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Remote Sensing and GIS Techniques for Detecting Temporal Changes of Small Water Bodies in Ghiduari Mouza of Atpara Upazila

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Abstract: Geographic Information System (GIS) and Remote Sensing (RS) techniques both are time oriented modern computer software based analysis tools which are using for different analysis purposes. Small water bodies (e.g. Pond, Dighi, Doba, Khal, Beel) are one of the most productive ecosystems but these small water bodies are changing rapidly in its size, shape and depth over time driving the environment and human being in critical situation. Different types of small water bodies are present and under critical situation in the study area. So, with the help of GIS and RS techniques a study was conducted to explore this. To collect primary data different methods had adopted which were informal interview, satellite image based survey and GPS survey. Data also collected from different secondary sources. Findings show that Pond is the most dominant feature and after that Doba, Dighi, beel and khal, changes are more in the depth then size and shape, seasonal changes are also found and factors behind the changing pattern of small water bodies are flood and sedimentation, drainage, agriculture, settlement and many more. To protect small water bodies have to adopt and implement appropriate National Wetland Policy through people's participation and participatory enforcement through targeted groups.

Keywords: Small water bodies; GIS; RS; Spatial Distribution; Seasonal Change; Environment; Ecosystem.

I. Introduction

Water is an essential resource for life on earth. We drink it, bathe in it, fish in it, keep cool with it, irrigate the plants, produce energy with it and also use it for transportation and recreation (Kudesia, 1990). Even though Bangladesh is famous, from ancient times, for its abundance of water from various sources, one of the major problems that the country has been suffering for decades is the scarcity of safe water. A small water body is the collective term for marshes or Beel, Dighi, Pond, Doba, Khal, and similar wetland. It's located mainly near agriculture and settlement area. In Bangladesh various uses of small water bodies are seen. Small water bodies play an important part in socio-economical sector in Bangladesh but these small water bodies are disappearing and changing in size, shape and depth enormously (Huda, 2004). Wetland plays vital role not only for environmental balance but also for socio-economic condition of human being. But rate of wetland transformation and changing are driving the environment of Bangladesh in critical situation (Khan, 1993). Presence of lakes in the residential areas is an advantage as it enhances the beauty of the area, influences the microclimate with its cooling effect at night while the banks of the lakes are utilized for recreational purposes. But by his study is found that the water qualities of the lakes are deteriorating seriously day by day (Saika, 2009). Das (2000) in his paper exhibited the present status of fresh water wetland of the country, evaluated the environmental impact of various development activities on wetlands and prepared recommendation for future action program. Gain in 1998 discussed in his book about the environment laws in Bangladesh and some selected environmental issues. He also included the causes and consequences of environmental issues and citizens, response to those there environmental issues.

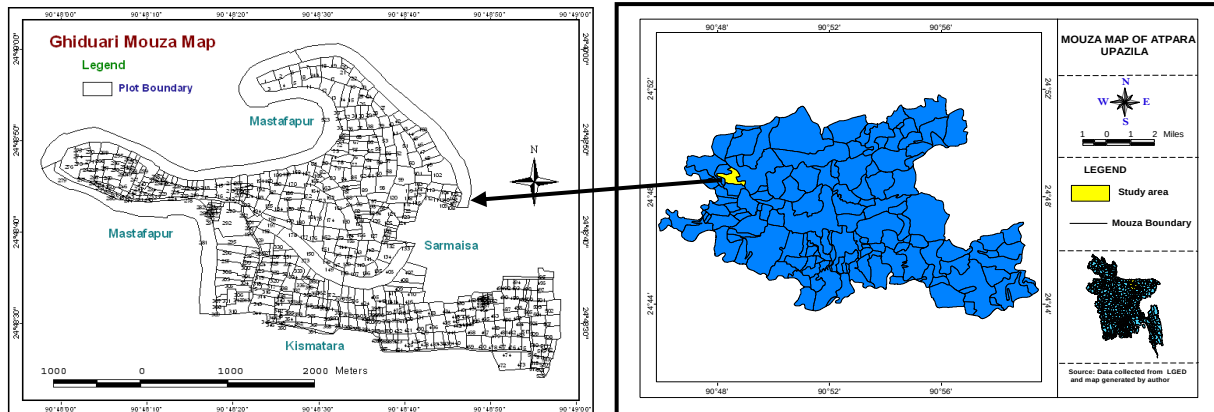
At present Small water bodies are in threatening situation for various reasons. The small water bodies are disappearing, changing in size, depth and shape rapidly due natural and artificial causes. So, by using two

modern computer software based techniques, Geographic Information System (GIS) and Remote Sensing (RS), a study carried out on small water bodies temporal and seasonal changes in the study area. The main aim of the study was to identify changes of small water bodies over time including the causes behind these changes. By this study it would be possible to show the changes of small water bodies over time by the GIS map, spatial distribution and concerned causes of changes.

II. Materials and Methods

Location of the Study Area

The study area is Giduari Mouza which is situated in Sarmaisa union of Atpara upazila under Netrokona District. There are various types of small water bodies found in this mouza whose shape, size and depth are changing day by day. Some parts of the mouza are surrounded by the river. The absolute location of study area is between $24^{\circ}81'$ and $24^{\circ}82'$ north latitudes and between $90^{\circ} 80'$ to $90^{\circ}82'$ east longitudes.



Map 1: Location of the study area inside the Upazila Mouza Map

Sources of Data Collection and Methodology

Data are collected for this study both from the primary and secondary sources using different techniques. To collect primary data different methods had adopted which are informal interview to know causes and factors behind the changes of small water bodies using Random Sampling Techniques. Small water bodies changes have identified with the help of previous and present satellite images by the small water based field survey to present in the GIS based map. To know the detail information about small water bodies changes focus group discussion was also done. A small water bodies based GPS Survey conducted in the study area for showing spatial distribution of small water bodies in the map using GIS Techniques. Secondary Sources of the this study were different journals, reports, research papers, searching wave site Google and others published and unpublished documents of government and non government. Temporal Satellite Image of the research area downloaded from Google Earth. Map and reports were collected from relevant organization. Finally, collected data were processed computer based statistical software and using Geographic Information System (GIS) and Remote Sensing (RS) Software to present changes by drawing different map with spatial distribution.

III. Result & Discussion

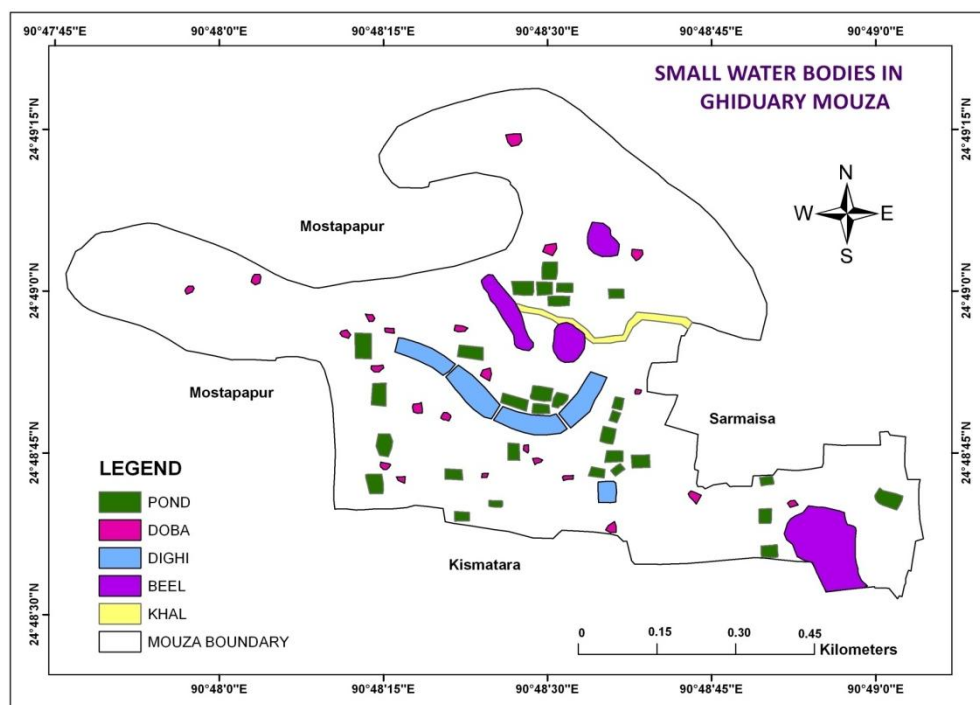
Area and Quantity

Different categories of small water bodies are identified in the study area. Among those Ponds are the highest number and then dobas, dighi, beels, and khal are respectively in next. . Among those Ponds are the highest number and then dobas, dighi, beels, and khal are respectively in next. The amount and area of small water bodies in the study area are shown in the following table and map in details.

Table 1: Area and quantity of small water bodies

Name of water bodies	Doba	Pond	Dighi	Khal	Beel
Total amount	23	30	5	1	4
Area(sq meter)	7050	21000	7020	650	9090

Source: Field Survey (2011)



Map-2: Spatial distribution of the small water bodies of Ghiduari Mouza

Changes Occurred in Water Bodies' Size, Shape and Depth

The small water bodies environment of the study area is changing rapidly due to presence of various factors over period of time. Degradation of small water bodies has caused several problems including extinction and reduction of wildlife, extinction of many indigenous wild and domesticated rice varieties, loss of many indigenous aquatic plants, herbs, shrubs and weeds, loss of natural soil nutrient, loss of natural water reservoirs and of their resultant benefits.

Table 2: Nature of changes of SWBs and its changing percentage

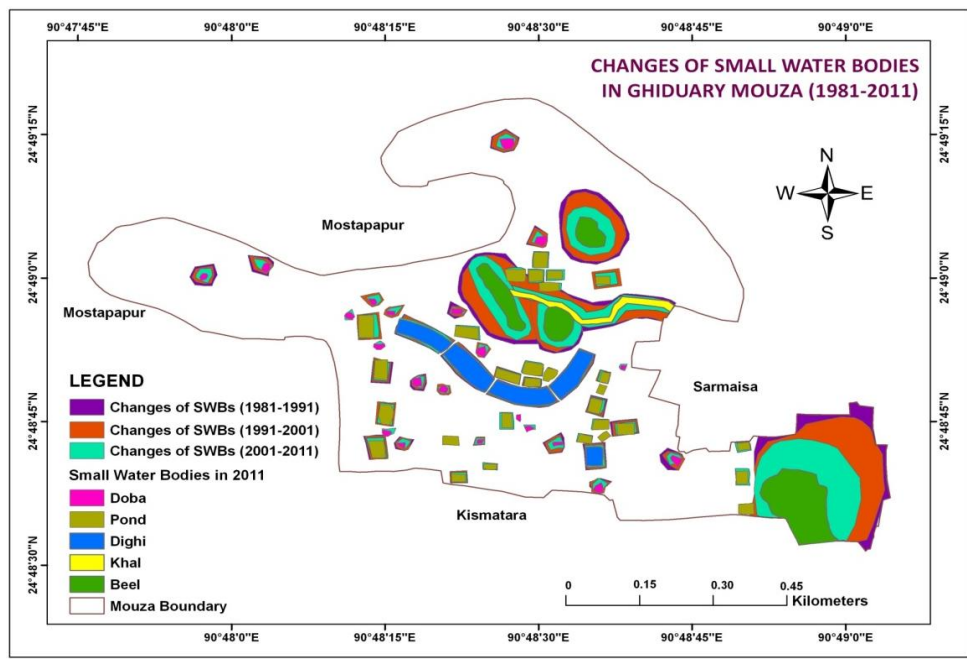
Changes of water bodies	No. of water bodies	Percentage (%)
Size	25	73.02
Shape	10	36.51
Depth	28	88.87

Source: Field Survey (2011)

The above table represents that maximum small water bodies are changed in the depth according to time which percentage is 88.87% and shape and size are also changed over time.

Changes of Small Water Bodies over Time

There are about 63 small water bodies in the study area and these are created in different time. The total aspects of these small water bodies are rapidly changing on account of various factors such as Flood and Sedimentation, Drainage, Settlement, Low cost of land, Agriculture, Plant residuals, climate change etc. The changes are comparatively more in beel, khal and doba than dighi and pond. There is a four beel and one khal and these beel and khal are naturally created. These beels and khal were stretched in large area. The area of beels which were in 1981 and now these turned into one third. In the case of khal, same condition is present. There is a 23 doba, 30 Pond and 5 dighi. Among these environment of doba are also changing rapidly than dighi and Pond. The doba which were naturally created and now are sustaining such condition that it is difficult to identify as a water bodies because of rapid changes in its size, shape and depth. Between dighi and Pond, the changing pattern is more in pond than dighi. But these two water bodies type changes are occurring in depth and shape then size because of good bank of these water bodies and maintenance. After all, the rate of changes which is occurring in the case of beel, khal and doba that indicate if this continue then day after tomorrow it will be hard to identify the trace of beel, khal and doba. Natural ecosystem will be seriously hampered and flora and fauna will be totally disappeared. Natural environment will destroy seriously and various kind of disaster will occur. These gradual changing patterns of small water bodies are shown by GIS Map clearly which are given below:-



Map-3: Changes of small water bodies of the study area (1981-2011)

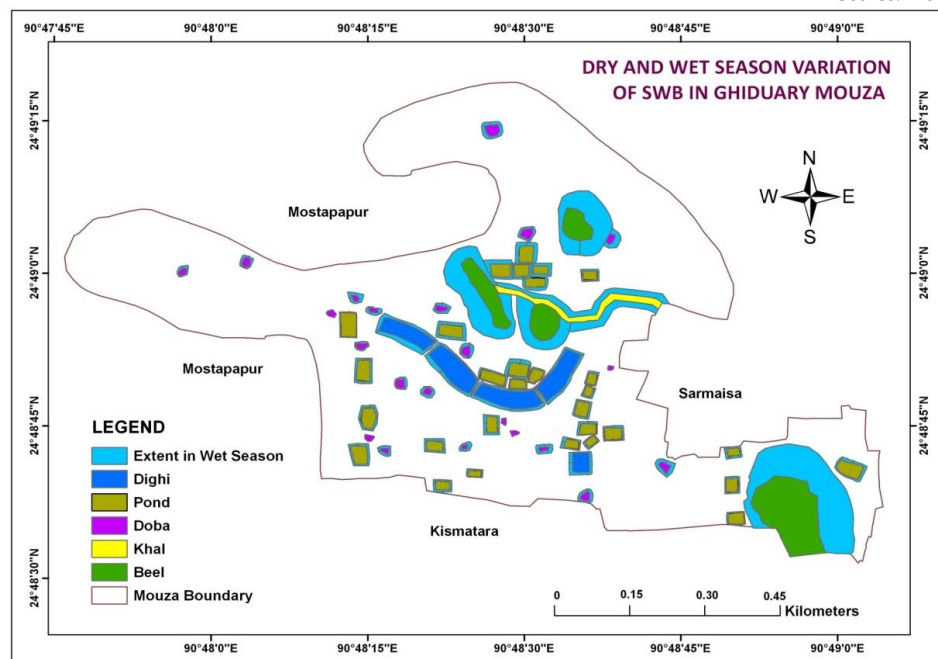
Seasonal Changes of Small Water Bodies

Seasonal changes are found in the study area small water bodies. Seasonal variation is more in beel, khal and doba than pond and dighi. The depth and area of beels are increased more in wet season and spread in surrounding area because it has no high bank.

Table 03: Seasonal variation of small water bodies water in study area

Title	Doba	Pond	Dighi	Khal	Beel
Total Amount	23	30	5	1	4
Area (sq. meter) in wet season	9025	23220	8090	900	15000
Area (sq. meter) in dry season	7050	21000	7020	650	9090

Source: Field Survey (2011)



Source: Author (2011)

Map- 4: Dry and Wet season variation of small water bodies in Ghiduary Mouza (2011)

Factors Associated with Small Water Bodies Changes

There are mainly two factors are involved in changing the small water bodies of the study area. This are-

1. Physical Factor
2. Socio-economic Factor

1. Physical Factor

Some physical factors are discussed below that changed to small water bodies.

(a) Flood and Sedimentation

Most of the area is low-lying area and this area is flooded more than 0.91m deep during monsoon. The land type of the area is dominant by recent sub – recent alluvium sediments and the area which is seasonally flooded 2 to 3 months during most of the seasonal flood. Floods affect the low-lying areas frequently. As a result of this, some of the areas are filled with silt and sand that brings by flood. Because of this flooding and sedimentation, the small water bodies of the study area keep changing their size, shape and depth.

(b) Drainage

The drainage system of the study area is very poor. Local canals, river and beels drain the excessive water during flood. But for a long time the canals, river and beel remain dry and those has been filled up with sediment come from nearer household. Moreover the canal and beels are filled with soil for agriculture purposes which decreases the water holding capacity. For the reason such kind practice created drainage congestion in this study area and its affect on those as well as other small water bodies.

2. Socio-economic/Cultural Factors

There are some socio-economic cultural factors which causes changes study area small water bodies. These socio-economic and cultural factors are discussed below-

(a) Settlement

Population is a big problem in Bangladesh. The study is not exceptional. For the increasing number of population, household is also required. That's why beel, doba and khal are filled and there new settlement built up. As a result, small water bodies are shrinking day by day by unplanned human activities.

(b) Low Cost

Generally the land value of the water bodies is very low. As most of the study area people are from low income group, they prefer to buy lands in the water bodiers area. It is one of the major causes for small water bodies change.

(c) Agriculture

Small water bodies soil is very fertile and suitable for agriculture purposes. The low-lying area is very fertile as they are flooded during the wet season. Like other parts of Bangladesh, agriculture is the dominant activities in Ghidiuari mouza. Introduction of non-scientific agriculture practice acting as catalyst for transformation of water bodies of Ghidiuari mouza.

(d) Plant Residuals

Plants residuals come from paddy field. The small water bodies of the study area are used seasonally for agriculture. Small water bodies are filled up by decomposing plant residuals. In the way to this cumulative deposition of very low lying area is converted into lowland and gradually it removed into medium high land.

Impacts of Small Water Bodies Change

Bangladesh's small water bodies resources have suffered considerably from the impacts of a burgeoning human population, including direct extraction and habitat loss. The impacts of human interfaces has been particularly damaging to the fragile ecosystems and sustainability of the small water bodies. Apart from changes in the land use pattern, increased human activities in the small water bodies areas have put on pressure on their ecosystem. Exploitation of aquatic vegetation and fruits on a large scale has caused several problems. This has also contributed to the decline of the fish and migratory birds. The study area Ghidiuari Mouza had a number of small water bodies in the earlier time. With the passage of time, a large part of these small water bodies have been changed into agricultural land and for other purposes.

Findings

- Pond is the most dominant feature in the study area and after that Doba, Dighi, beel and khal.
- Small Water bodies are changing more in the depth then size and shape.
- Seasonal changes of small water bodies are found more in the study area.
- Factors behind the changing pattern of small water bodies are flood and sedimentation, drainage, agriculture, settlement and some other causes like climate, unplanned government development activities, and many more.

Recommendations

- The land use regulation can be formulated so that planning, design and construction of infrastructures take into consideration of flood and water bodies resources management.
- Adopting and implementing plenty and appropriate National Wetland Policy through people's participation and participatory enforcement through targeted groups.
- Implementations of awareness development program involving people's participation through media, seminar etc and some government and non-government organizations should be more involved in conservation of small water bodies.

IV. Conclusion

Water is a vital aspect of human life. Without water any one can't continue his daily activities in a proper way. Small water bodies play vital role to the rural people's life. These are situated surrounding settlement and agricultural field in the study area. Various kinds of fishes are cultivated in this small water bodies especially in Dighi and Pond. The small water bodies especially naturally created small water bodies are changing rapidly and reducing its area with its depth because of various reasons. The seasonal variations are also found in study area small water bodies. Characteristics and using pattern are also changing over time.

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