IMPACT OF ANTHROPOGENIC ACTIVITIES ON HAIGAM WETLAND USING REMOTE SENSING AND GIS

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ABSTRACT:
Wetlands play a vital role in maintaining the overall cultural, economic and ecological health of the ecosystem; their fast pace of disappearance from the landscape is of great concern. Haigam wetland of Sopore Baramulla J&K—one of the beautiful wetland in Jammu and Kashmir is continuously changing due to un-planned anthropogenic activities like Human settlements, expansion of the agricultural fields and the siltation and the wetland of the village has been shrinking. This study evaluates wetland changes in Haigam Sopore Baramulla J&K, between 1969 and 20013. Spatial and temporal dynamics of wetland changes were quantified using one top sheet and two Liss-3 images and the post-classification change detection technique in remote sensing and GIS environment. The analysis revealed that area of wetland decreased significantly over the last 35 years by the conversation of the wetland into human non wetland use like Agricultural, human settlement, pasture land, orchids and vegetable gardens. The total area of the Haigam Lake was 754.32 ha in 1969 and after conversion of this wetland by humans into non wetland use like Agricultural, Human Settlement, orchids, and vegetables gardens it remains only 533.60 ha respectively in 2013. This changing trend of Haigam wetland makes the migratory birds population vulnerable, creating water logging problems and their consequences. Land filling and encroachment were recognized to be the main reasons for shrinking of the Haigam wetland. If the same pace continues then in the near future the Haigam wetland remains no more. If conservation measures are not taken then the consequences are severe and the effects are seen by everywhere especially on the local population.

KEY WORDS: Anthropogenic activities Haigam Wetland, GIS, Remote sensing.

INTRODUCTION:
The definition of wetlands used for this project was adapted from the U.S. Environmental Protection Agency (EPA) definition that describes wetland as “[areas] that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil

Wetlands are defined as lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water (Mitch and Gosselink, 1986).

The Kashmir valley in Jammu and Kashmir has a large number of wetlands. However, their ecological and socio-economic values were rarely explored. The famous wetlands of Kashmir are Dal Lake, Anchar, Wular, Haigam, Malgam, Haukersar and Kranchu lakes. These wetlands face serious threat from anthropogenic activities like increasing human settlements, urbanization, siltation, expansion of agricultural fields and the expansion of roads. The present study was carried out in Haigam wetland (Sopore) Reserves. The wetland contributes significantly to the livelihoods of local communities.

Haigam wetland reserve faces severe threat of siltation and agricultural fields by the local community. A great influx of heavy silt load into Haigam from Bakhul and Ningli perennial streams drain directly into this wetland which has resulted in deterioration of wetland quality and has reduced extent of the wetland area in the landscape. The willow plantation was destructed by cutting down the willow trees by the peoples for fuel wood was also observer. The willows were the habitat of many species of birds.

The primary focus of this study was to evaluate the impact of anthropogenic activities on Haigam wetland using remote sensing and GIS, the value of wetlands, the causes and consequences of the loss of wetlands. The encroachments and various developmental activities are the major constraints affecting wetland area changes and its environs.

AIMS AND OBJECTIVES:

AIM:

The aim of this study is to produce a land use land cover map of Haigam wetland at different epochs in order to detect the changes that have taken place particularly in the built-up and Agricultural land and subsequently predict likely changes that might take place in the same over a given period.

OBJECTIVES:

1. To see the anthropogenic activities on Haigam wetland.
2. Examine the extent of use of these wetlands by the local people and their perception and attitude towards this wetland.
3. To make people aware of the importance of wetlands.
4. To make a conservation plan for the Haigam Wetland
STUDY AREA:

Rakh Haigam is a Village in Sopore Tehsil in Baramulla District of Jammu & Kashmir State, India. It is located 22 KM towards North from District headquarters Baramulla, 63 KM from State capital Srinagar with coordinates 34°15'6"N 74°32'3"E.

The Haigam Wetland Conservation Reserve or Haigam Rakh as it is locally called is the largest remaining reed bed in the Kashmir valley, being of major ornithological importance. Haigam is named after a village of the similar name.

The wetland is 40 km from Srinagar, the state capital and located in district Baramulla (34015'N, 74031'E) of Jammu & Kashmir state on the flood plains of river Jhelum at an altitudinal height of 1580 m. It was notified as a game reserve for duck shooting as far back as 1945. Earlier the area was about 14 km with reed beds of about 4 kms (Holmes & Parr, 1988) but now the total reserve has shrunk to 7.25 kms. The wetland is maintained by the Department of Wildlife Protection, Jammu & Kashmir. The wetland is approachable by a motorable road of 5 km from the nearest main town Sopore. The wetland is surrounded all around by villages. Haigam village itself does not border the reserve. An offshoot village, Hanjypora, which is near the edge of the reserve, has the reserve office. The wetland is bounded in the north by Sopore- Sonawari general road. To its south, it is surrounded by villages of Goshbugh and Sukhul. To the east of the wetland is the human habitation of Aakhanpora and to the west it is bounded by village Hanjypora.

![Fig. study Area Haigam Wetland](image_url)
The wetland has been classified as wetland type 14, 15 & 19 because of the type of wetland habitat present i.e. freshwater marshes, swamps and rice paddies (Scott, 1989). The wetland is a shallow, permanent, freshwater lake with a maximum water depth 1.25 m. The greater part of lake is dominated by extensive reed-beds. The reed bed is partitioned by a number of boat channels varying in width from 1m to 4m. The wetland is fed by perennial streams of the Bakhul and Ningli flood channels and numerous smaller streams. The water table fluctuates seasonally and falls in late summer and reaches it lowest in autumn, and then begins to rise again in early winter. Dissolved oxygen reaches very low levels in summer. The underlying soils are silty-clayey loam type. The surrounding land is predominantly rice paddy and natural marsh, with some pastures which flood after heavy rains. The reserve is largely surrounded by a protective bank.

Inside this bank, strips of willows have been planted. These act as a silt trap. Outside the bank, and in some places inside, the land is mostly devoted to rice paddy. Slightly further from the bank, at least around Haigam, there are extensive orchards.

RESEARCH METHODOLOGY:

DATA COLLECTION:

Methods employed in this study involved a number of activities, both field and laboratory based, were undertaken in order to generate the necessary data. Initial desk study involved a GIS-based assessment of the spatial and temporal changes in the areal extent of the different land-use in order to assess land use changes and possible attendant impacts of human activities on the Haigam Wetland ecosystem.

Top sheet of 1969, Liss III and LISS IV images of 2011 and 2013 were used in the classification procedure. The images have 23 m spatial resolution. Topo sheet, Satellite images of 1969, 2011 and 2013 are taken, with the help of Arc map 9.1 and Edidas software’s. These satellite images were digitized at 5000-10,000 & 50,000 scales. At the end of digitization three maps are drawn i.e. 1969, 2010 and 2013 which shows the results in the form of change detection.

The 1969 top sheet shows the area of the wetland, where most of the portion is dominated by the water, then marshy area. With the passage of time the Haigam wetland is covered by the human settlement, agricultural lands and the siltation.

In 2011 major portion of the wetland is covered by the siltation, the second is the agricultural lands and the third portion covered with the buildup areas.
In 2013, area of the Haigam wetland is further reduced and the impact of human activities increases where siltation, agricultural and the habitation are dominated.

DATA PROCESSING:
Data were processed using ArcGIS 9.2, Erdas Imagine 8.9, Microsoft Office Excel, and Adobe reader. With the help of ArcGIS 9.2 Topo sheet of 1969 were digitized 5000 – 10000 scale, and after digitization different classes and their total area were obtained i.e. open water, open land, Agricultural fields, slit and habitation. These classes are shown in the table no 1.

Same technique were used with the Liss III images of 2011 and 2013, and after digitization of these satellites images slit load, habitation and agricultural land were increased and the open water and the area of Haigam lake were reduced. These classes were shown in table 2 and table 3.

The land use and land cover areas by pixels were then transferred from the attribute table in ArcGIS to Microsoft Office Excel 2007 to calculate the area covered by each class. And then the total area are then converted into different graphs, which shows that how much area of Haigam lake is covered by each class and these graphs are shown in the graph no 1,2 and 3.

ORGANIZATION OF FIELD WORK:
Field work for the whole study was operated from one location (located at village Gohal, of Haigam wetland, and from one field station (located at village Hanjipora, near Haigam wetland. Field sampling in peripheral villages to collect information on wetland resource dependency of the user communities in addition to a perception and attitude survey. A rapid survey for collection of secondary data from concerned government agencies the fieldwork for this study commenced from August 2014 to November 2015. In this duration, field data collection relevant to different objectives of the study was undertaken.

The data collected from the government agencies related for the conservation of Haigam wetland and interviews are also conducted from the local people about the wetland. After collecting both primary and secondary data, Results were drawn which shows that that the Haigam wetland is reduced in area by the anthropogenic activities like agricultural and human settlements.

RESULT AND DISCUSSION:
GIS-BASED MAPPING OF LAND USE CHANGES:
The research developed and used an integrated methodology of remote sensing data on a GIS platform to analyze and present data as a basis for monitoring land cover change. The GIS-based assessment of the temporal changes in the areal extent of the different land-use type involved evaluation of remotely sensed satellite imagery for the period of 1969, 2011 and 2013, while the
resulting evaluation were used to obtain scenario for the intervening period of 1969 and the future projection for the period of 2013.

The composite map of the spatial distribution and areal coverage of the different land use types for the periods of 1969 and 20013 are presented in Figure 1,2 and 3 while the evaluated results is presented in Table: 1, 2 and 3.

Fig.1 imagery map of spatial distribution of the land-use type of 1969

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Class Name</th>
<th>TOTAL AREA Ha</th>
<th>year 1969</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open Water</td>
<td>475.57967</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>open land</td>
<td>154.89732</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Swampy area</td>
<td>96.177498</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>agricultural land</td>
<td>27.635205</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>plantation</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>silt</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>build up</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

As presented in Table 1, a critical interpretation and evaluation of the top sheet of 1969 revealed that the area of **open water** of Haigam Lake is about **475.57Ha**, while the open land is about **154.89 ha**, the swampy area of Haigam lake is about **96.17 ha** and the total area of agricultural land is **27.63 ha** and there is no build up and silt class in this image. The Haigam Lake shows little anthropogenic changes and the lake is in its natural state.
Land use and land cover image of 2011:

![Map of Land Use and Land Cover Image of 2011](image)

**Fig. 2 imagery map of spatial distribution of the land-use type of 2011**

**Fig. Table: 2. Areas covered by different classes (2011)**

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Class Name</th>
<th>TOTAL AREA Ha</th>
<th>year 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Swampy area</td>
<td>396.282176</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Plantation</td>
<td>168.381506</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>agricultural land</td>
<td>103.343688</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Silt</td>
<td>84.878373</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>build up</td>
<td>1.372909</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Open Water</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>open land</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Nonetheless, considerable impact of human activities within the Haigam catchment is reflected in the considerable decline in area of open water, the image clearly shows that the agricultural land has been increased from **27.63 ha to 103.34 ha and** there is no **build up** class in 1969 which increased about **1.37 ha**. There is also no siltation class seen in top sheet of **1969** with the passage of time siltation load is increased **0 ha (1969) - 84.87 ha (2011)** (see Table 2).
Land use and land cover image of 2013:

![Image of land use and land cover]

**Fig.3: imagery map of spatial distribution of the land-use type of 2013**

**Fig. Table: 3. Areas covered by different classes (2013)**

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Class Name</th>
<th>TOTAL AREA (Ha)</th>
<th>year 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Swampy area</td>
<td>374.372988</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Plantation</td>
<td>159.226863</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>silt</td>
<td>114.315355</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Agricultural land</td>
<td>105.005902</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Build up</td>
<td>1.407683</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Open Water</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>open land</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Furthermore, the temporal and spatial changes in land use pattern are clearly evident as highlighted in Table no.4 that shows that the open water and the total area both reduced with the agricultural and human settlement. The agricultural land increases from **103.34 ha (2011)** to **105.00 ha (2013)** and the buildup is increased from **1.37 ha (2011)** to **1.40 ha (2013)**, while the silt load is also increased with the passage of time and increased from **84.87 ha (2011)** to **114.31 ha (2014)**. The map 1.2 and the table no. 3 also show that the open water and open land reduces from 1969 to 2013 and this time there is no such classes seen in the image and remained as zero. If the same
trend remains continue then time will come when the whole wetland is converted into human use and changed into non wetland use.

**Fig. Table: 4. Comparison table of different years showing different classes and their total area**

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Class Name</th>
<th>year 1969 T.A (Ha)</th>
<th>2011</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>plantation</td>
<td>0</td>
<td>168.381506</td>
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<td>6</td>
<td>Open Water</td>
<td>475.57967</td>
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<td>0</td>
</tr>
<tr>
<td>7</td>
<td>open land</td>
<td>154.89732</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The plantation of Haigam Lake is **zero** in **1969** and the same increased from **0 ha- 168.38 ha** and it reduces further due to the destruction of the same willow and other plantation by the humans and it remains only **159.22 ha**.

The plantation in and around the Haigam Lake protects the lake from the silitation as it checks the water and absorbs most of the silt during flood and in the rainy season. The plantation is also a habitat of thousands of birds and some animals, but its destruction leads to the disappearances of hundreds of bird’s species and also the migratory birds flow reduces in this wetland. The main cause of the destruction of willow plantation from the Haigam Lake is due to the negligence of the conservation authority and the government himself, as the persons named the (RAKHS) meaning the persons who take care of the wetland takes money from the people and in turn gives him permission to destroy the plantation.

The open water is about **475.57ha (1969)** and with the passage of time it reduces and converts into the swampy area and agricultural land. The reason of this conservation is the heavy silt load which makes the Haigam Lake shallow and covers the open water after that the aquatic vegetation increased and now there is no open water in this lake. The open water is habitat of thousands of migratory birds in the winter but now the wetland is visited by less migratory birds like ducks, mallard etc. the feeding channels and the destruction of the plantation around the catchment area and the expansion of the agricultural land results in heavy silt load into the Haigam lake.
DISTURBANCES AND THREATS:

Wetlands are disappearing throughout the world at an alarming rate. Loss of wetlands worldwide is estimated as 50% of those that existed since 1990 (Dugan, 1993; OECD, 1996) with most of the loss accounted from northern countries. Tropical and sub-tropical wetlands are increasingly being lost or degraded since 1950s through conversion to agriculture use. Agriculture is the principal cause for a total of 26% of wetland loss worldwide.

There are many threats to the Haigam wetland. The major problem is the increasing rate of siltation, Habitation and the agricultural land which has caused a noticeable deterioration in the wetland quality in recent years. Two factors contribute to this problem. First large-scale deforestation in the surrounding mountains has resulted in an increase in the silt load of water coming into the valley. Second, since most of the valley is agricultural land, there are fewer places for this silt to be deposited. Fertilizers enter the lake as run-off, accelerating the rate of Eutrophication. Other threats include encroachment as more land is converted to rice paddy, and heavy grazing damages in some parts of the marsh.

Another threat from the human side is the reckless killing and poaching of migratory birds resulting in the loss of these birds. The Haigam wetland was considered as a game reserve and the local people use pellet guns and traps to capture and kill these migratory birds, who are visitors in this wetland.

Another threat to these migratory and the local birds was the destruction of their nests by the removing of the macrophytic vegetation and the creed from the wetland by the local people and used as fodder for their cattle s.

The negligence of the government and the conservation authority of the Haigam wetland the wetland are shrinking both in area and the open water which are a habitat of thousands of migratory birds. The overuse of fish catching from the wetland by the surrounding people which decreases the fish population of the rivers and also in this wetland.

After massive encroachment, another threat faced by Haigam Wetland Conservation Reserve, an important wintering refuge for migratory waterfowls, shorebirds and trans-Himalayan species, is construction of a metalled road on one of its boundaries.

As on the spot visit revealed that construction of the road is going on from Akhnoonpora side of the Wetland. The road has been designed to connect Akhnoonpora with Gohal Tengpora and interior areas of Sopore. The spot on which the road is being constructed is actually an old bund, which helped to regulate water level in the wetland. The authorities last year widened the bund
with soil cover, saying it was necessary for its strength. Haigam Wetland which is included in Indian Bird Conservation Network on average. Construction of the road will wreak havoc on the wetland. There is already lot of human interference in the wetland by way of cultivation of paddy. After the road is constructed, the vehicular traffic on it will affect habitat of birds. I fail to understand how wildlife authorities are sitting silent on vandalism of the important wetland. The wildlife authorities did not take any action. It has been observed that migratory birds like to take refuge in adjoining wetlands around the Wular Lake including Haigam during daytime. If the road is allowed to be constructed, the birds will stop to visit the wetland due to noise of vehicles. The wetland is marred by various problems. Due to absence of any monitoring, the wetland has been turned into an animal farm with dozens of cows grazing in its breeding spots itself. According to experts, heavy grazing leads to destruction of breeding and feeding ground of birds. Moreover, there is no mechanism to regulate water level in the wetland as a result its waters keep draining out through breaches and conduits. The major destruction occurred by the negligence of the govt. and the conservation authority which do not show any conservation efforts regarding to this wetland.

**DISCUSSION:**

Wetlands play a vital role in maintaining the overall cultural, economic and ecological health of the ecosystem, their fast pace of disappearance from the landscape is of great concern. The Wildlife Protection Act protects few of the ecologically sensitive regions whereas several wetlands are becoming an easy target for anthropogenic exploitation. The Millennium Ecosystem Assessment Report (Millennium Ecosystem Assessment, 2005) highlights that in the last 50 years humans have changed ecosystems more rapidly and extensively than in any other period. This was done largely to meet growing demands for food, freshwater, timber, fiber and fuel. This resulted in a substantial and largely irreversible loss in diversity of life on earth, with 10-30% of the mammal, bird, and amphibian species currently threatened with extinction. The Living Planet Index, created by the World Wide Fund for Nature and the UNEP-World Conservation Monitoring Centre which provides a measure of the trends in more than 3,000 populations of 1,145 vertebrate species around the world showed that freshwater populations have declined consistently with an average decline of 50% between 1970 and 2000 (Loh *et al*; 2005).

Wetlands in India, as elsewhere are increasingly facing several anthropogenic pressures. Thus, the rapidly growing human population, large-scale changes in land use-land cover, burgeoning
development projects and the improper use of watersheds has all caused a substantial decline of wetland resources of the country.

The findings of the present study indicate that landscape composition of Haigam wetland has been modified by human intervention. The results clearly show the negative impact of the humans on the Haigam wetland.

The open water of the Haigam Lake was **475.57 ha** in **1969** but the same area was reduced and in **2013** it was **0% ha**.

The open water is a dwelling place for the migratory birds who visited this wetland on winter seasons in large numbers. The reason of the decline of the open water was the uncontrolled flow of siltation and the destruction of the plantation. The plantation prevents the silt load as it prevents the flow of water and acts as a barrier for the silt. With the destruction of the plantation the water enters directly into the wetland and it reduces the deepness of the lake and finally the open water is covered by the aquatic vegetation and barren area.

Results show that the plantation in and around the Haigam wetland was **0% ha** in 1969 but it increases as the local population plant the trees in and around the wetland and it is **168.38 ha** in **2011** and the same plantation cover decreases by the cutting of the trees by the local people and remained only **159.22 ha** in **2013**. The plantation protects the wetland as it slows down the silt in the Haigam wetland and this plantation is a habitat of hundreds of bird species. With the passage of time the same plantation is destroyed by changing this land into the Agricultural land and by the government employees named (Rakhs) are the people who are for the conservation of wetland, these people takes money from the people and in turn they give him permission to destroy the plantation in and around the Haigam wetland. The same plantation cover is reduced from **168.38 ha** in **2011** to **159.22 ha** in **2013**.

With the destruction of the plantation the migratory and the local bird population decreases and it becomes grassland for the animals. The people living around the Haigam wetland use this area for cattle greasing, and the cattle destroy the further area of the wetland. Another reason for the destruction of this plantation is the use of the plantation as a fuel wood by the local people. Now the area of Haigam wetland is barren with scattered trees.

The silt load was **0% ha** in **1969** and the same increased from 0 - **84.87 ha** in **2011** and it increases further and reached **114.31 ha** in **2013**. The reason was the cutting of the plantation of the catchment area which acts as a barrier and reduces the silt load.

However, the study shows that a great influx of heavy silt load into Haigam wetland from Bakhul and Ningli perennial Nallahs (streams) drains directly into the wetland. This heavy silt load has
contributed to loss in the area of aquatic habitats of this landscape. If the same pace of silt concentration enters into the wetland then the time is near when the whole wetland is turned into the barren area and finally becomes ground for playing and the land for agriculture and habitation.

Again, some processes e.g. siltation, settlements and agricultural lands has converted the wetland area into non-wetland land use types e.g. meadows in the landscape have been formed by filling of shallow water areas by sedimentation through feeder channels of wetland and through receding of water level. This seems to be reason that Haigam wetland still serves as a potential waterbird habitat and sustains a larger waterbird community because the extent of major aquatic plant communities; emergent vegetation, floating vegetation and submergent vegetation in Haigam wetland. Due to excessive siltation, habitation and agricultural lands in Haigam wetland, submergent vegetation has completely disappeared from the area. Absence of submergent vegetation could be attributed to a very heavy biotic pressure and more dependency of local people on wetland resources in Haigam wetland.

Haigam wetland reserve faces severe threat of siltation, agricultural, increased area of habitation and a high biotic pressure and a heavy dependency of local communities on its resources. This could be the reason that population of migratory waterbirds is low in Haigam wetland.

The agricultural land has increased from **27.63ha in 1969** and the same increased to **103.34 ha in 2011** and it increased further and reached to **105.00ha in 2013**. The increasing area of the agricultural land clearly shows the dependency of the people on this wetland and the inattention of the conservation authorities like wildlife department and the government of the state.

Due to the negligence of the conservation authority the agricultural land increased day by day and the pesticides, herbicides and the use of fertilizers in the agricultural lands for crop productivity are washed down into the Haigam wetland which results in Eutrophication of this wetland. Results also show that the growing agricultural fields in Haigam wetland results in the loss of this wetland by reducing the area and makes less area for open water which are Habitat of many migratory birds.

Result shows that the buildup area in and around the Haigam Lake was **0% in 1969**, the same area was increased and reached to **1.37 ha in 2011** and it increased further and reached to the **1.40 ha in 2013**.

The area of open land of Haigam wetland is **154.89 ha in 1969** which is filled by the water in the winter and rainy season and become a habitat for thousands of local birds and migratory birds. But the same open land is **0% in 2013**. Due to the negligence of the wildlife department and the
government of the state it is fully under the control of the local population who make this as their property and turns this land into residential, agricultural and the apple orchids and other purposes.

Haigam wetland which is included in the Indian bird conservation network on an average receives nearly 300,000 migratory birds, ducks and waterfowl species. Being an important breeding site for the birds and refuge over a dozen species of shorebirds and several Trans-Himalayans species. But due to alleged callousness of officials of wildlife and other departments, farmers from the nearby the villages gradually started to encroach upon the wetland by cultivation of paddy, human settlement and orchids.

Another threat to the Haigam is the construction of the metalled road, the road is being constructed is actually an old bund, which helped to regulate water level in the wetland. The authorities last year widened the bund with soil cover, saying it was necessary for its strength. Haigam Wetland which is included in Indian Bird Conservation Network on average receives nearly three lakh migratory birds, ducks and waterfowl species, making it a major attraction for tourists, locals and scientists. Construction of the road will wreak havoc on the wetland. There is already lot of human interference in the wetland by way of cultivation of paddy. After the road is constructed, the vehicular traffic on it will affect habitat of birds. I fail to understand how wildlife authorities are sitting silent on vandalization of the important wetland. The wildlife authorities did not take any action. It has been observed that migratory birds like to take refuge in adjoining wetlands around the Wular Lake including Haigam during daytime. If the road is allowed to be constructed, the birds will stop to visit the wetland due to noise of vehicles.

The human growing human settlements in and around the Haigam wetland is another threat to this wetland which results in the loss of this wetland.

Haigam wetlands provide conductive breeding habitats to some resident waterbird species in spring season, which usually starts from month of March to May in the Kashmir valley. Peatland and Willow Salix Alba plantation represent important breeding habitats in Haigam wetland.

The destruction of willow plantation in the Haigam wetland by the local people and the people living around this wetland for fuel wood and other purposes results in the destruction of the breeding grounds of these birds and finally the number of migratory birds becomes less.

Results suggest desiltation of the wetland through either dredging or digging in the wetland. This would consequently increase expanses of open water and other marshy habitats that would increase the potential of the wetland to sustain abundant waterbird communities. Further siltation of Hygam wetland can be prevented by diversion of Bakhul and Ningli flood channels to outside of
the wetland. Furthermore, the application of proper soil and water conservation practices throughout the watersheds is of major importance.

Management should consider protection of these habitats in spring season. In Hygam wetland, it is essential to maintain discrete patches of tall emergent as nesting cover for breeding waterbirds, especially of Mallard *Anas platyrhynchos* which breeds only in wetlands of Kashmir in the entire Indian sub-continent.

The study has revealed that there are complex interactions between wetlands and the fringe society. A range of direct use values on which the sustenance of local people surrounding Hygam wetland depends comes from this wetland. Local economy of these areas has benefited by wetland resource uses. The local populations have the right to access to resources of these wetlands and this access exists only for a period of three months in a year.

Larger families, less education and families with a large livestock population showed more wetland resource dependence. Harvesting of reeds was a common resource use in Haigam wetland and livestock grazing in this wetland. The continued exploitation of these wetland resources will consequently have an adverse effect on their long-term sustainability. Due to the fact that a large population surrounding these wetlands is uneducated and unemployed, cattle is an integral part of their economy. These are the reasons that these wetlands are being used especially to meet fodder requirements of livestock. Because the social and ecological sustainability of local communities and their well-being is linked to availability of wetland resources, other livelihood options like eco-tourism can be a good means of generating alternative employment opportunities and reducing pressure on wetlands. Further, increase in the level of education among locals, reduced family sizes and alternative fodder requirements for livestock of local people could help achieve sustainable and wise use of two wetland reserves. The peripherals of wetlands can be managed as grazing pastures and for cultivation of forage species for livestock and this can largely reduce the pressure on wetland resources.

The overall results highlight the negative impacts of the human-induced influence on the Haigam Wetland ecosystem through land-use and waste effluent discharges with attendant degradation / loss on one hand. On the other hand it also highlights the fact that wetland serves as purifier, buffer and sink for the dissolved contaminants from the feeding villages drainage water system. The overall implication of the study is that there is the need to control the increasing encroachment of farming and building activities around the Haigam wetland to avoid removal of the vegetation and degradation of the ecosystem. Hence, the study recommends the adoption of Integrated Water
Resources and Environmental Management in order to ensure proper ecosystem functioning of such wetland and thus safeguarding the overall quality of the wetland ecosystem.

**MANAGEMENT AND CONSERVATION:**

Haigam wetland initially was a vast expanse of open grassland. It used to be a roosting place for the migratory birds of Wular Lake. However, later on it was taken over by Maharaja Hari Singh and it took the shape of a permanent water body when a peripheral bund was constructed around it. The villages at present surrounding the wetland are Infact the villages settled by the then Maharaja himself from far flung areas for labour work. These areas were managed by Twaza (Hospitality and Protocol) Directorate to serve as a venue providing sport for themselves and their distinguished guests. Thus an adequate coverage to land and water game birds and animals was provided, with strict enforcement of laws. After 1947, management of these reserves in Kashmir region reverted to Fisheries Directorate till 1954, when Dachigam, Cheshmashahi and Rajparian (Daksum) Rakhs were upgraded as Game sanctuaries in 1951. The administration then passed successively to Forest Department, (1954-60), then Twaza Directorate (1960-64) and back to fisheries Directorate (1972 to ending 1977), during the course many areas were transferred to Forest Department for future forestry management. In 1978 the administration again resettled to Directorate of Game Preservation of Forest Department, which finally emerged as an independent Department of Wildlife Protection in 1982, with the extension of 18 to 43 protected areas both old and new in all the regions, giving a sudden boost of over 15,000 kms from 0.20% to 7.5% of total land surface in the state.

Management of the Haigam wetland should incorporate ideas and opinions of local people. When decisions affecting wetlands are made with inadequate knowledge of local people conservation programs are unlikely to be successful.

Hokersar wetland, Wular Lake and Dal Lake has been listed under National Wetlands Conservation Programme (Islam and Rahmani, 2008). The wetland has also been internationally designated as Ramsar site. In the light of results of present study, Haigam wetland also fulfills more than one criterion for qualification as a Ramsar site and deserves to be on the national priority list of wetlands of India.

**CONSERVATION MEASURES TAKEN:**

The entire wetland is protected as conservation reserve by the Department of Wildlife Protection, Jammu & Kashmir. Active measures have been taken to restrict siltation, to maintain areas of open water, and to prevent further encroachment of rice paddies and the human habitation. The state
government of Jammu & Kashmir State has asked the central government to include Haigam Rakh in the National Wetland Conservation Programme.

CONSERVATION MEASURES PROPOSED:
Existing management policies will be continued and waterfowl hunting will be maintained at a regulated level. Increasing attention will be given in controlling encroachment, particularly the conversion of marginal areas to rice paddy. Plans include:
(a) The erection of a barbed wire fence around the lake to prevent further encroachment;
(b) The diversion of the Bakhul flood channel to minimize the silt load entering the lake;
(c) The construction of a sluice gate.

CONCLUSION AND SUGGESTIONS:
The goal of this research was to see the impact of anthropogenic activities on Haigam wetland and develop a future plan for its conservation by using remote sensing and GIS. Wetland landscape has been analyzed. The results show that the total area has been reduced by converting it into agriculture land, habitation, orchids, vegetables gardens and the silt load drastically from 1969 to 2013. The total areas of open water in 1969 were 475.57 ha and it reduced drastically with the passage of time and remains 0 ha in 2103, which also reduces the flow of migratory birds in winter season and also the habitat of thousands of local aquatic species are destroyed.

In short the total area of Haigam wetland reduced greatly from 754.32 ha in 1969 and remains only to 533.60 ha in 2013 due the conservation by human activities like agricultural activities, human settlements and the siltation.

Conservation steps taken are not enough; wildlife conservation authorities and the Government should take their responsibility if they want to preserve the Haigam wetland for further destruction. The funds giving by the govt. should be utilized properly and a proper conservation plan should be prepared and followed. The awareness of the local villagers and the youth towards the wetland will help the wild life conservation to prevent the wetland, seminars, discussions and the importance about the wetland should be given so that the people know the importance of the Haigam wetland.

It is noteworthy that even a small country like UK could designate 161 wetlands as Ramsar sites, India being a mega-diversity country, so far managed to delineate a mere six sites till date.

SUGGESTIONS:
After studying the wetland results shows the negative impact of humans on the Haigam wetland, the following suggestions should be done to protect the beautiful wetland which is habitat of thousands of local and the migratory birds, fishes and the aquatic life.
1. **Protect Wetlands Locally:**

Local governments and the wildlife conservation authority play a key role in filling the gaps in wetland protection if they understand their duties regarding the Haigam wetland, because they have primary responsibility for local land use management. Prevent of grazing, overfishing, killing of migratory birds, siltation and the cutting of the trees in the Haigam wetland are the responsibility of the Haigam conservation authority.

2. **Buffers and Greenbelts:**

Perhaps the most effective management practice to protect Haigam wetland from adjacent human activities is to establish and maintain a vegetative buffer (or greenbelt) around the wetland. A greenbelt is simply a strip of plantation which covers the wetland.

**Fencing:**

As now there remains only a small portion of Haigam wetland and the major area of this wetland is covered by the human purposes. Fencing is one of the simplest ways to protect the remaining area of Haigam wetland. Even if you can't fence all of your wetland, you can often fence off overused places where extra protection is necessary. There are several things to consider when determining what fencing is best for you.

**Fertilizers and Pesticides:**

The catchment areas agricultural fields are a serious threat to the Haigam wetland as the pesticides, herbicides and the chemical fertilizers used for crop production are directly drain into this wetland which pose a serious threat to the aquatic flora and fauna of this wetland.

3. **Recreational Use:**

Haigam wetland is one of the most beautiful wetlands in Kashmir, but due to negligence of the conservation authority the wetland is degraded fast. This wetland should be converted for recreational purposes, so that it become a hub for touristic visit and also a income for the surrounding villages, who are totally depend on this wetland.

4. **Banning on conversion of wetland into agricultural lands:**

The Haigam wetland is continuously changed into agricultural fields as shown clearly in the results. Some people illegally grab most of wetland land. These activities should be banned if conservation authority wants to protect the wetland.

5. **Diversion of the major Flood channels of Bakhul and Ningal:**

The Bakhul and the Ningal are the two channels which directly drain into the Haigam wetland. These rivers are responsible for the major siltation load into the wetland. To protect the Haigam
wetland from siltation from these rivers a diversion is required so that the water is not directly drain into the wetland.

6. **Awareness camp** should be organized for the local people and the surrounding catchment areas about the importance of the wetlands.

7. **Results suggest** desiltation of the wetland through either dredging or digging in the wetland. This would consequently increase expanses of open water and other marshy habitats that would increase the potential of the wetland to sustain abundant water bird communities.

8. **Yearly** conservation measures should be revived at the end so that it may know how much area is increased under the control of the local population. So that it may help to protect the area.
REFERENCES:


