	20	3	30	8	26.67
3	6	60	3	30	4	40	13	43.33
2	3	30	5	50	1	10	9	30.00

3.2 Reasons for land fragmentation

Several reasons are responsible for land fragmentation including alarming rate of population growth, conflict of interest and due to lack of proper planning for land use planning. Around 97% people (Table IV) were mentioned that the rapid growth of population is the main reason for land fragmentation. The underlying causes were mentioned by the respondents were that in modern age people are interested in living independently, which encourages the nuclear family system. So the land is getting fragmented and people are creating houses and work places horizontally. Growing population is the main reason then followed by industrialization, in appropriate land use planning, increased nuclear family and digging ponds, canals and ponds respectively.

Table IV reason for land fragmentation

Reasons	Farmers n=10		Landlords n=10		Service-holders n=10		All N=30	
	No	%	No	%	No	%	No	%
Growing population	9	90	10	100	10	100	29	96.67
Increasing rate of nuclear family	4	40	8	80	9	90	21	70.00
Industrialization	8	80	9	90	8	80	25	83.33
Digging canals, ponds	4	40	4	40	3	30	11	36.67
Inappropriate land use planning	6	60	8	80	7	70	21	70.00

3.3 Impacts of land fragmentation in daily life

The pattern of land fragmentation has annoyance on daily life. Land fragmentation causes several impacts in our daily life including poverty, food crisis and threatening in daily life style. 84% respondents were opined that agricultural are decreasing day by day followed by poverty, livestock redistributed and no or less land for gardening respectively (Table V). Among the service holder 90% respondents were mentioned poverty is the ultimate result due to land fragmentation and increase of nuclear families.

Table V Impacts in daily life

Impacts of land fragmentation	Farmers n=10		Landlords n=10		Service-holders n=10		All N=30	
	No	%	No	%	No	%	No	%
Decrease of agricultural land	9	90	8	80	8	80	25	83.33
Livestock is redistributed	8	80	5	50	7	70	20	66.67
Poverty	5	50	7	70	9	90	21	70.00
Less land for gardening	2	20	7	70	8	80	17	56.67

3.4 Impacts land fragmentation in agriculture

The disadvantages of the consequences in land fragmentation are of many. The uses of chemicals and hybrid seed are increasing at the alarming rate for increased agricultural production which leads detrimental impacts on health and environment. 87% respondents were pointed that land fragmentation is leading increased uses of chemicals followed by decreases soil fertility, decreased vegetable production and decreases grain production respectively (Table VI). For land fragmentation most of the lands are getting industrialized and the lad for agriculture is losing number day by day, due to this the crops and trees are getting damaged.

Table VI Impacts in agriculture

Impacts in agriculture	Farmers n=10		Landlords n=10		Service-holders n=10		All N=30	
	No	%	No	%	No	%	No	%
Decreasing soil fertility	8	80	7	70	8	80	23	76.67
Decreasing crop production	5	50	5	50	7	70	17	56.67
Decreasing vegetable production	6	60	6	60	8	80	20	66.67
Increasing use of chemical fertilizer	9	90	8	80	9	90	26	86.67

3.5 Impacts on society and sustainable development

In Rajshahi district there were many gardens of mango trees before 1970 but now most of the families have no garden even they have no extra space in the homestead. The mental and physical growth of the children are hampering due to lack of free space for play and recreation. They are getting robotic day by day. 96.66% respondents were reported that now a day’s people are leading mechanical life style for their existence (Fig 2). In addition to that most of the people are lacking from awareness and lack of mutual trust in respect to land fragmentation and family breakdown.

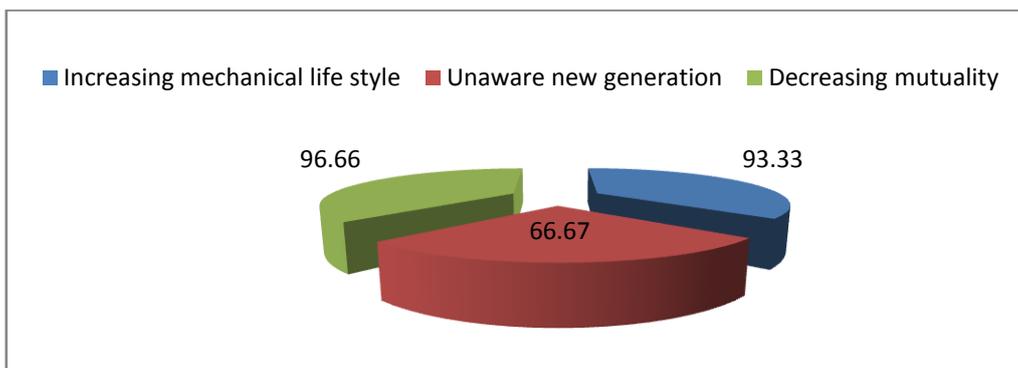


Figure II

3.6 Disadvantaged Economics

Many disadvantages are occurring due to family break down and increasing the number of nuclear family with the relationship of land fragmentation. In the link to land fragmentation, Rajshahi is losing the fruit production as well as crops and vegetable production areas. As a result the people are becoming poorer due to low income and hampering economic sector is getting impacted as well as livestock is redistributed from the poor to the wealthy (Table VII).

Impacts	Farmers n=10		Landlords n=10		Service- holders n=10		All N=30	
	No	%	No	%	No	%	No	%
Poor fruit production	9	90	10	100	9	90	28	93.33
Poor crops and vegetable production	10	100	7	70	8	80	25	83.33
Low income	8	80	5	50	7	70	20	66.67

3.7 Impacts on environment

Green spaces are decreasing due to land fragmentation. The trees have been cut down with the increase human settlement. So the nature is getting imbalanced as a result the disasters like earthquake, flood, tornado etc. are appearing. Around 100% respondents were (Figure III) reported that land fragmentation is also responsible for disasters and other consequences of environment including water flow, soil erosion, air and water pollution. The consequences are likely acceleration of soil erosion and drastic reduction of trees due to increase settlement and nuclear family.

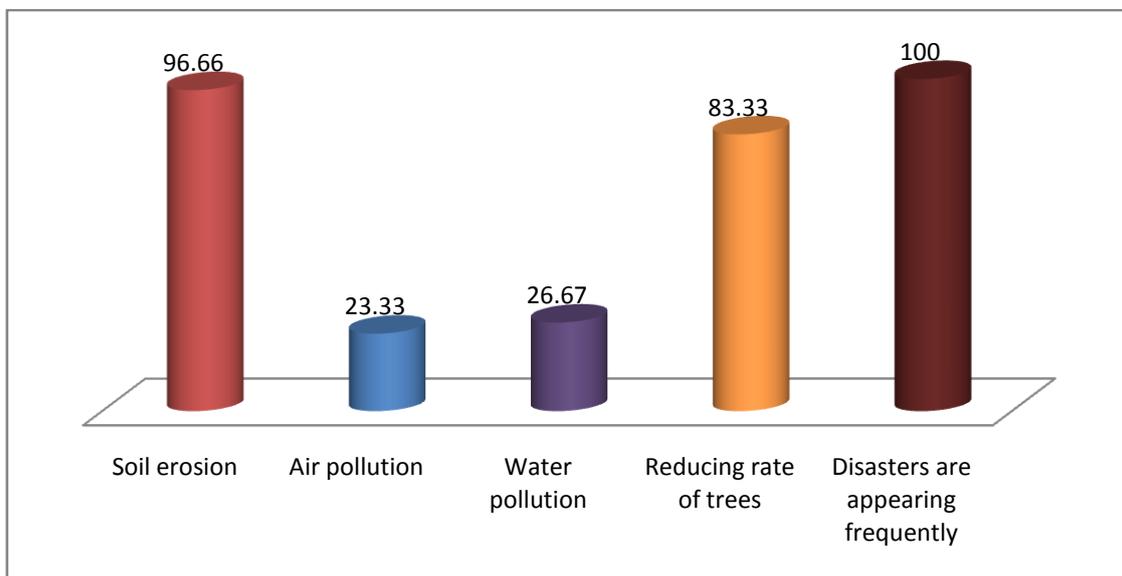


Figure III Impacts on Environment

3.8 Possible solution in reducing impacts of land fragmentation

In avoiding the aforesaid problems we have to provide emphasis on solutions related land fragmentation and nuclear family. People can live in multistoried buildings to manage the wastage of their productive agricultural lands. 90% respondents were mentioned that the infrastructure should be developed avoiding agricultural land followed by option for multistoried infrastructure for both residents and industries avoiding horizontal expansion, maximum utilization of land, adopting land use policies, encouraging people to live in extend family, utilization of marginal land and creating vertical scope for agriculture respectively (Table VIII).

Table VIII Possible Solutions

Solutions	Farmers n=10		Landlords n=10		Service-holders n=10		All N=30	
	No	%	No	%	No	%	No	%
Developing multistoried Infrastructure	7	70	9	90	10	100	26	86.67
Avoiding agricultural land	10	100	8	80	9	90	27	90
Adopting policy on land uses	5	50	8	80	10	100	23	76.67
Encourage living in extend family	7	70	5	50	4	40	16	53.33
Utilization of marginal land	5	50	4	40	6	60	15	50
Maximum utilization of land	8	80	7	70	10	100	25	83.33
Vertical uses of land	0	0	0	0	2	20	2	6.67
Create awareness among people	7	70	4	40	3	30	14	46.67

4. DISCUSSIONS

According to the study, land is fragmenting due to rapid development, urbanization, excessive pressure of population growth, increasing number of nuclear family, rapid industrialization and development of new infrastructure. There are no many research findings were found on land fragmentation. Several recommendations such as vertical development of infrastructures and imposing of taxes on such structures, accumulated zonal growth planning, population growth control and development of awareness among the people were made by the respondents.

The vacant land in and around Rajshahi district has decreased due to increasing demand of land for non-agricultural uses. The fruit production areas are reducing due to increasing number of nuclear families and homesteads, land fragmentation, urbanization, and construction of new roads. The industrialization, urbanization and developed of new homesteads have destroyed fertile agricultural land. The rivers and canals are now encroached upon and used for disposal of wastes and garbage.

In the study areas it has been recorded that a significant increase in residential area (homesteads) to accommodate the increasing nuclear families and this also leading towards on the way to drastic land fragmentation [11].

5. CONCLUSION AND RECOMMENDATIONS

Diverse factors are affecting the supply and demand of land and its uses in Rajshahi districts. The increase of nuclear families and land fragmentation is limiting agricultural production day by day. With uncontrolled population growth and economic development in the study area, the land use pattern is changing rapidly. This is due to lack of awareness, living in the nuclear family and conversion of agricultural land to other uses. The agricultural land is encroached by the pressure groups during the last few years. It was found that agricultural lands of the study area were losing every year. The land use pattern of Rajshahi District has been changing rapidly which is creating pressure on agricultural land. Without taking proper planning and implementation of the agricultural land of the study area, this trend would face a great challenge.

Based on the present findings, the following recommendations are proposed for future planning, the infrastructure should be developed vertically; zonal growth planning should be accumulated; taxes can be imposed for new infrastructures; population growth rate should be controlled; and most importantly, awareness should be grown up among the people. Additionally the followings recommendations were made for the next steps:

- Specific studies on causes and consequences of land fragmentation and impacts on agriculture should be carried out.
- Need special attention on vertical scope in agriculture.
- Uses of multi-trellis for agricultural production should be encouraged.

- Uses of living trees, roof top, chala, unused land, marginal land may be the option for production pocket for agriculture.
- Use live fence instead of traditional fence to ensure production and protection at the same time.
- Swampy area and shady areas should be brought under agricultural production system.

REFERENCES

- [1] Mahbub A. 2003. Agricultural land loss and food security: An assessment. IRRI, Manila, The Philippines.
- [2] Bhuiyan M. 2003. Has urbanization caused agricultural landloss? The Daily Star, November 1 2003.
- [3] Ram R and Kolakar S. 1993. The Future of Our Land: Facing the Challenge. Hall of India Pvt. Ltd., New Delhi.
- [4] Vink RK. 1975. A framework for land evolution. www.mpl.fr/creat/taller-columbia/FAO/AGLL/pdf.docs
- [5] Di Gregorio CM and Jansen J. 1998. A new concept for a landcover classification system. Land 2(1): 55-58.
- [6] Lillesand TM and Kiefer RW. 2002. Remote Sensing and Image Interpretation. John Wiley and Sons, Inc. New York.
- [7] FAO (Food and Agriculture Organization) 2000. Yearbook 49:Production. Rome, Italy.
- [8] Islam KN. 2000. Temporal Mapping and Spatial Analysis of Land Transformation Due to Urbanization and its Impact on Surface Water System: A Case from Dhaka Metropolitan Area. Int. Arch. Photogram. Remote Sensing XXX (B7): Amsterdam. Studies conducted by UNDP & World Bank-WB
- [9] Rahman MR, Islam AHM and Hassan MS. 2005. Change detection of winter crop coverage and the use of Landsat data with GIS. J. Geo- Environ. 4: 1-13.
- [10] Rahman MR and Saha SK. 2009. Spatial dynamics of cropland and cropping pattern changes analysis using landsat TM and IRS P6 ISSII satellite images with GIS. Geo-Spatial Info. Sci. 12: 17-21.
- [11] Rahman, M.M. 1993. Landuse Pattern of Narayanganj Municipal Area: Present and Future. Unpublished Master Thesis Paper, Department of Geography and Environment, Dhaka University, Dhaka.
- [12] BBS (Bangladesh Bureau of Statistics) 2008. Economic Review 2008. Ministry of Planning. Government of Bangladesh.

Annex 1

- ✚ Location map of the study area.



Location Map Of The Study Area